“Vets Wisdom”

A Guide for Veterinary Science Optional in Civil Service Examination, Indian Forest Service and State PCS Examinations.

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TO MY MOTHER

Dear Friends,

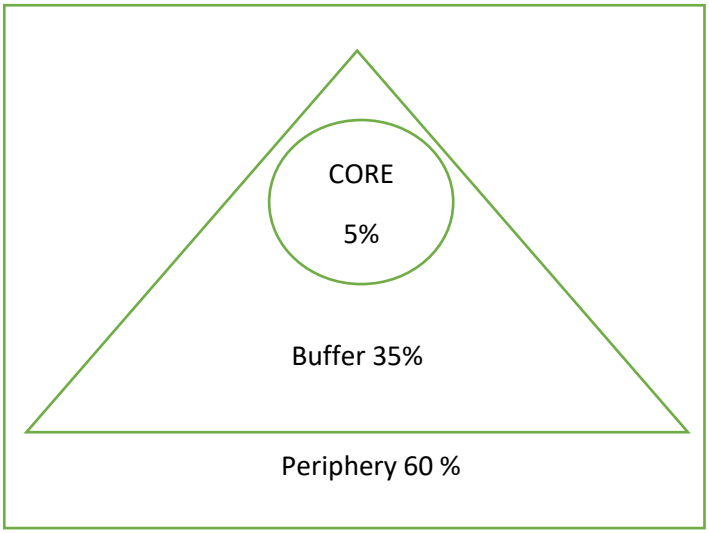
Let me Congratulate you all for Starting your Civil Service Examination preparation and opting Veterinary Science Optional. This Book is my sincere effort to contribute in success of my fellow veterinarians and other graduates who are willing to opt Veterinary Science Optional in Civil Service Examination, Indian Forest Service and State PCS Examinations.

We need more Veterinarians in Bureaucracy for uplifting Veterinary and Animal Husbandry Department. This will improve life of half of Indian people who all depends on agriculture and animal husbandry for their livelihood. **"Vets Wisdom"** Book is not written by me but compiled by me from different books, internet and notes of students.

What will be Our Strategy ?

<u>This BOOK is an effort on my side to help you learn these strategies which will help you crack this exam in your first attempt.</u>

- ✓ 1st thing first, Let's begin our preparation by learning syllabus of veterinary Science Optional. Its better if I use word "**Cramming Syllabus** by Heart". I have used bold words, Please Start cramming them.
- ✓ Secondly, **analyse previous years papers** and you must find out underlying but subtle pattern of repetition of questions and topics. Although I have done that research and effort for you all. But I will advise you, to start developing that skill by yourself also.
- ✓ Thirdly, look at 3 regions of following Diagram:



- ✓ The **Core region** of above diagram reflects most important and most frequently asked questions and topics in UPSC CSE or any other state PCS Exam, but it constitutes only 5 % of total SYLLABUS. But weightage of questions asked from it is approximately 50%. Hence, we have to learn to identify these topics and to focus maximum time on these areas.
- ✓ Similarly, **Buffer region** is 2nd most important area of syllabus which constitutes roughly 35% of syllabus but covers approximately 35% of questions of exam.
- ✓ Lastly, Periphery region is least important of all but covers maximum syllabus that is 60%. We all tend to dedicate equal time to entire syllabus. That is the most important cause of failure. Hence you must abandon the "Principle of Equality" among topics and subjects.
- ✓ Fourthly, **Revision** make everything stay in your Mind. Keep Revising @. It is a simple logic, when you spend more time with someone or something it will surely help you in time of need be it a topic or a friend.
- ✓ Fifthly, No one can become **perfect without Practice.** Please Write answers Daily

I have included, analysed and commented on Veterinary Science Optional Syllabus and Previous years papers**. This will help you prepare better and, in a time, bound manner. Hence increasing your Productivity and effectiveness.**

Content

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- Animal Nutrition
- Animal Physiology
- Animal Reproduction
- LPM
- Genetics and Animal Breeding
- Extension

Paper 2

- Anatomy, Pharmacology and Hygiene
- Animal Diseases
- Veterinary Public Health
- Milk and Milk Products Technology
- Meat Hygiene and Technology

- Year wise Previous years papers
- Important Topics
- Syllabus-wise Study Material
- My Suggestions
- Practice Questions

PAPER 1 Syllabus

1.Animal Nutrition:

1.1 Partitioning of food energy within the animal. Direct and indirect calorimetry.

Carbon - nitrogen balance and comparative slaughter methods.

Systems for expressing energy value of foods in ruminants, pigs and poultry.

Energy requirements for maintenance, growth, pregnancy, lactation, egg, wool, and meat production.

1.2 Latest advances in protein nutrition. Energy protein interrelationships.

Evaluation of protein quality.

Use of NPN compounds in ruminant diets.

Protein requirements for maintenance, growth, pregnancy, lactation, egg, wool and meat production.

1.3 Major and trace minerals - Their sources, physiological functions and deficiency symptoms.

Toxic minerals.

Mineral interactions.

Role of fat-soluble and water - soluble vitamins in the body, their sources and deficiency symptoms.

1.4 Feed additives - methane inhibitors, probiotics, enzymes, antibiotics, hormones, oligosaccharides, antioxidants, emulsifiers, mould inhibitors, buffers etc.

Use and abuse of growth promoters like hormones and antibiotics - latest concepts.

1.5 Conservation of fodders.

Storage of feeds and feed ingredients.

Recent advances in feed technology and feed processing.

Anti - nutritional and toxic factors present in livestock feeds.

Feed analysis and quality control.

Digestibility trials - direct, indirect and indicator methods.

Predicting feed intake in grazing animals.

1.6 Advances in ruminant nutrition.

Nutrient requirements.

Balanced rations.

Feeding of calves, pregnant, work animals and breeding bulls.

Strategies for feeding milch animals during different stages of lactation cycle.

Effect of feeding on milk composition.

Feeding of goats for meat and milk production.

Feeding of sheep for meat and wool production.

1.7 Swine Nutrition.

Nutrient requirements.

Creep, starter, grower and finisher rations.

Feeding of pigs for lean meat production.

Low cost rations for swine.

1.8 Poultry nutrition.

Special features of poultry nutrition.

Nutrient requirements for meat and egg production.

Formulation of rations for different classes of layers and broilers.

2. Animal Physiology

2.1 Physiology of blood and its circulation, respiration; excretion.

Endocrine glands in health and disease.

2.2 Blood constituents - Properties and functions-blood cell formation

Haemoglobin synthesis and chemistryplasma proteins production, classification and properties, coagulation of blood;

Haemorrhagic disorders-anticoagulants-blood groups-Blood volume

Plasma expanders-Buffer systems in blood.

Biochemical tests and their significance in disease diagnosis.

2.3 Circulation - Physiology of heart, cardiac cycle, heart sounds, heartbeat, electrocardiograms.

Work and efficiency of heart-effect of ions on heart function metabolism of cardiac muscle, nervous and chemical regulation of heart, effect of temperature and stress on heart, blood pressure and hypertension, osmotic regulation, arterial pulse, vasomotor regulation of circulation, shock.

Coronary and pulmonary circulation, Blood-Brain barrier- Cerebrospinal fluid- circulation in birds.

2.4 Respiration - Mechanism of respiration,

Transport and exchange of gases -neural control of respiration-chemoreceptors-hypoxia-respiration in birds.

2.5 Excretion-Structure and function of kidney-formation of urine-methods of studying renal function

Renal regulation of acid-base balance: physiological constituents of urine-renal failure-passive venous congestion-Urinary secretion in chicken-Sweat glands and their function.

Bio-chemical test for urinary dysfunction.

2.6 Endocrine glands - Functional disorders their symptoms and diagnosis.

Synthesis of hormones, mechanism and control of secretion- hormonal receptors classification and function.

2.7 Growth and Animal Production

Prenatal and postnatal growth, maturation, growth curves, measures of growth, factors affecting growth, conformation, body composition, meat quality.

2.8 Physiology of Milk Production, Reproduction and Digestion- Current status of hormonal control of mammary development, milk secretion and milk ejection,

Male and Female reproductive organs, their components and functions.

Digestive organs and their functions.

2.9 Environmental Physiology

Physiological relations and their regulation; mechanisms of adaptation, environmental factors and regulatory mechanisms involved in animal behaviour, climatology - various parameters and their importance.

Animal ecology.

Physiology of behaviour. Effect of stress on health and production.

3.Animal Reproduction:

Semen quality- Preservation and Artificial Insemination

Components of semen, composition of spermatozoa, chemical and physical properties of ejaculated semen, factors affecting semen in vivo and in vitro.

Factors affecting semen production and quality, preservation, composition of diluents, sperm concentration, transport of diluted semen.

Deep freezing techniques in cows, sheep, goats, swine and poultry.

Detection of oestrus and time of insemination for better conception.

Anoestrus and repeat breeding.

4.Livestock Production and Management:

4.1 Commercial Dairy Farming

Comparison of dairy farming in India with advanced countries.

Dairying under mixed farming and as specialized farming, economic dairy farming. Starting of a dairy farm, Capital and land requirement, organization of the dairy farm.

Opportunities in dairy farming, factors determining the efficiency of dairy animal.

Herd recording, budgeting, cost of milk production, pricing policy; Personnel Management.

Developing Practical and Economic rations for dairy cattle; supply of greens throughout the year, feed and fodder requirements of Dairy Farm.

Feeding regimes for young stock and bulls, heifers and breeding animals; new trends in feeding young and adult stock; Feeding records.

4.2 Commercial meat, egg and wool production- Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry.

Supply of greens, fodder, feeding regimes for young and mature stock.

New trends in enhancing production and management. Capital and land requirements and socio-economic concept.

4.3 Feeding and management of animals under drought, flood and other natural calamities

5.Genetics and Animal Breeding:

History of animal genetics. Mitosis and Meiosis: Mendelian inheritance; deviations to Mendelian genetics; Expression of genes;

Linkage and crossing over; Sex determination, sex influenced and sex limited characters;

Blood groups and polymorphism; Chromosome aberrations; Cytoplasmic inheritance.

Gene and its structure; DNA as a genetic material; Genetic code and protein synthesis;

Recombinant DNA technology. Mutations, types of mutations, methods for detecting mutations and mutation rate. Trans-genesis.

5.1 Population Genetics applied to Animal Breeding- Quantitative Vs. qualitative traits;

Hardy Weinberg Law; Population Vs. individual; Gene and genotypic frequency;

Forces changing gene frequency; Random drift and small populations; Theory of path coefficient; Inbreeding, methods of estimating inbreeding coefficient, systems of inbreeding,

Effective population size; Breeding value, estimation of breeding value, dominance and epistatic deviation; Partitioning of variation;

Genotype X environment correlation and genotype X environment interaction; role of multiple measurements; Resemblance between relatives.

5.2 Breeding Systems- Breeds of livest- sock and Poultry.

Heritability, repeatability and genetic and phenotypic correlations, their methods of estimation and precision of estimates;

Aids to selection and their relative merits; Individual, pedigree, family and within family selection;

Progeny testing; Methods of selection; Construction of selection indices and their uses;

Comparative evaluation of genetic gains through various selection methods; Indirect selection and correlated response;

Inbreeding, out breeding, upgrading, cross-breeding and synthesis of breeds; Crossing of inbred lines for commercial production;

Selection for general and specific combining ability; Breeding for threshold characters. Sire index.

6.Extension:

Basic philosophy, objectives, concept and principles of extension.

Different Methods adopted to educate farmers under rural conditions. Generation of technology, its transfer and feedback.

Problems and constraints in transfer of technology.

Animal husbandry programmes for rural development.

Paper 2 Syllabus

2.1 Anatomy, Pharmacology and Hygiene

This part is very Lengthy and Least Important, we will prepare this in LAST PHASE !!
Because 80% of it is Part of Periphery Region.

1.1 Histology and Histological Techniques:

- ✓ Paraffin embedding technique of tissue processing and H.E. staining
- ✓ Freezing microtomy- Microscopy Bright field microscope and electron microscope.
- ✓ Cytology-structure of cell, organelles and inclusions;
- ✓ cell division-cell types
- ✓ Tissues and their classification-embryonic and adult tissues
- ✓ Comparative histology of organs-Vascular, Nervous, digestive, respiratory, musculo-skeletal and urogenital systems Endocrine glands -Integuments-sense organs.

1.2 Embryology

- ✓ Embryology of vertebrates with special reference to aves and domestic mammals
- ✓ gametogenesis-fertilization-germ layers
- ✓ foetal membranes and placentation-types of placenta in domestic mammals
- ✓ Teratology-twins and twinning-organogenesis
- ✓ germ layer derivatives- endodermal, mesodermal and ectodermal derivates.

1.3 Bovine Anatomy-

- ✓ Regional Anatomy: Para-nasal sinuses of ox
- ✓ surface anatomy of salivary glands.
- ✓ Regional anatomy of infraorbital, maxillary, mandibuloalveolar, mental and cornual nerve block.
- ✓ Regional anatomy of paravertebral nerves, pudendal nerve, median ulnar and radial nerves-tibial, fibular and digital nerves-Cranial nerves
- ✓ structures involved in epidural anaesthesia-
- ✓ superficial lymph nodes-
- ✓ surface anatomy of visceral organs of thoracic, abdominal and pelvic cavities
- ✓ comparative features of locomotor apparatus and their application in the biomechanics of mammalian body.

1.4 Anatomy of Fowl

- ✓ Musculo-skeletal system-functional anatomy in relation to respiration and flying, digestion and egg production.

1.5 Pharmacology and therapeutic drugs

- ✓ Cellular level of pharmacodynamics and pharmacokinetics.
- ✓ Drugs acting on fluids and electrolyte balance.
- ✓ Drugs acting on Autonomic nervous system.
- ✓ Modern concepts of anaesthesia and dissociative anaesthetics. Autacoids.
- ✓ Antimicrobials and principles of chemotherapy in microbial infections.
- ✓ Use of hormones in therapeutics-chemotherapy of parasitic infections.
- ✓ Drug and economic concerns in the Edible tissues of animals
- ✓ chemotherapy of Neoplastic diseases.
- ✓ Toxicity due to insecticides, plants, metals, non-metals, zootoxins and mycotoxins.

1.6 Veterinary Hygiene with reference to water, air and habitation

- ✓ Assessment of pollution of water, air and soil-Importance of climate in animal health-
- ✓ effect of environment on animal function and performance-relationship between industrialization and animal agriculture
- ✓ animal housing requirements for specific categories of domestic animals viz. pregnant cows and sows, milking cows, broiler birds-
- ✓ stress, strain and productivity in relation to animal habitation.

2. **Animal Diseases**

2.1 Etiology, epidemiology pathogenesis, symptoms, post-mortem lesions, diagnosis, and control of **infectious diseases** of cattle, sheep and goat, horses, pigs and poultry.

2.2 Etiology, epidemiology, symptoms, diagnosis, treatment of **production diseases** of cattle, horse, pig and poultry.

2.3 **Deficiency diseases** of domestic animals and birds.

2.4 Diagnosis and treatment of non-specific conditions like

- ✓ Impaction, Bloat, Diarrhoea, Indigestion
- ✓ Dehydration, stroke, poisoning.

2.5 Diagnosis and treatment of the neurological disorders.

2.6 Principles and methods of immunization of animals against specific diseases

- ✓ herd immunity
- ✓ disease free zones
- ✓ 'zero' disease concept
- ✓ chemoprophylaxis.

2.7 Anaesthesia-

- ✓ local, regional and general-preanesthetic medication.
- ✓ Symptoms and surgical interference in fractures and dislocation.
- ✓ Hernia, choking abomasal displacement-Caesarean operations.
- ✓ Rumenotomy-Castrations.

2.8 Disease investigation techniques.

- ✓ Materials for laboratory investigation
- ✓ Establishment of Animal Health Centres
- ✓ Disease free zone.

3. **Veterinary Public Health**

3.1 Zoonoses

- ✓ Classification, definition, role of animals and birds in prevalence and transmission of zoonotic diseases-
- ✓ occupational zoonotic diseases.

3.2 Epidemiology

- ✓ Principle, definition of epidemiological terms, application of epidemiological measures in the study of diseases and disease control.
- ✓ Epidemiological features of air, water and food borne infections.
- ✓ OIE regulations, WTO, sanitary and phytosanitary measures.

3.3 Veterinary Jurisprudence-

- ✓ Rules and Regulations for improvement of animal quality and prevention of animal diseases
- ✓ State and central rules for prevention of animal and animal product borne diseases-
- ✓ S P C A- Veterolegal cases- Certificates Materials and Methods of collection of samples for veterolegal investigation.

4. Milk and Milk Products Technology

4.1 Market Milk:

- ✓ Quality, testing and grading of raw milk. Processing, packaging, storing, distribution, marketing, defects and their control.
- ✓ Preparation of the following milks: Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milks.
- ✓ Preparation of cultured milks, cultures and their management, yoghurt, Dahi, Lassi and Srikhand.
- ✓ Preparation of flavoured and sterilized milks.
- ✓ Legal standards.
- ✓ Sanitation requirement for clean and safe milk and for the milk plant equipment.

4.2 Milk Products Technology:

- ✓ Selection of raw materials, processing, storing , distributing and marketing milk products such as Cream, Butter, Ghee, Khoa, Channa, Cheese, condensed, evaporated, dried milk and baby food, Ice cream and Kulfi;
- ✓ By-products, whey products, butter milk, lactose and casein.

- ✓ Testing, grading, judging milk products- BIS and Agmark specifications, legal standards,
- ✓ Quality control and nutritive properties.
- ✓ Packaging, processing and operational control. Costing of dairy products.

5. Meat Hygiene and Technology

5.1 Meat Hygiene

5.1.1 Ante mortem care and management of food animals, stunning, slaughter and dressing operations;

- ✓ abattoir requirements and designs;
- ✓ Meat inspection procedures and judgment of carcass meat cuts-
- ✓ grading of carcass meat cuts-
- ✓ duties and functions of Veterinarians in wholesome meat production.

5.1.2 Hygienic methods of handling production of meat-

- ✓ Spoilage of meat and control measures- Post – slaughter
- ✓ physicochemical changes in meat and factors that influence them- Quality improvement methods –
- ✓ Adulteration of meat and detection Regulatory provisions in Meat trade and Industry.

5.2 Meat Technology

5.2.1 Physical and chemical characteristics of meat-

- ✓ Meat emulsions-
- ✓ Methods of preservation of meat- Curing, canning, irradiation etc
- ✓ packaging of meat and meat products, processing and formulations.

5.3 By- products

- ✓ Slaughter house by- products and their utilization- Edible and inedible by products-
- ✓ Social and economic implications of proper utilization of slaughter house by-products
- ✓ Organ products for food and pharmaceuticals.

5.4 Poultry Products Technology

- ✓ Chemical composition and nutritive value of poultry meat, pre – slaughter care and management.
- ✓ Slaughtering techniques, inspection, preservation of poultry meat and products.
- ✓ Legal and BIS standards. Structure, composition and nutritive value of eggs.
- ✓ Microbial spoilage. Preservation and maintenance.
- ✓ Marketing of poultry meat, eggs and products.
- ✓ Value added meat products.

5.5 Rabbit/Fur Animal farming

- ✓ Rabbit meat production.
- ✓ Disposal and utilization of fur and wool and recycling of waste by products.
- ✓ Grading of wool.

Paper I

4. Livestock production and management

4.1 Commercial Dairy Farming & Comparison of dairy farming in India with advanced countries.

- ✓ Dairying under **mixed farming** and as specialized farming, economic dairy farming.
- ✓ Starting of a dairy farm, Capital and land requirement, organization of the dairy farm. Opportunities in dairy farming,
- ✓ **Factors determining the efficiency** of dairy animal.
- ✓ **Herd recording**, budgeting, cost of milk production, pricing policy; Personnel Management.
- ✓ Developing Practical and Economic rations for dairy cattle; **supply of greens throughout the year**, feed and fodder requirements of Dairy Farm.
- ✓ **Feeding regimes** for young stock and bulls, heifers and breeding animals; new trends in feeding young and adult stock; Feeding records.

4.2 Commercial **meat, egg and wool production-**

- ✓ Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry.
- ✓ Supply of greens, fodder, feeding regimes for young and mature stock.
- ✓ New trends in enhancing production and management.
- ✓ Capital and land requirements and **socio-economic concept**.

4.3 Feeding and management of animals under **drought, flood and other natural calamities**

Last year papers of CSE

2018

a) Write BIS specification of nutrient requirements for chicken
b) Differentiate between Green fodder and Straws
c) Feeding schedule for breeding bulls
d) Write a short note on stall-feeding of goats
e) Describe the managemental practices to be adopted during the transport of dairy cattle through road and rail.
f) What are the modern management practices for enhancing productivity of pig?

2017

a) Write in brief on the following:
   (i) Feeding of lambs for mutton production.
   (ii) Feeding schedule of calves from birth to 3 months age
b) What points will you consider while formulating a ration for a dairy buffalo? A farmer gives 20 kg green maize (25% DM, 1-2% DCP and 16% TDN), 5 kg wheat straw (90% DM, 0% DCP and 40% TDN) and 4 kg concentrate mixture (90% DM, 14% DCP and 68% TDN) daily to a lactating buffalo weighing 450 kg and yielding 10 kg milk with 7% fat during her first lactation. The maintenance requirement is 280 g DCP and 3-4 kg TDN, whereas the requirement for 1 kg milk production is 63 g DCP and 460 g TDN. Indicate the deficiency or excess of nutrients in terms of DCP and TDN.
c) Explain, how will you ameliorate the problem of infertility in cattle and buffaloes under field conditions.
d) Importance of colostrum feeding and management of new born calf.
e) Plan for supply of green fodder throughout the year in an organized dairy farm.
f) A farmer wants to start a dairy farm with 100 lactating crossbred cows. Suggest

a plan with respect to capital, land, dairy equipment and feeding and breeding management practices.

g) What are the common **natural calamities** encountered by animal owners in India?

h) How will you manage to feed the animals during **scarcity conditions**? What do you understand by good managemental practices? How will you develop a practical and economic ration for commercial broiler production?

i) What is herd recording Explain the purpose and types of records to be maintained in an organized livestock farm.

2016

a) Why are broilers and layers fed different types of rations? What are the similarities and dissimilarities in these two rations?

b) How will you design an economic ration of pigs for production of lean meat? Explain

c) Why is green fodder considered as an essential constituent of ration for young and mature livestock? How will you ensure round the year supply of green fodder for dairy animals?

d) For a long time in India, mixed farming has been advocated more than the **specialized farming**. However, recent trends indicate that specialized farming is also gaining ground. What could be the reasons behind this changed mindset?

e) Plan a dairy farm to produce approximately 500 kg milk per day year round. Indicate the feed and fodder requirements and the breeding programme to maintain the constancy of milk production.

2015

a) What are the feeding habits of goats? Enlist the common feeds and fodders for goats.

b) Compute a ration for a dairy cow weighing 400 kg and yielding 10 kg of milk with 4% fat from wheat straw (0% DCP and 40% TDN), green berseem (2% DCP and 12% TDN) limited to 15 kg and concentrate mixture (12% DCP and 70% TDN). The maintenance requirement is 250 g DCP and 3 kg TDN, whereas the requirement for 1 kg milk production is 45 g DCP and 300 g TDN.

c) Traits of economic importance Guidelines to feed high yielder cows

d) What could be the delayed consequences of natural disasters?

e) What feeding practices are suggested for adult female pigs?

f) What different systems of brooding are being practiced in poultry? How would you prepare a brooder house to receive chicks?

2014

a) Describe expected impacts, adaptation and mitigation strategies in livestock to **global warming**.

b) Dairy industries in advanced countries are more **mechanized and systematic** than in India. Explain with reasons and remedies

c) Explain the mode of feeding and management practices of **young piglets** particularly for piglet anaemia and piglet diarrhoea

d) In Indian rural conditions why dairying under **mixed farming** is economically more viable than dairying under **specialised farming**? Discuss

2013

a) Describe factors determining efficiency of **traits of economic importance** in dairy animals.

b) Discuss **milk pricing policy** with respect to the producers

c) Discuss complete feeding system for dairy farms

d) Describe categories of livestock **farm labor** and discuss ways to improve their efficiency
e) What is the current status of egg production in India? What management practices are followed in raising a flock of layer birds from day old chicks?
f) What are the **economic considerations in livestock farming** in India? Discuss
g) When **natural calamities** strike, what strategy needs to be adopted for livestock management in the affected areas? What preventive measures could be taken to minimize losses from such calamities
h) A farmer, who has sufficient agricultural land, wishes to establish a dairy farm with 10 cattle. Suggest how he should prepare the **budget estimates** for his dairy farm listing all items/parameters he must consider with justification
i) Discuss **scientific practices for managemen**t of young buffalo calves from birth to 3 months of age

2012

a) Enumerate advantage and disadvantage of mixed farming discuss its suitability in cases of marginal form holding (15 Marks)
b) You wish to set up a commercial poultry form with facility of hatchery. How would you go about retting it? Discuss its critical component (24)
c) Discuss the modern manipulation technique which can be used to improve the
   i) Egg production in poultry (8)
   ii) Wool production in sheep (8)
   iii) Meat production in pig (8)
d) Discuss the technological application being put into practice for improving digestibility and nutritive value of wheat bran & paddy straw. (20)
e) Discuss the formulation of balanced diet in following group –
   1) Lactating dairy cattle (8)
   2) Pregnant cattle (8)
   3) Sheep reared for wool production (8)
   4) Heifers (8)

2011

a) Discuss recent trends in feeding of calf from birth to 3-month age (20)
b) Write in brief factor determining the efficiency of dairy cows (10)

2010

a) Principle of clean milk production – (12)
b) Which modern feeding standard would you recommend while formulating ration for high yielding cross bred cow giving full justification for its adoption under Indian context? – (20)
c) Imp of hay & silage in livestock farming – (12)
d) Livestock records and their important – (12)
e) Summer anestrous in buffalo – ()
f) Describe the care and management of heifers on a dairy farm – (20)
g) Dairy full is considered as half of herd – justify the statement – (20)
h) Enumerate managemental practice for breeding full – (20)
i) In poultry production culling may sometime be essential if profit is to be essential. explain the statement illustrating you answer with situation in which this need to be practiced.

2009

a) Management of lactating dos – (12)
b) Selection of full for breeding purpose (20)
c) Brooding and rearing of poultry layers (20)
d) Sanitation and disinfection on pig farm – (20)
e) Discuss important of shelter for buffalo and cross bred cows draw a layout plan of shelter for 10 lactating jersey cows. – (25-35)

f) Describe the important of colostrums, calf starter and milk replacers for neonates – (45)
g) What is wool and how does it differ from hair? – (15)

2007

a) Steaming up – (20)
b) Name ten agro industrial by product used in livestock feeding – (10)
c) Agro industrial by product are gaining momentum day by day in livestock feeding. How do you proceed in preparing safer feed from their product – (50)
d) Why is fertility status of cattle and buffalo low in India? Give suggestion for improving the fertility status of cattle and buffalo in India. – (60)
e) Package of practice in supply of green fodder to dairy cattle round the year. - (20)
f) Management of livestock in draught condition. – (20)
g) Adopted in livestock rearing. Explain advantage and limitation in each forming system. Suggest a feasible farming system in ort suitable to Indian condition - (60)

2006

a) What is least cost ration? What is its significance under Indian condition? Write procedure of developing least cost ration – (60)
b) Care of neonates – (20)
c) Discuss various factor which can improved efficiency of dairy animals at a commercial dairy farm having 200 adult murrah buffalo in semi-arid Indian condition – (20)

2005

a) Maintenance of lactation in cows – (20)
b) Factor affecting growth in buffalo. – (20)
c) Management of newly born calf?

2004

a) What do you understand by commercial dairy farming? How does dairy farming in India differ from advanced countries? – (60)
b) Method of control of heat stress – (20)

2003

a) Describe the symptom of heat in cow and buffalo. What is best time of breading to obtain best result? How breading efficiency in measured? Suggest suitable management practice to improve the breeding efficiency of above species. – (60)
b) Compare dairying under mixed farming and specialized dairy farming primarily from standpoint of economic return to the owner. Which on of there is best suited to an average Indian farmer and why? – (60)
c) Write about care of cow before and after parturition. Also describe care of newly born calf. Is it practical to practice weaning in India? Write a note on method of raising/weaning in India. – (60)

2002

a) Enumerate various type of essential records to be maintained by commercial dairy farm and justify their maintenance in estimating and controlling cord of milk production. – (60)
b) Describe management of livestock during flood and thereafter. – (60)

2001

a) Mixed farming v/s specialized farming. – (20)
b) Discuss various method of improvement of poor-quality roughage. Which method is suitable and application under Indian condition? Also indicate the method commonly used by farmers to improve nutritional value of straw. – (60)

2000

a) Management of piglet up to weaning. – (20)
b) Computation of ration for pregnant cross bred cow yielding 10 kg. of milk. – (20)
c) Draft animals are redundant following machines action in agriculture. Give comment with justification. – (60)
d) Discuss the important of livestock farming under Indian condition. Compare dairy farming as practiced in India with that in advanced countries. Show how would you make dairy farming a more profitable enterprises than it is present. – (60)
e) Dipping in sheep. – (12)
f) Backyard Poultry. – (12)
g) Write a note on resent status of reproductive efficiency of Indigenous cow and buffalo. Outline step to attain higher level of rep efficiency under Indian Condition. – (60)

1999

a) Swine feed has become very costly. Describes as how you will formulate a balanced swine ratio most ecumenically without adversely affecting the growth of baby growing pig and quality of meat production. – (60)
b) Economic dairy farming. – (20)
c) Modern trend in enhancing production of egg and poultry meat. – (20)
d) Describe the merit and demerit of deep litter system and battery system of housing poultry which system will you recommend to poultry farmer in India and Why?

2 TOPICS COVERED IN THIS SECTION:

Dairying under mixed farming and as specialized farming, economic dairy farming.

1. **Dairying under mixed farming and as specialized farming**

Mixed Farming

It is a type of farming under which crop production is combined with livestock raising. Livestock enterprise is complementary to crap production and at least 10% of livestock must contribute to its gross income

Advantages

1) Draught animal for crop production and rural transport
2) Crop feed to animal -> both add to productivity of each other manure
3) Gives balanced labour
4) Proper use of byproducts
5) Offer higher returns
6) Soil fertility in enhanced

Disadvantages

1) Inefficient of management
2) Disease transmission from animal to plant and plant to animal.
3) Better equipping of farm is not possible.

Large Scale Farming

1) Increased efficiency and full utilization of labor.
2) Lower machine cast as a result of greater annual use.
3) Economical use of building.
4) Economy in buying and selling.

Small Scale Farming

1) Close attention and supervision.
2) Efficient use of family labour.
3) High productivity.
4) Intensive cultivation
5) Better use of farm by products.

Specialized farming

When major resources are devoted to or income is derived from single enterprises called specialized farming. For example – dairy farming, poultry farming, sugar cane farming.

Advantage

1) Better use of land.
2) Better management and marketing.
3) Less equipment and labour are needed.
4) Efficiency.

Disadvantage

1) Greater risk.
2) Productive resources are not fully reutilized.
3) Byproduct are not properly used.

Economic Dairy Farming:

4 TOPICS COVERED IN THIS SECTION:

Starting of a dairy farm, Capital and land requirement, organization of the dairy farm. Opportunities in dairy farming, Factors determining the efficiency of dairy animal, Dairy Farm Records/ Record keeping,

1. Starting of a Dairy farm

Site selection and management for lodging, milking and new pasture or crop area depends upon

1) Availability of water resources
2) Crops and natural environment

Types of Animal Housing

1) Convectional bran/stanchion bran
   a) In tropical (no full wall only half wall)
   b) Suitable for temperate Himalayan region
2) Loose Housing
   a) Keep loose throughout day incept milking
   b) Suitable for all except temperate region and high rainfall zone.
   c) Conclusion given individually before milking
   d) Easy to construct and cheap
   e) Overcome summer sterility (B/2 voluntary movement)

Factors affecting Site Selection

a) Good drainage plenty water, sunshine
b) Near market
c) On elevated land (drainage), parlous sail
d) Availability – electricity, vet-dry, A.I.
e)

Foundation

a) 2 – 4 time wider than structural wall
b) On hard land

Plan and Layout

Depending on climatic zone and number of cows.

a) Single row housing
   1) In hot humid region
   2) In smaller unit
b) Double row housing
   1) In large limit
   2) That is tail to tail sys.

Air and Ventilation

a) Plain and hotter region – Open type
b) Temperate Himalayan – Where enclosed bran, ensure proper ventilation

Ventilation – methodical exchange of fresh air for foul air

a) Inlet ventilator – window
b) Outlet ventilator – on roof

Ancillary Structures

a) Stores
b) Milk house
c) Dry fodder room
d) Water supply
   1) Drinking water (contamination few)
   2) Cleaning water (supply with valve)
e) Manure disposal
   1) Solid removed – twice a day
   2) Solid and Liquid flushed together
f) Liquid and solid manure
   Slurry in Biogas plant

Organization of the dairy farm / Economics of Dairy Farming:

It helps in ascertaining **the income and expenditure (economics)** of dairy farm. The parameters adopted for working out the economics of dairy farming comprising ten animals buffalo/crossbred cow separately had been worked out on the following techno-economic basis:

1. The unit is managed by own family members with the help of one labour.

2. The average cost of milk buffalo has been taken as Rs. 60,000 and of a crossbred cow at Rs. 50.000 each.

3. The milk animals will be purchased during their 2nd lactation and in first month of lactation period.

4. Average lactation period has been taken as 300 days in case of buffaloes and crossbred cow, followed by a dry period of 100 days in buffaloes and 80 days in crossbred cow.

5. The average milk production per lactation has been taken as 3,000 litres in case of buffalo and 3,600 litres in case of crossbred cow.

6. The average sale price of milk per litre has been taken as Rs. 25.00 for buffalo milk and Rs. 20.00 for cow milk.

7. At the time of purchase, as also during the period of rearing the probability of producing male and female progeny in taken as 50: 50.

8. Insurance charges is calculated at the rate of 4 per cent per animal per year.

9. The cost of green fodder, dry fodder and concentrates has been taken as Rs. 100.00, Rs. 350.00 and Rs. 1500 per quintal respectively.

10. The cost of rearing call has been taken as Rs. 3,500.00 in the first year in case of buffalo and Rs. 4,500.00 in the first year for cross bred cow.

11. Generally the mortality of calf has been taken at 15-20 per cent during the first year, and an adult mortality 2-3 per cent.

12. Depreciation on milk animals (Livestock), buildings and equipments are calculated at the rate of 10 per cent.

13. Expenses on veterinary aids have been taken as Rs. 500.00 per animal per year in case of buffalo and Rs. 500.00 per animal per year for crossbred cow.

14. Male calves will be disposed of for making them as bullocks.

15. Dispose of milk buffalo after 6-7 lactation and crossbred cow after 7-8 lactations and replacing them with younger sock of known pedigree or from the heifers reared at the farm.

16. Labour charges have been taken as Rs. 6,000 per labour per month along with other facilities such as residential accommodation etc.

17. 1.50 hectares of irrigated cultivated land for fodder requirement will be sufficient for 10 animals.

18. One animal produces 12 quintals of farm yard nature (F.Y.M.) which will be sold as Rs. 100 per quintal.

19. Regular supply of dry and green fodder and concentrates is a pre-requisite for a successful dairy farming.

20. To overcome gynecological problems, vaccinations and to improve overall management at the farm help will be taken from veterinary services. To reduce the calf mortality preventive deworming and to reduce age at first calving. Summer management including water bath and allowing may be practiced.

Factors affecting Economics of 10 cross lived cow/buffalo dairy unit (In Short)

1) Capital Investment
    - Cost of 10 milky animals
    - Cost of shed
    - Cost of equipments
2) Feed and fodder requirement (per day)
    - Green, Dry Concentrate
3) Insurance
4) Medicine
5) Average days in milk and dry period
6) Income – Milk, Manure
7) Profit – Net & Gross

Factor determining efficiency of dairy animal

a) Daily Practice
- Exercise, Grooming
- Feeding policy, Watering
- Methods of milking
- Daily inspection

b) Routine Practice
- Clipping of hairs, Dehorning, Trimming of hoof
- Identification, control of vices
- Maintaining accurate records

c) Practices related to hygiene

- Vaccination programme
- Disease resistance
- Health and hygiene
  1) Manure disposal, deworming
  2) Sanitation and disinfection control
  3) Flies

d) Others

- Season of the year of calving
- Breed, age, conformation
- Housing
- Optimum dry period

Opportunities in Dairy Farming in India

1. Entrepreneurship in Dairying: Operating one's own dairy farm, involving milk production activities.
2. Field Artificial Insemination Services
3. Ration Balancing Advisory Services
4. Working as dairy farm managers.
5. As milkers
6. As Manager in a Cooperative set up.
7. Manufacture of cattle feeds and other value-added products.
8. Veterinary services for animal health and breeding.
9. Import-Export (Machinery/Ingredients/Products).
10. Dairy extension worker—imparting vocational training.
11. Consultancy services.

Economic characters of dairy cattle

The various economic characters in Dairy Cattle management are

1) Lactation yield

   The lactation yield in a lactation period is known as lactation yield

2) Lactation period

The length of milk producing period after calving is known as lactation period. The optimum lactation period is 305 days.

3) Persistency of yield

During lactation period the animal reaches maximum milk yield per day within 2-4 weeks which is called peak yield.

4) Age at first calving
5) Service period

It is the period between date of calving and date of successful conception.

6) Dry period

It is the period from the date of drying (stop of milk production) to next calving.

7) Inter calving period

This is the period between two successive calving.

8) Reproductive efficiency

The reproductive efficiency means the greater number of calves during life time, so that total life time production is increased, the reproduction or breeding efficiency is determined by the combined effect of hereditary and environment.

9) Efficiency of feed utilization
10) Disease resistance.

Dairy Farm Records/ Record keeping

For example, Pedigree sheet, Breeding register, calf-register, growth record, daily feeding register, herd health register, daily milk record etc.

Record keeping is a necessary element of good livestock business management. With no written records, farmers have to depend on their memory while making decisions regarding their farm practices.

Advantages of Record Keeping at farm

- Records provides basis for evaluation of animals from past records hence helps in **selection and culling animals**
- Helps in **preparing pedigree** and history record of animals.
- Helps in assessing the past records and designing **better breeding plans** to check inbreeding, selecting superior parents and helps in better replacement and culling practices.
- Helps in analysing feeding cost and benefits from animal product outputs. Hence helps to formulate **economic feeding strategies** for optimal productions.
- Helps in detection of abnormal conditions or **disease status** of the herd that leads to loss in body weight, loss in milk production etc.
- Help to formulate in time precautionary measures like vaccination, deworming etc.
- Helps in **fixing proper prices** of animal meant for purchase and sale.
- Helps in ascertaining **the income and expenditure (economics)** of dairy farm.
- Helps in estimating the **cost of milk production**.

<u>Types of Records to be maintained at a dairy farm</u>

1. **Livestock register**: This register records the number of the animals at the farm along with their identification number, date of birth, sire number etc
2. **Calving register:** This register maintains the records of calving that take place in the farm
3. **Daily milk yield register:** This register records the daily milk yield performance of the cows.
4. **Calf register:** maintains the records of calf at the farm, calf number, sex of the calf etc.
5. **Growth record of young stock:** this record maintains the weight of the young stocks at different intervals.
6. **Daily feeding register:** This register records the amount concentrate, dry fodder, green fodder and other feeds given to the animals daily.
7. **Herd health register:** This register maintains the record of the diseased animals along with history, symptoms, diagnosed disease, treatment given and name of the veterinarian who treated.
8. **Cattle breeding register:** This register maintains the details of breeding practices in the farm.

5 TOPICS COVERED IN THIS SECTION:

Herd recording, Budgeting, Cost of milk production, Pricing policy; Personnel Management.

1. Herd Recording: Methods of Milk Recording

Herd-recording refers to recording milk production of dairy farm. It originated in Denmark. The first Milk Recording Society was formed at Denmark in 1895. Later on, it was adopted by America, Netherland and other European countries. Thereafter it was adopted by most countries in the world wherever dairying progressed.

Following are the methods of milk recording:

1. Recording milk daily.

2. Recording milk weekly.

3. Recording milk certain days in a week.

Some dairy farmers record the milk yield of each cow daily. Other prefer to record the milk yield and fat per cent, whereas few farmers prefer to record milk yield, fat per cent and quantity of feed given to cows. The accuracy and reliability of data depends upon the method and time interval given for recording milk. For true picture it is better that milk recording be done every day.

Advantages:

1. Effect of the age of cow, kind of feed quantity of feed, stage of lactation, lactation length, dry period, calving interval, month and season of calving on quality of milk produced can be ascertained.

2. Pedigree and history sheet can be maintained.

3. Some information like average milk yield, lactation length, dry period, milking average, herd average can be obtained.

4. It is useful for quickest means of improvement (breed-wise) of the herd.

5. Helps in selection by culling uneconomic animals by knowing persistency and peak yield, and average milk of a cow when compared with herd average.

6. Helps in fixing the price of animal.

7. Animals can be registered in central herd book.

8. Helps in economic feeding of animals after determining requirement based on production.

Materials Required for Milk Recording:

1. Milk receiving apparatus.

2. Herd recorder (spring balance), calibrated to weigh minimum of 100 gm (3. Milk cans.

4. Strainer.

5. Milk produce register.

2. Budgeting

Budgeting refers to process of estimating costs, returns and net profit on a dairy farm.

1) Comparative budgeting (complete budget).
   - Quick and effective.
   - Based on long term expectation of yields prices and cost.
2) Annual Budgeting
3) Partial Budgeting

Advantage

1) Evaluate old plan and guide to new plan.
2) Help forming rational dairy policies.
3) Guide eco and efficient use of available resources.
4) Makes aware of wastes in operation of form.
5) Comparative study of receipts, expenses and net earnings on farm.

3.Determination of Cost of Milk Production

Cost of milk production means all the expenses incurred in production of milk. It is beneficial to all those in milk production enterprise and an essential information for consumers as well. In rural India, milk production is largely a subsidiary activity to the agriculture in contrast to organized dairying in Western countries. Small farmers and landless labourers usually maintain 1-3 milch animals. As a result, small quantities of milk are produced, in a scattered manner all over the country. This situation makes determining cost of milk production complex.

Methods of Determining Cost of Milk Production:

1. Survey method.

2. Direct observation method.

3. Formula method.

1. Survey Method:

In this method investigator goes to individual dairy farmer or dairy farm and **collects the information** pertaining to cost of milk production from the records maintained at the dairy farm. The data regarding expenses on feeding, labour, care, milk production, income from sale of milk, calf and manure up to 1 year or 2 calvings are collected. The cost of milk production is determined dividing the total expenses by milk yield.

2. Direct Observation Method:

An investigator, in this method, **observes all the day-to-day expenses** incurred on the different items of milk production and keep on recording.

He studies himself all the expenses on feeding, building; equipment, care, health, labour, etc. which add to cost of milk production to determine the cost per litre of milk in a similar manner as in survey method.

3. Formula Method:

Feeding alone constitutes about 65-70 per cent of the cost of milk production. A **regression equation** was also developed at the Dist. Dairy Demonstration Farm, Mathura which helps to determine expenses on feeding.

Factors Affecting Cost of Milk Production:

1. Milk yield per animal and breed.

2. Feeding policy-pasturing, proportion of green to dry fodder per animal.

3. Fodders and concentrates-quantity and their quality.

4. Number of milking animals on dairy farm.

5. Water, medicine etc., expenses.

6. Managemental factors care and supervision.

7. Labour

Milk production depends on breeding, feeding and management of animals. Several other factors, e.g. calving season, age at first calving, service period, stage of lactation, number of lactations, dry period, frequency of milking, age of animals, body size, etc., have considerable influence on milk yield of animals.

4. Pricing Policy for Raw Milk

The price of raw milk determines the level of profit, so it plays a crucial role in encouraging milk producers to produce more milk per animal and per household. A good pricing policy for raw milk collection has to take care of three variations as given under.

1. Seasonal variation

This is due to seasonality in calving, availability of green fodders and climatic stress.

2. Compositional variation

Fat and SNF are two major constituents of milk which are considered for price fixation. The '2-

axis pricing policy' gives importance to both fat and SNF. This type of pricing discourages adulteration.

3. Spatial variation

Price of agricultural commodities varies from region to region. Milk producers near cities get more price than those located far off

What is a Rational milk pricing policy?

- A guaranteed price and market to the producers throughout the year
- A regular supply of wholesome milk at a reasonable price to the consumers
- An attractive margin of profit to the milk processors and product manufacturers

1) **Fixing the price from producer's viewpoint**

The price should be related to the cost of milk production. The system must ensure a fair margin of profit to the producers.

2) **Fixing the price from milk processor's viewpoint**

Price fixation should consider the stage of operation of the plant, Plant capacity utilization, Total cost of transportation, processing /manufacturing and distribution

Pricing Systems

Various pricing systems functioning in the country for milk procurement are given below:

1. Pricing on fat content

A very large section of dairy industry is buying the milk on fat basis, disregarding the SNF content of milk

2. Pricing on volume or weight

This method is also known as flat rate. It saves time and is simple to calculate but encourages adulteration i.e. watering or skimming.

3. Pricing on total milk solids

The traditional milk traders generally price the milk on the basis of total milk solids.

4. Two-axis pricing of milk

According to this pricing policy, the price of milk is calculated by fixing a predetermined rate for fat and SNF.

6. Kilo fat system

A system based on 'kilo fat' became a practice for purchase of buffalo milk. Under this system, an amount in rupees per kg of fat means an amount payable on that quantum of milk which would yield one kg of fat

5. Personnel/Labor Management

Labor makes up around 15-20% of total farm expenses, and labor turnover can cost 150% of the employee's salary. Therefore, proper labor management can greatly impact the productive and financial success of dairy farm. Managing labor is a very important part of being a manager of a dairy operation. One must strategically **hire efficient and honest labor, train new labor, manage** all laborers to ensure productivity on the farm, continually train labor, communicate effectively, and fire labor if necessary.

Management principles:

1. Organize work to maximize efficiency and productivity;
2. Train and motivate workers to implement work systems;
3. Monitor both the work and work systems to ensure desired results are attained

Extrinsic motivators that managers can control are:

- Compensation and hours
- Job description
- Recognition and incentives
- Feedback
- Knowledge, training, and skill

Care of the New-Born calf

1. Remove the **mucus from the nose** and mouth and clean it. If the calf does not start breathing, artificial respiration should be used by pressing and relaxing alternatively, the chest walls with hands.

2. Observe as to whether **the navel cord** is still attached. The navel cord should be disinfected. The navel cord of the calf is tied about 2.5 cm away from the body and cut about one centimeter below the ligature. Apply tincture of iodine to the cut end and repeat it 2-3 days.

3. Then, if the cow does not lick the calf dry, or if the weather is cold, the herdsman should **wipe the calf to clean and dry.**

4. The next important step to follow is to feed the **Colostrum within 15 minutes** of calving, the calf should be fed with colostrum at the rate- 1/10th of body weight and buffalo calves at the rate - 1/15th of body weight. Colostrum containing low fat, high protein, vitamins and minerals forms a balanced feed for new-born calves. This helps to protect the calf against various diseases as it contains antibodies. Colostrum also helps to eliminate the material accumulated in the digestive tract before it was born.

5. **If meconium /first faecal matter** is not voided out, mild enema by dissolving soap in a liter of warm water should be given.

6. **Weaning:** If weaning at birth is followed care should be taken to see that adequate colostrum is fed for the **first 3-4 days.** If weaning is practiced 4 days after calving, then further ration has to be fed as per the schedule described.

7. **Calf rearing system** varies with the facilities available to farmers. They may be reared **indoors or outdoors** or partly indoors and partly outdoors. The important factors to be considered are: Availability of quality fodder & Climatic

8. **Identification:** This is essential for good management, especially in breeding farms. The best method of permanent identification is by **tattooing** the inside of the ear with indelible ink. **Metal ear tags or button with letters** and numbers may be inserted in the ear as a means of identification. Neck strap or neck-chain with a number plate attached, make an easy method of identification.

9. **Body weight:** of the calf is recorded on a balance along with length, breadth and height for the computation of milk allowance. Well-fed cross bred calves on an average should gain 400 grams a day or 2.5 to 3 kilograms per week.

10. Removal of **supernumerary teats** is also important and this has to be carried out before development begins. This is usually done in the first month of age with the help of a short pair of sterile scissors.
11. **Dehorning or disbudding:** Disbudding is carried out either by the use of hot iron, caustic sticks and electrical dehorning cone. Both the buds are destroyed at the early age (within 3 to 10 days).

12. **Feeding Management:**
    Utensils in which whole milk or milk replacer is fed to calves, must be clean and should be cleaned after each feeding. Severe digestive upsets can result from such contamination of the

feeding parts. Either the nipple pail or the open type buckets are satisfactory for feeding milk or milk replacer.

CARE AND MANAGEMENT OF HEIFERS

1. Heifers are reared indoors or outdoors- 9-12 months.

2. Outdoors-protection from the adverse climatic condition, rain, hot sun, snow, heavy winds biting flies, parasitic infestation.

3. Exotic Breeds-Heifers performance is low in tropical areas in the outdoors.

4. Small breeds –Age at first breeding -15 months. Large breeds-18 months.

5. Adequate live weight would be 200-225 kg for smaller breeds and 275 kgs for the larger breeds.

6. Cross bred heifers show signs of heat as early as 10 months of age but none of them are mated until attain the body weight of 225/275 body weight or a minimum of 14 months age.

7. Age at first calving 25-28 months.

Feeding of Heifers

1. Concentrate feed

   3 months to 1 year: 1 kg
   Above one year: 2 kg
   Pregnant Heifers: 3-3.5 kg

2. Green Fodder

   a. Leguminous fodder: 10 kg
   b. Non-Leguminous fodder: 25 kg
   c. Dry fodder: 3kg

Vaccination Schedule.

- Brucella Strain 19 –to prevent abortion due to Brucellosis-Vaccinated at the age of 4-6 months of Calf.
- Other Contagious Disease Vaccination are done accordingly prior to the prevalence of disease and prior to rainy season
- Foot and Mouth disease: Once in 4 months/9 months/12 months.
- Rinderpest: 1-3 years
- Haemorrhagic Septicaemia: 1 year
- Anthrax: 1year
- Black Quarters: 1year

Housing:

A. Outdoor system / Grazing method

B. Indoor method

<u>Outdoor system / Grazing system</u>

Reared chiefly of grazing
1. Care to be taken not to overstock on limited grazing land.
2. Rotational grazing.
3. Arrangement of shade and drinking water – pasture land
4. Concentrate feed is to be provided – Centrally located feed trough.
5. Protect from rain.

<u>b. Indoors</u>

1. Management in covered area.
2. Sufficient concentrate feed and fodder provided.

Steaming up of heifers.

Feeding grains to pregnant heifers prior calving at 1.5 Kg. per day. It helps in their growth, bear the stress of foetus. It produces more milk after calving and increases lactation length.

Pregnant Heifers are to be housed along with milking cows at least a month prior to calving. The udder should be washed warm water and mopped with cloth to accustom her to feel the hands in this place. Just few days prior to calving pulling teats slightly may be practiced so that heifer would not excited.

Control of Parasites – Dewormed periodically 4 months intervals Grooming is to be practiced to avoid ecto- parasites.

Care, management of Pregnant animals

1. Identify pregnant-after A.I.-90 days
2. Provide gentle treatment
3. First quarter of gestation period are critical
4. In early stages of pregnancy disturbances can cause abortion.
5. Provide concentrate feed 3.5 kg per day.
6. Provide 25 – 35 Kg Greed fodder per day and 5 Kg Paddy straw.
7. Minimum 45 – 60 days of dry period is essential.
8. Avoid long distance travel.
9. Avoid slippery condition in the shed.
10. Avoid chasing by dogs, bulls or children.
11. Avoid infighting between pregnant animals.
12. Separate pregnant animals from recently aborted animals or carriers of diseases like brucellosis.
13. Provide adequate clean drinking water
14. Protect against extremes of climate

Care and Management: Lactating animals.

1. Protection against harsh weather
2. Hygiene and sanitation of cattle shed and animals grooming, washing, disinfection etc.
3. **Feeding**

a) concentrate: DM, DCP TDN

b) Roughages

Thumb Rule: 450 –500 g Concentrate / Kg. milk production

DCP 15%, TDN 75%, GNC 25% Wheat Bran: 40%, Mineral Mixture: 1% Salt :1%

Green Fodder – 1/3 Leguminous: 2/3 Non-Leguminous

4. Peak yield – 6 weeks: ensure right Calcium-Phosphorus ratio in feed
5. Breeding – 60 days after calving does not come to heat
6. Artificial Insemination – Pregnancy verification – 90 days
7. Drying – withdraw concentrate, feed dry fodder, milking alternate M/E –4 days.
8. **Periodical vaccination**

RP, BQ, Hs, Anthrax Once in a year.

Foot and mouth – once – 4 months

Care and management of Work Bullocks

1. 60% - 70% of time – allotted to care and management of limbs and neck.
2. Avoid over working the bullocks. The work should be evenly distributed in such a way that

light and heavy work are distributed evenly.

3. Protect the bullocks from rain and inclement weather exposure
4. Lean type roof on the side of farmers house.
5. Shoe the bullock properly before using them for work on hard ground.
6. The hoof should be prepared first and shoe should made to fit the natural shape of hoof.
7. Grooming is essential as it increases cutaneous respiration, spreads subcutaneous uniformly and parasitic infection is avoided.
8. Feeding depends of type work

- Maintenance – 1.5Kg. concentrate
- In addition, 25 Kg of green and 3 to 5 Kg of dry fodder should be given

<u>Feeding of Goat</u>

Nutrition:

Feeding Habits of Goat

1. Goats generally **accept a wide variety** of feeds but what is acceptable to one may not be equally acceptable to the others
2. They prefer to select from the **wide variety of feeds** and vegetarians (Preferably leaves) and like fresh fodder, grains, seeds and pellets rather than the wet feeds, silages, chopped greens, soiled forages and hays.
3. Goats have **higher tolerance** to the wide variety of otherwise undesirable phytochemical compounds which enable them to consume a wide range of plant species.
4. In comparison with cows, then milch goats require a **higher amount of TDN.**

5. Goats have the capability of consuming dry matter to the tune of 5 to 8% of its body weight. As a species, it **can utilize lignin and cellulose better** than the other ruminants and sustain water deprivation for longer periods. The **nitrogen recycling** through rumen is also considered better.
6. Goats are normally reared **on browse and pasture forage** that other ruminants do not consume.
7. Major part of feed of goats comes from natural vegetation on common grazing land range land and other non-cultivable areas.

Summary

Browsing/ selective feeding of
1. Tender twigs and leaves – not available for other species.
2. Wider feed acceptability.
3. High crude fiber digestibility
4. Consuming more dry matter / unit body weight
5. High convertibility: 45-71% , cow : 38%
6. Capable of thriving on bushes, shrubs, herbs, tree foliage and tree leaves.
7. Highly prehensile tongue and mobile upper lip.
8. Small in size – split feeding is essential
9. Faster passage and fermentation rate
10.To certain extract withstand toxic alkaloids

Model Concentrate Mixture:

Composition :

Maize	: 60%	
GNC	: 20%	
Fishmeal	: 10%	DCP : 18%
Wheat Bran	: 7%	TDN : 70-80%
Mineral Mixture	: 2%	
Salt	: 1%	
Antibiotics		
Vitamin mixture	: 25 gm	

	Young	Grower	Adult
Maize	60	30	36
GNC	20	30	21
Fishmeal	10	-	-
Molasses	-	7	-
Bran	7	30	40
Mineral Mixture	2	2	2
Salt	1	1	1

Management during Farrowing

1. This period is critical as there is more mortality (20-30%)
2. Transferred to Farrowing pen at least one week prior to expected Farrowing
3. Date is noted by date of service.
4. Before transferring, animal as well as should be cleaned and thoroughly disinfected.
5. Chopped straw to the tune of 4ll is added. But unchopped straw is not advisable as
piglets get entangled.
6. Daily exercise.
7. Time of Farrowing is noted by nervousness, tendency to form nest and colostrum
secretion.
8. During Farrowing sows should not be disturbed as they become nervous. But attendants should be ready to save the piglets from crushing.
9. Farrowing happened within 2-4 hours and placenta shed within 2 hours.
10. Feeding prior to Farrowing should be restricted and laxative diet.
11. Space allowance: 40 – 60sq.ft

Brooder Management

1. Spread finally grained maize over the newspaper before the arrival of chicks.
2. Give cool water after boiling. Add electrolytes, B Complex and antibiotics.
3. Distribute chicks equally after counting under the brooders.
4. Before putting chicks under the brooder scale their beaks with water.
5. For first 3 days provide crushed maize twice a day. Also provide ground maize in the feeder.
6. Change newspaper sheets immediately if they get wet.
7. Remove newspapers on 5th day.
8. Remove wet litter under waterers immediately and add fresh liter.
9. On fifth day give Lasota F1 Vaccine.
10. According to the age of the birds brooder temperature should be adjusted.
11. Medication and vaccination
    a) 1st day give 5% glucose in water.
    b) 2nd to 4th day - antibiotic + Vit.A + B Complex.
    c) 5th day - RDVF vaccination
    d) 10th day - IBD vaccination.
12. Daily morning and evening wash the waterer and give freshly boiled and cooled water.
13. Give 24 hrs. light up to 3 weeks to induce night feeding.
14. Debeaking is done at 2nd week to prevent cannibalism and feed wastage.
15. Chick mash should contain 22% protein and 2800 kcal/kg ME

Practical and economic ration for Sheep, Goat & Swine:

For economic ration we should consider some important points:

1) feed animal according to their body condition and stages like pregnancy, lactation period and breeding etc.
2) feeding demands varies with purpose of sheep raising like milk, wool, or meat.
3) ration should be combination of both economic and balanced one.

<u>Steps for economic ration</u>:

A) sheep raised almost entirely on roughage which is easily available and cheap and local.
B) grazing is good method because during grazing they eat enough to maintain their body weight.
C) one of best and economic method is alternative method that is 1time stall or intensive feeding and 1time grazing on the same day.
D) if animal usually graze then it is important to provide supplement in order to provide elements for their lustre of wool and milk. High energy ration should be provided to raised animal for meat purpose.
E) leaves of some plants like neem, peeple,

babul, etc are rich in nutrients and play a vital role in economic and balanced ration.

Practical and economic ration for goat:

Goat have special feeding habits from other animals. By their mobile upper lips and very prehensile tongue goat are able to graze very short grasses and to browse on foliage and they are able to meet their nutrients requirements.

Some considerations are:

1) feed supplies according to their body weight and physiological condition of body.
2) feed according to purpose whether for milk and meat.
3) Provision of both economic and balanced ration.

Steps for economic ration:

A) browsing and open grazing is good options in order to save feed so, allow them to graze.
B) 1time grazing and other time stall feeding in a day help in manage economic ration.
C) leaves of some special plants like neem and peeple but avoid plants having anti-nutritional factor.
D) main ingredient of ration is roughage and green fodder which is easily available in fields and is cheap and local and also provision of supplements. Economic ration for swine.

Feeding accounts over the 75percent of total cost of raising pigs so, it is important to make the ration at most economic level.

1) Pigs consume more feed per unit body weight than lamb, chicken or calves.
2) **Swine are more efficient in converting feed than other species, this results in faster growth per unit body weight.**

Important points for economic ration:

1) Feed according to physiological condition of body.

2) Ration should have good protein quality so supplement with concentrates, vitamin like B and D, niacin and riboflavin to prevent neurological disorder.

3) grains form base of feed like maize, oats, sorghum etc they are easily available, cheap and local and one should grow them in their own field to decrease cost of ration.

4) Use by products: by products of oil, extraction industry like oil cakes, milling industry (wheat, oil, bran), dairy industry (whey, skimmed milk), slaughter house (meat meal and bone meal), etc.

5) waste products from households like wheat, pulse, potato, yams, molasses etc and other wastes can replace grains in swine ration and help in make ration economical.

Castrating Piglets

Castration, or the removal of the testicles, is carried out on the male pig which is not needed for breeding. If the blood vessel to the testicle is cut straight through, or pulled, heavy bleeding can occur. Bleeding is reduced by scraping the twisted blood vessel with a knife until it is cut through. Castrated animals are quieter and easy to handle. The

castrated animal is fatter and produces meat which does not have a strong smell.

Why Pigs are castrated?

Male pigs (boars) can fight causing injury to one another. Castrated pigs are quieter and easier to handle. Castrating the pig makes it put on more fat and the meat does not have a strong piggy smell. Young pigs should be castrated at 2 to 3 weeks of age.

Restraining the piglet for castration

You will need someone to hold the piglet for castration. The pig should be held by the hind legs with its head down and its body should be firmly held between the handler's knees.

You will need a very sharp, clean knife, scalpel or razor blade. Remove the sow from the litter and if possible put her where she cannot see or hear them.

- Clean the scrotum with warm water and soap and dry it.
- Move the testicle into the scrotum with your finger and then firmly grip the scrotum below the testicle between your thumb and index finger.
- Make a cut 1 - 2 cm long in the bottom of the scrotum. The testicle should pop out through the cut.
- Pull the testicle out of the scrotum and cut through the white cord leaving the red blood vessel uncut.
- Pull the testicle out slightly further and twist it around several times before cutting the twisted blood vessel by scraping up and down with the knife. This helps to reduce bleeding. Do not pull to break the vessel.
- Do not put your fingers in the scrotum. Apply either tincture of iodine, gentian violet, Dettol or an antibiotic powder or a sulpha powder to the castration wound. Remove the second testicle in the same way.

Put the piglets and their mother on clean bedding. Watch piglets for sig Feeding and Housing for Pigs

Feeding Pigs

The pig is omnivorous and can eat meat and plants. The digestive system of the pig can also use bulky feeds containing a lot of roughage. Pigs must have plenty of clean, fresh water every day.

Types of feed to give to pigs

Pigs will eat anything. They will eat grass and all types of plants. They can be kept in a well fenced field where they will eat all of the plants and grass there. The pig not only eats the green parts of plants but will also dig into the ground and eat all the roots. A pig with a nose ring cannot root up plants.The pig's eating habit can be used by man. If a pig is put in a field it will clear it, plough it and fertilize it.

Pigs will grow and get fat more quickly if they are fed concentrate feed. Grain which has been well ground into meal is a good feed. Waste vegetables and household scraps can also be given to pigs. Household scraps, especially those containing meat, must be well boiled (pig swill) before being given to the pig. The pig must always be able to drink fresh clean water. A sow with young will need 20 - 30 litres of water a day.

How often will a pig need feeding ?

Pigs can be kept in a sty when they will need to be fed twice a day with one feed in the morning and one in the evening. Pigs in the field can be offered meal once a day or given extra feed, e.g. vegetable waste or swill, when it is available.

Weaning

Piglets show an interest in solid feed when they are 1 or 2 weeks old. They can be offered a handful of cereal, sugar or powdered milk to start with. Piglets will take milk from the mother until they are about 7 weeks old. They will gradually take less milk and eat more solid feed until they are weaned. Piglets in the field will naturally start to eat solid feed but it must be offered to those that are housed. The young animals need to be gradually given new feed to avoid digestive problems.
Remember that a pig should rush to eat its feed. Lack of interest in feed is a sign of ill

health and you will need to look at the animal to determine the cause of health problems.

Housing for Pigs

Pigs can be kept in a field where there is a shelter or they can be kept in a pig sty. Pigs should not be allowed to wander about free. There will be no control over what they eat or where they go and disease will spread.

Keeping pigs in a field

Wild pigs live amongst bushes and the roots of tress. When pigs are kept with access to a warm, low area to lie and sleep in, as they would in the wild, the pigs do better. Pigs can be kept in a field where they can feed on grasses and plants. If pigs are kept this way, the field must be surrounded by either a strong fence or a wall. Pigs will push their way out of a field if the fence is not strong enough. The animals are given shelters called pig arks to sleep in. These can be made of wood or metal sheets and should contain bedding. The arks can be moved to fresh ground when necessary.

Housing and Pens for pigs

Pigs can be kept alone or in small groups in a pig sty, a concrete or solid floored pen with a low shelter. When building a sty you should choose an area which is never flooded in the rainy season. It should not be too near to houses so that smells and flies are a nuisance. The floor should be concrete and sloping away from the sleeping area so that urine flows out and away. The concrete floor should be laid on a good foundation and will need to be 5 - 6 cm thick. If the concrete is too thin and cracks, the pigs will soon start to dig it up. An earthen floor cannot be kept clean and will lead to problems with parasites and other diseases. The walls of the sty need to be fairly smooth so that they can be kept clean. Cracks in the walls will allow dirt and germs to accumulate.

The animals should be given plenty of bedding in the shelter. Pigs will always dung away from their sleeping and feeding areas. The dung can be removed every day allowing the pen to be kept clean and avoiding the buildup of waste and smells.

Housing for piglets

Breeding sows and their litters can be kept in sties or using the open field system. Plenty of bedding should be given to help keep the young animals warm and it must be changed frequently. If a litter is raised in a sty, the sty should be thoroughly cleaned and scrubbed out after the litter has been weaned and moved elsewhere. If a litter is raised in the field, the shelter should be moved to a new site for the next litter to avoid disease problems, especially from parasitic worms, developing.

Whatever the housing method used, piglets should have access to a warm area which the sow cannot reach. This is called a creep and piglets can be given feed here and can lie down without the risk of the mother lying on top of them. The sow is prevented from entering the creep by placing a temporary wall of boards or strong rails across part of the shelter. The bottom rail is about 30 cm from the ground allowing the small piglets to pass under it.

Do not allow pigs to wander free around the community. This results in the spread of disease among the animals and also between them and people

ns of infection in the wound for the next week. Infected castration wounds swell, piglets do not want to walk or are lame.

Pregnancy and Farrowig in pigs

Pregnancy in pigs lasts for 3 months 3 weeks and 3 days. A well-fed sow will produce at least 10 piglets (litter) from each pregnancy and may have 2 litters each year.

Care of the Pregnant Sow

If the sow shows no sign of being in heat 3 weeks after mating she is pregnant. The pregnancy will last about 3 months 3 weeks and 3 days. During the pregnancy, the sow will need plenty of feed high in nutrients and will especially need more feed towards the end of the pregnancy. She should be given some feed high in nutrients e.g. grain and green stuffs every day. Giving the sow

access to clean soil or grass with roots from land where no pigs have been kept will allow her to get the minerals she needs. Give the sow plenty of clean bedding when birth is close.

Sign that the pig is ready to farrow

The sow becomes restless and starts to make a nest within 24 hours of giving birth.
The teat will produce milk when gently squeezed.
Blood stained fluid may be passed from the vagina 1 to 2 hours before birth begins and if small greenish pellets appear the first piglet will appear within an hour.
Gently rubbing the udder will make the sow relax and lie on her side in the position to give birth.

Normal Farrowing

Farrowing is a natural process and the sow will usually need no help. Once the first piglet is born the others, and the afterbirth, will quickly follow. Farrowing should be completed within 2 to 3 hours. The navel cord will break (you do not need to cut it) and the piglet will immediately search for a teat and milk. If the navel bleeds, tie it tightly with a clean string or cord.

When and How to help in Farrowing

If the sow shows all the signs of farrowing but she has not produced a piglet and is pawing with a hind leg, or if 45 minutes has passed since the first piglet appeared and there is no sign of the second you will have to help the sow.

- Wash your hands and arms with warm water and soap and scrub under your finger nails.
- Wash the region of the vulva.
- Make your hands soapy or put olive or sunflower oil on your hands.
- Put your hand into the vagina and feel for the piglet or matter causing the blockage and try to remove it.
  Clear the piglet's mouth and nose of mucous and if it is not breathing you can slap it to encourage it to breath. Gently rub the piglet dry and put its mouth on a teat.

Animal Nutrition

1.1 Partitioning of food energy within the animal. Direct and indirect calorimetry. Carbon – nitrogen balance and comparative slaughter methods. Systems for expressing energy value of foods in ruminants, pigs and poultry. Energy requirements for maintenance, growth, pregnancy, lactation, egg, wool, and meat production.

1.2 Latest advances in protein nutrition. Energy protein interrelationships. Evaluation of protein quality. Use of NPN compounds in ruminant diets. Protein requirements for maintenance, growth, pregnancy, lactation, egg, wool and meat production.

1.3 Major and trace minerals – Their sources, physiological functions and deficiency symptoms. Toxic minerals. Mineral interactions. Role of fat-soluble and water – soluble vitamins in the body, their sources and deficiency symptoms.

1.4 Feed additives – methane inhibitors, probiotics, enzymes, antibiotics, hormones, oligosaccharides, antioxidants, emulsifiers, mould inhibitors, buffers etc. Use and abuse of growth promoters like hormones and antibiotics – latest concepts.

1.5 Conservation of fodders. Storage of feeds and feed ingredients. Recent advances in feed technology and feed processing. Anti – nutritional and toxic factors present in livestock feeds. Feed analysis and quality control. Digestibility trials – direct, indirect and indicator methods. Predicting feed intake in grazing animals.

1.6 Advances in ruminant nutrition. Nutrient requirements. Balanced rations. Feeding of calves, pregnant, work animals and breeding bulls. Strategies for feeding milch animals during different stages of lactation cycle. Effect of feeding on milk composition. Feeding of goats for meat and milk production. Feeding of sheep for meat and wool production.

1.7 Swine Nutrition. Nutrient requirements. Creep, starter, grower and finisher rations. Feeding of pigs for lean meat production. Low cost rations for swine.

1.8 Poultry nutrition. Special features of poultry nutrition. Nutrient requirements for meat and egg production. Formulation of rations for different classes of layers and broilers.

Partition of Energy in Animal Nutrition

Energy gained from food is partitioned for different uses. Gross energy, digestible energy, metabolisable energy and the net energy are all used for different functions.

Gross energy is lost through fecal excretion, digestible energy is lost through urinary functions.

Metabolisable energy is lost through the increase of heat and

Net energy can be lost through functions such as the production of milk in lactation or through an animal reproducing

Equation for calculating metabolisable energy:

ME = (protein x 3.5) + (fat x 8.46) + (carbohydrate x 3.5) kcal/100gms

Energy Requirements Calculation:

Formula Example:

RER = (30 x bw in kg) + 70kcal

RER stands for resting energy requirement and represents kcal. In order to determine the Resting Energy Requirement of an animal the body weight (in kilograms) is multiplied by 30. 70 is then added to the outcome of this calculation which then gives the RER for that animal in kcal.

MER Calculation:

Formula Example:

MER = RER x 2

MER stands for maintenance energy requirement. Before working out the MER of an animal, the RER must first be calculated. Once the RER is known, this outcome is then multiplied by two. Animals in different life stages however require more energy than others. In this case, a young cow who is growing and has only 50% of their adult weight requires the normal MER x 2.

Calf (Dairy):

RER:

(30 x 28.8kg) + 70kcal

= 864 + 70kcal

= 934kcal

MER:

934 x 2

= 1868kcal x 2

= 3736kcal

The result is that the calf requires 3736kcal per day in order to grow normally.

Energy Requirements in Sickness:

Formula Example:

RER X 1.25

RER still refers to Resting Energy Requirement and the 1.25 represents how much more energy an animal needs if they have had minor surgery or trauma. To calculate this, the original method of calculating RER is used then the outcome of the calculation is multiplied by 1.25.

Minerals are micro-nutrients and there are two types. Essential minerals refer to those that the body needs in order to function correctly. There are two categories of these minerals which are macrominerals and microminerals.

Microminerals are needed in smaller amounts compared to macrominerals however they are both important for the functioning of the body. Each mineral has a different function

within the body and there are different sources for each.

Macrominerals, their functions & sources:

Potassium and Sodium are both needed for fluid balance, muscle contraction and nerve transmission. They can both gained through table salt and within vegetables and unprocessed meats however these contain only small amounts.

Calcium and phosphorus are needed in order to have healthy bones and teeth. Calcium is also used to help muscles function correctly, aid blood clotting and to regulate blood pressure.

Phosphorus can be found in every cell within the body. Sources of calcium include milk and canned fish which contains bones for example sardines or salmon. Phosphorus is also found in milk but also in meat and eggs.

Magnesium is used for bone development also and is needed to make protein. Magnesium also helps to keep the immune system healthy, a role which phosphorus also performs. Nerve transmission is also aided by magnesium as well as being used to make protein. Magnesium can be sources from nuts and seeds as well as green vegetables and seafood.

Sulfur is found within protein molecules and can be sources from meat, fish, eggs and nuts.

Chloride is used for proper fluid balance and is found within stomach acid which is used to break down food which has been ingested. Chloride is found in table salt and there are small amounts within meat, vegetables and bread

Microminerals, their functions & sources:

Iron is needed in order to aid energy metabolism. Within the body, iron is found within red blood cells and can be sourced from red meat, fish but especially shellfish as well as egg yolks and green vegetables.

Zinc is important for reproduction as it is a part of many processes needed to reproduce. It aids normal fetal development, the production of sperm as well as normal growth and sexual maturation. In addition to this, zinc is needed for immune system health and is needed by the body for making genetic material. This important micromineral can be sourced from fish, meat and vegetables.

Iodine is found within the thyroid hormone within the body. This is used for regulating growth and development as well as aiding metabolism. Seafood, bread and dairy products are all a source of iodine.

Selenium is an antioxidant and can be found in meats, grains and seafood. When together with enzymes, selenium have the ability to neutralise free radicals which have been produced as byproducts of a chemical reaction. Free radicals are unstable molecules which are highly reactive.

Copper is used for iron metabolism as well as being a part of many enzymes within the body. It is found in nuts, seeds and whole grains as well as organ meats such as liver and heart.

Manganese is also part of enzymes within the body and this can be sourced from organ meats including liver and kidneys, just like copper.

Fluoride is used for the formation of bones and teeth and helps to protect the formed teeth from tooth decay. Drinking water and fish are both good sources of fluoride and are a good way of getting this micromineral into the diet.

Chromium helps to regulate glucose and blood sugar levels. In order to do this it works closely with insulin. Whole grains, nuts and cheeses are good sources of chromium and liver is high in this micromineral.

Molybdenum is part of enzymes within the body and can be gained from leafy green vegetables, milk and liver.

Iron is classed as what is known as a trace nutrient. There is also silicon, vanadium, cobalt and nickel included in this.

Direct calorimetry

METHODS ADOPTED TO ESTIMATE ENERGY REQUIREMENTS FOR MAINTENANCE:

Energy requirements are best determined by measurement of energy expenditure.

Energy expended for maintenance of an animal is converted into heat and leaves the body.Thus an intake sufficient to offset the loss represented by the fasting metabolism would be the requirement if the animal is maintained under basal conditions.

Data on maintenance requirements of energy have mainly been obtained in three ways.

Fasting metabolism as a basis for estimating maintenance requirement.

By short and long-term trials with mature, non-producing animals fed at the maintenance level.

Data on maintenance requirements are obtained by extrapolation of intake of feed towards zero level production.

Fasting metabolism as a basis for estimating maintenance requirement:

Dry non-producing, mature animals were fasted, kept in a thermoneutral environment and their heat production was determined (fasting catabolism). This gives an estimate about the minimum quantitity of net nergy which must be supplied to the animal to keep it in energy equilibrium. This can be estimated by both direct and indirect calorimetry.

Direct calorimetry

This is simple in theory, difficult in practice; sensible heat loss (heat of radiation conduction) from the animal body can be measured with two general types of calorimeters, adiabatic and gradient.

The insensible heat (latent heat of water vapourized from the skin and the respiratory passages) is estimated by determining in some way the amount of water vapour added to the air, which flows through the calorimeter. For this, rate of airflow and change in humidity is measured.

Adiabatic calorimeters

In this type an animal is confined in a chamber constructed in such a way that heat loss through the walls of the chamber is reduced to near zero. This is attained by a box within a box.

When the outer box or wall is electrically heated to the same temperature as the inner

wall, heat loss from the inner wall to the outer wall is impossible.

Water circulating in a coil in such a chamber absorbs the heat collected by the inner wall; the volume and change in temperature of the water can be used to calculate sensible heat loss from animal body.

The construction and operation are complicated and very expensive.

Gradient calorimeters

Calorimeters of this type allow the loss of heat through the walls of the animal chamber.

The outer surface of the wall of the calorimeter is maintained at a constant temperature with a water jacket; the temperature gradient is measured with thermocouples, which line the inner and outer surfaces of the wall.

By the use of appropriate techniques, it is possible to measure separately the radiation component of the sensible heat loss.

Indirect Calorimetry

Animal body ultimately derives all of its energy from oxidation, the magnitude of energy metabolism can be estimated from the exchange of respiratory gases.

Such measurements of heat production are more readily accomplished than are measurements of heat dissipation by direct calorimetry.

A variety of techniques are available for measuring the respiratory exchange; all ultimately seek to measure oxygen consumption and CO2 production per unit of time.

1. Open circuit system:

Devices allow the animal to breath atmospheric air of determined composition; the exhaust air from a chamber or expired air from a mask or cannula, is either collected or else metered and sampled and then analysed for O2 and CO2 content.

Analysis of gases has been accomplished with chemical and volumetric or manometric techniques.

2. Closed circuit system:

Devices require the animal to rebreathe the same air.

CO2 is removed with a suitable absorbent which may be weighed before and after use to determine its rate of production.

The use of oxygen by the animal body decreases the volume of the respiratory gas mixture, and this change in volume is used as a measure of the rate of oxygen consumption.

Oxygen used by the animal is then replaced by a metered supply of the pure gas.

Both O2 consumption and CO2 production must be corrected for any difference in the amounts present in the circuit air at the beginning and end of the experiment.

Methane is allowed to accumulate in the circuit air and the amount present is determined at the end of the experiment.

3. Indirect Calorimetry by the measurement of respiratory exchange:

The substances which are oxidised in the body, and whose energy is therefore converted into heat, fall mainly into the three nutrient classes of carbohydrates, fat and proteins.

In an animal obtaining all its energy by the oxidation of glucose, the utilisation of 1 litre of oxygen would lead to production of 673/(6x22.4)=5.007 Kcal of heat, for mixtures of carbohydrates the average value is 5.047 Kcal, and for mixtures of fats alone, the average value is 4.715 Kcal per litre.

Such values are known as thermal equivalents of oxygen, and are used in indirect calorimetry to estimate heat production from oxygen consumption.

They oxidise a mixture of Carbohydrate & Fat (and of protein also), so that in order to apply the appropriate thermal equivalent when converting oxygen consumption to heat production it is necessary to know how much of the oxygen is used for each nutrient.

The proportions are calculated from what is known as the respiratory quotient (RQ).

This is the ratio between the volume of carbon dioxide produced by the animal and the volume of oxygen used.

Since, under the same conditions of temperature and pressure, equal volumes of gases contain equal numbers of molecules, the RQ can be calculated from the molecules of carbon dioxide produced and oxygen used.

From equation (1) the RQ for carbohydrate is calculated as 6 CO2/6 O2 = 1, and from equation (2) that of the fat, tripalmitin, as 51 CO2/72.5 O2=0.70.

If the RQ of an animal is known, the proportions of fat and carbohydrate oxidised can then be determined from standard tables.

For example, an RQ of 0.9 indicates the oxidation of a mixture of 67.5% carbohydrate and 32.5% fat, and the thermal equivalent of oxygen for such a mixture is 4.924 Kcal/litre.

The mixture oxidised generally includes protein.

The quantity of protein catabolised can be estimated from the output of nitrogen in the urine, 0.16g of urinary N being excreted for each gram of protein.

The heat of combustion of protein (i.e. the heat produced when it is completely oxidised) varies according to the amino acid proportions but averages 5.3 Kcal per g.

Protein, however, is incompletely oxidised in animals because the body cannot oxidise nitrogen, and the average amount of heat produced by the catabolism of 1 g. of protein is 4.3 Kcal.

For each gram of protein oxidised, 0.77 litres of carbon dioxide is produced and 0.96 litres of oxygen used, giving an RQ of 0.8.

In practice heat production calculate from respiratory exchange in ruminants is corrected for this effect by the deduction of 0.5 Kcal for each litre of methane.

An alternative means of over-coming difficulties of this kind is to calculate heat production from oxygen consumption alone.

If a respiratory quotient of 0.82 and a thermal equivalent of 4.8 are assumed, departures from this RQ of between 0.7 and 1.0 cause a maximum bias of no more than 3.5% in the estimate of heat production.

A further simplification is possible in respect of protein metabolism.

The thermal equivalent of oxygen used for protein oxidation is 4.5 Kcal per litre, not very different from the value of 4.8 assumed for carbohydrate and fat oxidation.

If only a small proportion of the heat production is caused by protein oxidation it is unnecessary to assess it separately, and so

urinary nitrogen output need not be measured.

An example of the calculation of heat production from respiratory exchange is shown below:

Calculation of the heat production of a calf from values for its respiratory exchange and Urinary Nitrogen excretion.

Measurement of energy retention by the Carbon and Nitrogen balance technique:

- The main forms in which energy is stored by the growing and fattening animal are protein and fat, for the carbohydrate reserves of the body are small and relatively constant.
- The quantities of protein and fat stored can be estimateed by carrying out a carbon and nitrogen balance trial; that is by measuring the amounts of these elements entering and leaving the body and so, by difference, the amounts retained.
- The energy retained can then be calculated by multiplying the quantities of nutrients stored by their calorific values.
- Both carbon and nitrogen enter the body only in the food, and nitrogen leaves it only in faeces and urine.
- Carbon, however, leaves the body also in methane and carbon dioxide and the balance trial must therefore be carried out in a respiration chamber.
- The procedure for calculating energy retention from carbon and nitrogen balance data is best illustrated by considering an animal in which storage of both fat and protein is taking place.
- In such an animal intakes of carbon and nitrogen will be greater than the quantities excreted, and the animal is said to be in positive balance with respect to these elements.
- The quantity of protein stored is calculated by multiplying the nitrogen balance by 100/16 (=6.25), for body protein is asumed to contain 16% nitrogen. It also contains 51.2% carbon, and the amount of carbon stored as protein can therefore be computed.
- The remaining carbon is stored as fat, which contains 74.6% carbon. Fat storage is therefore calculated by multiplying the carbon balance, less that stored as protein, by 100/74.6.
- The energy present in the protein and fat stored is then calculated by using average calorific values for body tissues.
- These values vary from one species to another, for cattle and sheep those used are commonly 9.37 Kcal per g for fat and 5.32 Kcal per g for protein.

Measurement of Digestibility Co-Efficient

The potential value of a food for supplying a particular nutrient can be determined by chemical analysis, but the actual value of food to the animal can be arrived at only after making allowances for the inevitable losses that occur during digestion, absorption and metabolism.

The first tax imposed on a food is that represented by the part of it which is not absorbed and is excreted in the faeces.

The digestibility of a food is most accurately defined as that proportion which is not excreted in the faeces and which is, therefore assumed to be absorbed by the animal.

It is commonly expressed in terms of dry matter and as a coefficient or percentage. When the digestibility is expressed in percentage it is known as digestibility coefficient.

The digestibility coefficient determined is apparent, since the faeces/dung contain metabolic (mucosal debris, unspent enzymes,

undigested microorganisms) as well as undigested feed.

Dung (digested DM excreted) = 3.7 kg from feed + 0.3 kg from body

Thus the apparent digestibility of feed is less than the true digestibility.

The losses of the ingested carbohydrates as methane and carbon dioxide are also accounted in digestibility. So digestibility of carbohydrates is overestimated.

Digestibility coefficients are estimated for all organic nutrients.

For ash or minerals, it is not estimated, because it does not contribute to energy to the feed, and most of the absorbed minerals are excreted through the gut.

In a digestion trial the faecal matter is only analysed, whereas in a metabolism trial both faecal matter and urine will be analysed for losses of nutrients of dietary origin.

Methods of Determining Digestibility

I. In vivo method

- In this animals like sheep, goat, rabbit, pig, dairy cattle etc in which digestibility of a feed is to be determined are used.
- The two in vivo methods are :
    - Direct Method or Conventional method
    - Indirect: In the indirect method there are two methods:
        - Difference Method
        - Indicators/Markers Method

II. Semi in vivo methods

- Nylon bag technique
- VIVAR technique

III. In vitro methods

- Using rumen liquor
- Using enzymes instead of rumen liquor
- RUSITEC method

Digestibility by Difference

Difference method

- When the digestibility of poor quality non-maintenance type of forage like stovers, kadbi, straws or mature grasses is to be determined because these cannot be fed as sole source of nutrients.
- If the digestibility of oilseed cakes, cereal grain and concentrate mixture is to be determined then difference method is followed since these cannot be fed as sole feed to ruminants.

Procedure

For example, if the digestibility of nutrients in a concentrate like maize grain or groundnut cake and in a poor quality roughage like straw is to be determined then three digestibility trials in a sequence are conducted.

- 1st digestion trial
    - feed the animals with a good quality roughage like legume hay e.g. cowpea hay to determine the digestibility of nutrients in it.
- 2nd digestion trial
    - the same animals are fed the same good quality fodder i.e. cowpea hay that was fed during first digestion trial along with known quantity of concentrate like groundnut cake or maize grain etc whose digestibility is to be estimated by difference.
- 3rd digestion trial
    - by feeding the same animals with the concentrate whose digestibility was estimated in the second trial along with the poor quality roughage i.e. grass whose digestibility is to be determined. The digestibility of poor quality roughage will be determined by difference using predicted value of groundnut cake with the help of earlier trials *(a)* and *(b)*

Indicator Method of Determining Digestibility

- In some circumstances the lack of suitable equipment of the particular nature of the trial may make it impracticable to measure directly either food intake or faeces out put, or both. For instance, when animals are fed as a group it is impossible to measure the intake of each individual.
- Digestibility can still be measured, however, if the food contains some substance which is known to be completely indigestible.
- If the concentrations of this indicator substance in the food and in small samples of the faeces of each animal are then determined, the ratio between these concentrations gives an estimate of digestibility.
- For example, if the concentrations of the indicator increased from 1% dry matter to 2% in the faeces, this would mean that 50% of the dry matter had been digested and absorbed.

- The indicator may be a natural constituent of the food or be a chemical mixed into it. It is difficult to mix chemicals with foods like hay, but an indigestible constitutent such as lignin may be used.
- Other indicators in use today are fractions of the food known as indigestible acid-detergent fibre and acid insoluble ash (mainly silica) and also some naturally occuring n-alkanes of long chain length (C_{25}- C_{35}).
- The indicator most commonly added to foods is chromium in the form of chromic oxide, Cr_2O_3.Chromic oxide is very insoluble and hence indigestible; moreover, chromium is unlikely to be present as a major natural constituent of foods.
- For non ruminants ,titanium dioxide may be added to foods as an indicator.
- Chromic oxide may be used as an indicator in a different way, to estimate faeces output rather than digestibility.
- In this application the marker is given for 10 -15 days in fixed amounts (eg. administered in a gelatin capsule) and once its excretion is assumed to have stabilised its concentration in faeces samples is determined.Faeces dry matter output (kg/day) is calculated as follows:
- Marker dose (g per day)/ Marker concentration in faeces DM (g/kg). For example, if an animal was given 10 g of chromic oxide per day and the concentration of the marker was found to be 4 g/kg faecesDM, faeces output would be calculated as 10/4 =2.5 kg DM/day. If food intake was known, dry matter digestibility could be calculated in the usual way.

The ideal specification of an indicator/marker are:

- It should be totally indigestible.
- It should not have any pharmacological action on the digestive tract. It should be inert to the digestive system.
- It must mix intimately and remain uniformly distributed in the digesta.
- It should pass through the tract at a uniform rate and should be voided entirely.
- It can readily be determined chemically, and
- Preferably be a natural constituent of the feed under test.

Indicators may be used to measure digestibility of feed under the following circumstances:

- If metabolism cages and other facilities for direct collection of feces and urine voided are not available
- If animals are fed in groups, then it is impossible to record the feed consumed and feces voided by each animal in the group but still it is possible to measure digestibility of feed by the indicator method.
- To know intake of herbage from cultivated or natural pastures and digestibility of nutrients in the pasture consumed by the animal**.**

Measurement of Pasture Consumption & Digestibility

- It is essential to know the quantity of forage a grazing animal consumes from the pasture or a range and the nutritive value of the pasture. So initially pasture grasses were harvested and digestion trials were conducted in the stall. This method was not correct since the grazing animals have a tendency of selective grazing. Subsequently the grazing animals were harnessed with faeces collection bags and faeces voided in 24 hours was determined. This can provide total dry matter voided.
- Pasture grasses were harvested and fed in the stalls to determine digestibility coefficients. From these two figures the total dry matter intake (DMI) of the animals was calculated.

- It is difficult to obtain, the representative sample of forage actually eaten by the grazing animal and quantitative collection of faeces by faeces bag. Therefore markers have been used for both the determination of digestibility of pasture herbage and DMI through grazing.
- Digestibility can be determined through use of an internal indicator.
- Faecal output is measured concurrently by using an external marker and intake is calculated as follows.
- Normally chromic oxide is fed in a capsule to the grazing animals and the number of grab samples of faeces are taken at different time interval to determine the average concentration of the indicator per unit weight of faeces.

- For example: A grazing animal was fed 2 g of Cr_2O_3 in a capsule per day. Find out the forage intake and its DM digestibility.

Use of markers

- Measurement of digestibility coefficients without total faecal collection
- Measurement of herbage intake in grazing animals
- Markers are used for quantifying the rate of passage and extent of digestion in different segment of the gut.
- Rare earths (Lanthanam,Samarium,cerium,ytterbium and dysprosium) may be used as reliable markers of particulate phase of digesta.
- Polyethylene glycol (PEG), Chromium, EDTA and Cobalt EDTA are liquid phase markers in ruminant studies.

TOTAL DIGESTIBLE NUTRIENTS

This is the simplest form of energy evaluation wherein the animal requirements and the value of feeds in meeting these requirements are expressed in terms of the weight of digestible material in the feed.

The digestibility of nutrients is determined by digestibility trials.

TDN is simply a figure, which indicates the relative energy value of a feed to animals.

It is ordinarily expressed in Kg or in percent.

It can be calculated by the formula

TDN (%) = % digestible crude protein + % digestible crude fibre + % digestible N-free extract + (2.25 x % digestible ether extract).

% TDN = % DCP + % DCF + % DNFE +(2.25 x % DEE)

The digestible ether extract is multiplied by 2.25 because on oxidation fat provides 2.25 times more energy as compared to carbohydrates.

Merits:

- It is easiest to determine the digestible values through digestive trials unlike the ME and NE, which require complicated equipments and procedures.
- The TDN values for most of the feedstuffs are obtained from carefully conducted digestion trial and are available in standard books.
- The energy requirements of the ruminant were in TDN values.

TDN IN ENERGY EVALUATION

- Position of TDN in energy evaluation system:
- TDN is based on the Atwater physiological fuel values for human nutrition.
- In human after digestion and absorption the energy losses of carbohydrate and fat is negligible, only for protein there is some metabolic loss.
- So, for all three nutrients the physiological fuel values represent the metabolisable energy values.
- In case of ruminants (where the TDN system is commonly followed) even after digestion there is high gaseous loss that occurs in the form of methane and CO2 in case of carbohydrates.
- Moreover the urinary loss is high in case of ruminant animals when compared to human beings. Hence it can be concluded that,
- As far as carbohydrate (CF ; NFE) and fat is concerned the TDN system can be fit into DE system in ruminants.
- In case of protein, the TDN system not only considered faecal loss but also urinary loss. So in case of protein the TDN system can be fit into ME system.
- If the TDN system completely fits into the DE system, then the %DCP should be multiplied by a figure of 1.3.

Factors affecting the Total Digestible Nutrients (TDN) value of feed

- Percentage of dry matter : The more the water present in a feed, the less is the other nutrients and resulting in a lower total digestible nutrient value (TDN) .
- Digestibility of dry matter : Unless the dry matter of a feed is digestible, it has no TDN value. eg. Mineral oil has a high gross energy value, but it cannot be digested and so has no digestible energy or TDN value.
- Amount of mineral matter in the dry matter : The more mineral matter a feed contains, the lower will be the organic matter and its TDN value.
- Digestibility of fat in the dry matter: The more digestible fat a feed contains, the greater will be the TDN valu

Weakness of the TDN system

- It is based on proximate analysis of the feed,which does not partition the feed into well defined chemical constitutents. Almost all proximate principles are composed of more than one chemical compound.
- The highly digestible nitrogen free extract (NFE) contain part of hemicellulose and lignin, while crude fibre residue contains all the original cellulose, variable proportions of the hemicellulose, and small and variable proportion of lignin. That is why the assumption about high digestibility of NFE and low digestibility of crude fibre is always not true and for some feeds crude fibre is as digestible as NFE.
- The factor, 2.25 used in case of fat to equalise its high energy content with that of carbohydrate and protein is not always a constant.
- It is also based on human and dog experimental data. The ether extract of

various feeds differ in the true fat content.
- It does not measure energy in energy units.
- It attempts to measure what feed 'contains' rather than what they accomplish or produce.
- It over estimates the energy value of forages in relation to concentrates.
- The term TDN implies that digestion losses only are taken into account. But actually this is not the case. To put protein on an equivalent carbohydrate basis, as was done for fat, digestible protein should have been multiplied by a factor namely,1.3 (5.2/4=1.3). But this is not being done. That is how calculation of TDN took account of urine as well as digestion losses. Actually, as calculated, it is a measure similar to ME for those species having no gaseous losses. Thus TDN doe not mean what it implies.

Systems for expressing energy value of foods in ruminants, pigs and poultry:

- Energy is the force that enables to sustain life activities is energy. Energy required for maintenance of life includes:
- Mechanical energy for essential muscular activities like heart beat, respiration etc.,
- Chemical energy like movement of dissolved substance against concentration gradient, synthesis of enzymes & hormones.
- Energy required for performance of work / production includes:
  1. Muscular work.
  2. Milk production.
  3. Growth.
  4. Egg production.
  5. Wool production.

Food evaluation systems are based on digestible, metabolic and net energy.

The various systems in vogue are DE, ME, NE, physiological fuel value, total digestible nutrients, starch equivalent, Armsby NE system and Scandinavian food unit system.

Actually, the only useful form of energy is Net energy.

Although the experimental determination is somewhat tedious, in most of the developed countries, most systems of feed evaluation at present is based on net energy.

1. Gross energy.
2. Digestible energy.
3. Metabolisable energy.
4. Net energy.
5. Physiological fuel value.
6. TDN.
7. Starch equivalent

Basic unit of energy:

Calorie: One calorie is the energy required to raise the temperature of 1g of water to 15.5°C from 14.5°C. 1000 calories = 1Kcal (amount of heat required to raise 1kg of water to 1°C). 1000 Kcal = 1Mcal or Therm.

Gross Energy

It is defined as the energy liberated as heat when feed, faeces or any other substance is fully oxidised by burning a sample completely in a bomb calorimeter.

Digestible energy

It is the energy of the feed less the faecal energy. Energy lost in faeces accounts for the largest loss of energy, which ranges between 20 to 40%.

METABOLISABLE ENERGY

- It is the digestible energy less the energy lost in urine and combustible gases leaving the digestive tract , chiefly methane.
- It can also be defined as ingested gross energy minus faecal energy minus urinary energy minus gaseous energy.
- It is the portion of energy available for metabolism.
- ME is commonly used to evaluate feedstuffs for poultry because the birds void urinary and faecal losses together.
- Urinary losses of energy is quite stable in a given species and is usually 2-3% of GE. The losses are more in ruminants.

HEAT INCREMENT (HI)

- Heat increment is the amount of energy lost as a result of chemical and physical processes associated with digestion and metabolism.
- HI increases with the amount of feed consumed and may be used in animals reared in cold environment to warm the body otherwise.
- HI is a wasteful process.
- HI is also called as specific dynamic effect it consists of the following
- Heat of nutrient metabolism.
- Heat of fermentation.
- Heat production from work by the kidney.
- Heat production from increased muscular activity due to nutrient metabolism.
- HI is greater in ruminants compared to monogastrics

NET ENERGY (NE)

Net energy is obtained from ME by subtraction of heat increment.

NE is that portion of energy that is completely useful to the animal for maintenance and production purpose.

The portion of NE used for maintenance is the energy required to sustain life processes.

The other portion of NE is used for tissue gain or milk or egg production.

Feeding standards

Feeding standards are statements or quantitative descriptions of the amounts of one or more such nutrients needed by animals.

- Feedings standards are the tables, which indicate the quantities of nutrients to be fed to the various classes of livestock for different physiological functions like growth, maintenance, lactation, egg production and wool growth.
- The nutrient requirements are generally expressed in quantities of nutrients required per day or as a percentage of diet.
- For dairy animals, nutrient requirements are generally expressed as separate body functions but in case of poultry and pigs, combined requirements of maintenance and other body functions are given.
- There are two terms, which has been used, in the feeding standards.
- One is the nutrient allowance and another is the nutrient requirement.
- The former gives an extra allowance of nutrient over the requirement, which gives a margin of safety whereas latter term gives the requirement for optimum production.
- For convenience, all such feeding standards are grouped under major heading on the basis of principles of the standards such as

1. Comparative type
2. Digestible nutrient system
3. Production value type

CP = Crude Protein

DCP = Digestible Crude Protein

DTP = Digestible True Protein

AP = Available Protein

TDN = Total Digestible Nutrient

SE = Starch Equivalent

DE = Digestible Energy

ME = Metabolizable Energy

NE = Net Energy

CALCULATION OF STARCH EQUIVALENT:

The percentages of the digestible nutrients are multiplied by the respective starch equivalent factors.

The arithmetic sum of these products is called as production value/starch value

Concentrate – Golden number (0.95):

For concentrates the actual starch value is obtained from the production value by multiplying with the 'golden number' or 'value number'.

The value number expresses the ratio between the starch value of a feedstuff and that of the pure nutrients contained in the feedstuff.

Actual SE of concentrates =

Calculated production value x 0.95 Golden number

Roughages (Correction factor):

The production value of a roughage would be reduced by 0.58 units for every 1 per cent crude fibre present in the roughages.

Actual SE of roughages =

Calculated production value x (CF% x 0.58) Correction factor

Limitations:

The starch equivalent system suffers from the same weaknesses as other net energy systems namely,

The starch value of the ration is not constant at different levels of feeding, but decreases with increasing levels.

The starch value differs considerably for different productive purposes, even at the same level of feeding.

For fattening the efficiency is lower than for other functions like growth, lactation, etc.

Non-Protein Nitrogen Compounds

NPN is an important source of nitrogen for ruminant animals.

Its use depends upon the ability of the rumen microbes to use them in the synthesis of their own cellular tissues and thus supply animal protein in the form of microbial protein.

Rumen microbes use NPN in the synthesis of their own cellular tissues and thus supply animal protein in the form of microbial protein.

Urea

- It is a nitrogen rich (46%), white, crystalline compound with the formula NH2-C=O-NH2.
- Rumen microbes hydrolyze urea with the help of urease enzyme and produce ammonia.
- The wastage of nitrogen may occur with excessive absorption of ammonia from the rumen leading to ammonia toxicity which cause ataxia, muscular twitching, tetany, excessive salivation, bloat and respiratory disorders.
- Urea should be given in such a way as to slow down its rate of breakdown and enhance NH3 utilization for protein synthesis.
- Rumen microbes require readily available source of carbohydrate to serve as energy for capturing ammonia and therefore urea diet should contain readily available carbohydrate so that the animal can satisfy the needs of its rumen microorganisms.
- One gram of urea should be given along with 0.13g of anhydrous sodium sulfate at the N:S ratio of 15:1 thus minimize sulfur containing amino acids deficiency.
- Urea does not provide energy, minerals, or vitamins to animals so adequate supplementation of these nutrients in diet is necessary.
- To avoid the danger of toxicity, frequent, small intake of urea is preferable.
- Urea can provide 287.5 % of Crude protein (46 x 6.25).
- Rumen microbes hydrolyze urea with urease to produce ammonia.
- Excessive absorption of ammonia from the rumen leads to ataxia, muscular twitching, tetany, excessive salivation, bloat and respiratory disorders.
- Readily available carbohydrate and slow urea hydrolysis enables microbes to utilize ammonia effectively for microbial prolification.

- N:S ratio of 15:1 is necessary to avoid sulfur containing amino acids deficiency.

Biuret

- Heating urea produces Biuret.
- It is a colourless, crystalline compound having 40.8% nitrogen equivalent to 225% of crude protein.
- Biuret is expensive compared to urea and requires longer adaptation period for the microbes to utilize.

Single Cell Protein

- Single cell organisms like yeast & bacteria grow rapidly and provide protein.
- Nowadays, single cell organisms like yeast and bacteria are exploited in various fields.
- They can grow very rapidly and double their cell mass in large-scale fermentors.
- A range of nutrient substrates can be used including cereal grains, sugar beet, sugar cane, and its byproducts, waste products from food manufacture to culture bacteria such as Pseudomonas sp are grown.
- SCP has high levels of nucleic acids of 5-12% DM in yeast and 8-16% DM in bacteria.
- Some of the purine and pyrimidine bases in these acids can be used for nucleic acid biosynthesis.
- Uric acid or allantoins, the end products of nucleic acid catabolism, are excreted in the urine of animals consuming SCP.
- Although SCP does contain a crude fibre fraction and lacks cellulose, hemicellulose and lignin, it contains glucans, mannans and chitin.
- Dietary SCP for broilers is 2-5% concentration and nearly 10% is recommended for laying hens.

Determination of Nutritive value of protein

Nutritive value of protein can be determined either by

Chemical evaluation or

Biological experiments.

Chemical score:

In this concept it is considered that the quality of a protein is decided by that essential amino acid which occurs in greatest deficit when compared with a standard.

The standard generally used is egg protein.

Essential amino acid Index : (EAAI)

Is defined as the geometric mean of the egg ratios of essential amino acids.

Advantage : Predicting the effect of supplementation in combination of proteins.

BIOLOGICAL EXPERIMENTS

A knowledge of the amino acid content of proteins can only help to interpret nutritional differences among proteins in terms of their amino acid make up.

Quantitative data regarding the relative digestibility coefficient and nutritive value of protein i.e. suitability to meet the protein requirements of the body can be obtained only through experiments on animals or human beings.

Digestibility Co-efficient.

Protein efficiency ratio (PER)

Net protein retention (NPR)

Gross protein value (GPV)

Nitrogen Balance Experiments

Biological value

Net protein utilization (NPU)

Protein replacement value (PRV)

Digestibility Coefficient of protein refers to the percentage of the ingested protein absorbed into the blood stream after the process of digestion is complete.

The digestible protein in a food may be determined by digestibility trials.

For determination of digestibility coefficient the following data are required.

Food nitrogen in take.

Total faecal nitrogen excreted and metaboic faecal nitrogen (when an animal is fed on nitrogen - free diet certain amount of nitrogen is excreted in the faeces. This is derived mainly from the digestive juices. This is called metabolic faecal nitrogen).

PROTEIN EFFICIENCY RATIO (PER)

The protein efficiency ration normally uses growth of the rat as a measure of the nutritive value of dietary proteins.

It is defined as the weight gain per unit weight of protein eaten and may be calculated by using the following formula.

PER = Gain in body weight / Protein consumed

NET PROTEIN RETENTION (NPR)

A modification of PER method, where the weight gain of the experimental group is compared with a group on a protein - free diet, gives the “net protein retention”.

NPR = (Weight gain by test protein group – weight loss of non protein group)/Weight of protein consumed

GROSS PROTEIN VALUE (GPV)

The live weight gains of chicks receiving a basal diet containing 80g crude protein/kg are compared with those of chicks receiving the basal diet plus 30g/kg of a test protein, and of others receiving the basal diet plus 30g/kg of casein.

The extra live weight gain per unit of supplementary test protein, stated as a proportion of the extra live weight gain per unit of supplementary casein, is the gross protein value of the test protein, i.e.

GPV = A /Ao

Where A is g increased weight gain/g test protein, and Ao is g increased weight gain/g casein.

NITROGEN BALANCE EXPERIMENTS

A more accurate evaluation of protein may be obtained by using the results of nitrogen balance experiments.

In such experiments the ‘N’ consumed in the food is measured as well as that voided in faeces, urine and any other ‘N’ containing products such as milk, wool or eggs. When the ‘N’ intake is equal to the out put the animal is in ‘N’ equilibrium.

When the intake exceeded the out go, it is in positive value, when the out go exceed the intake the animal is in negative value.

Systems for Expressing Protein value

CRUDE PROTEIN

The proximate composition of the feed provides this information.

However, the evaluation of feed based on the Crude protein content is not satisfactory as the utility of protein cannot be judged based on chemical composition.

DIGESTIBLE CRUDE PROTEIN

As determining the DCP of large number of foods is impracticable, often the crude protein value of the feed and the digestible coefficient of crude protein is referred from the tables available in the literature.

This holds good for concentrates which has relatively constant composition and digestibility coefficient.

With roughage, a different approach is usually taken owing to their greater variability

and relatively greater importance of metabolic faecal nitrogen in material of low protein content.

In this case regression equation for DCP and CP are used to calculate the former. A typical equation

DCP (g/kg DM) = CP(g/kg DM) X 0.9115 – 36.7

Is widely used for grasses, hays and silages.

DEGRADABLE AND UNDEGRADABLE PROTEIN

Proposed by the Agricultural Research Council (ARC) for the UK and based on the classification of protein as 'Rumen degradable (RDP) and undegradable dietary protein(UDP)'.

The requirements of RDP & UDP to ruminants under various physilogical conditions have been assesed and fed accordingly.

METABOLISABLE PROTEIN

'Metabolisable protein' system is used in the USA .

Metabolisable protein is that part of the dietary protein which is absorbed by the host animal and is available for use at tissue level.

It consist partly of dietary true protein which has escaped degradation in the rumen but which has been broken down to amino acids which are subsequently absorbed from the small intestine.

Recent advances in feed technology and feed processing:

Processing methods to improve nutritive value

PHYSICAL TREATMENT

Soaking:

Chopped straw is soaked in water overnight. Softens the straw leading to increased intake.

Disadvantage is mould growth.

Chaffing:

Decreasing particle size. Increases surface area for action of rumen microbes and hence increase digestibility.

Grinding:

Particle size is reduced still further. (0.1 to 0.3 cm).

Disadvantage is that it increases rumen flow rate, decreases retention time in the rumen leading to decreased production of acetate causing a condition of low milk fat syndrome.

Steam pressure – Straw treated with Steam at pressure of 21.1 kg/cm2 for 10 to 30 seconds. Causes rupture of ligno celluosic bonds to a certain extent and makes cellulose available for microbial action.

Explosion:

Chopped or ground straw is treated with steam at pressure of 22.5 kg/cm2 for two minutes and pressure is suddenly released.

Causes rupture of ligno celluosic bonds to a certain extent and makes cellulose available for microbial action.

Irradiation:

Straw is treated with γ irradiation.

Causes rupture of ligno celluosic bonds and makes cellulose available for microbial action.

Pelleting:

Particle size is reduced to 0.1 to 0.3 cm and pelleted through 1-2 cm die.

Retention time in the rumen increases and the disadvantage of only grinding is overcome.

CHEMICAL TREATMENT

Acid treatment:

Straw is soaked in dilute acids for a specified period of time, washed with water drained and fed to the animals.

Not popular due to the corrosive action of acids.

Causes rupture of ligno celluosic bonds and makes cellulose available for microbial action.

Alkali treatment:

Straw is treated with NaOH, NH4OH, CaOH, KOH, Urea.

When straw is exposed to the alkali the ester linkages between lignin and cellulose / hemicellulose are hydrolysed causing the cellulose / hemicellulose to be available for digestion by microbes.

NaOH treatment:

Beckman process:

Straw is soaked for 1-2 days in dilute solution of NaOH (15-30 g / litre), washed to remove excess alkali and fed to the animals.

Dry method:

Straw is chopped and sprayed with NaOH 300g/ litre (170 litre / tonne of straw)

Ammonia treatment:

Anhydrous form or concentrated solution is used – 30 to 35 kg/ tonne of straw.

Straw is stacked, ammonia solution is sprayed over the straw, kept covered for 20 days and then fed to the animals.

This method not only increases the digestability of the straw it also increases the nitrogen content of it.

Disadvantage – On opening the stack most of the ammonia is lost by volatilization.

Sometimes there is formation of toxic imidazoles from reactions between ammonia and sugars leads to dementia (Bovine bonkers)

Procedure for preparing Urea Enriched Paddy Straw:

Required Materials:

Paddy straw - 100 kg.

Urea - 4 kg.

Water (Clean) - 65 litres

Spinkler

Procedure:

To enrich 100 kg of paddy straw

Dissolve 4 kg urea in 65 litres of water

Spread a polythene sheet/Gunny bag on the floor. Initially spread 5 kg of paddy straw in layers.

Using the sprinkler, sprinkle the prepared urea solution over the paddy straw ensuing that all the paddy straw is wet by it.

Similarly spread another layer of paddy straw over the first layer and repeat the sprinkling of urea solution.

Repeat the spreading and sprinkling for the entire 100 kg of paddy straw and heap it and cover the straw with polythene sheets to prevent the escape of ammonia liberated from urea. This step facilitates the breakage of lignocellulose bond by ammonia thereby releasing cellulose from lingin bondage for digestion and utilisation.

After 21 days the urea treated paddy straw is ready for feeding.

BIOLOGICAL TREATMENT

Growing cellulolytic microorganisms such as white rot fungi Trichoderma viridae, Trichoderma lignorum.

Growing mushrooms:

Straw is steam treated, packed in polythene bags, inoculated with seed material of mushroom, bag when filled with mycelia slit open to allow fruiting, after harvesting of mushrooms the spent straw is used as feed.

Single cell protein production:

Straw is hydrolysed, steam treated, treated with ammonia, inoculated with Candida utilis and incubated, after

harvesting of SCP the spent straw is used as feed.

Enzyme treatment:

Pretreatment of straw with lignase

Preparation of silage

Straw sprayed with water, additives such as molasses added and ensiled in a silo.

Nitrogen content is increased by adding urea or poultry manure.

The above treatments cause biodegradation of lignin and increases the digestibility of cellulose. They also increase the protein content of the straw.

Effect of Various Treatment:

Advantage:

- Increases palatability.
- Increases digestability.
- Certain treatments increase nitrogen or protein content.
- Improves animal performance.

Disadvantage:

- Increase feed cost.
- Technology or methodology involved.

Animal Diseases

2.1 Etiology, epidemiology pathogenesis, symptoms, post-mortem lesions, diagnosis, and control of **infectious diseases** of cattle, sheep and goat, horses, pigs and poultry.

2.2 Etiology, epidemiology, symptoms, diagnosis, treatment of **production diseases** of cattle, horse, pig and poultry.

2.3 **Deficiency diseases** of domestic animals and birds.

2.4 Diagnosis and treatment of non-specific conditions like

- Impaction, Bloat, Diarrhoea, Indigestion
- Dehydration, stroke, poisoning.

2.5 Diagnosis and treatment of the neurological disorders.

2.6 Principles and methods of immunization of animals against specific diseases

- herd immunity
- disease free zones
- 'zero' disease concept
- chemoprophylaxis.

2.7 Anaesthesia-

- local, regional and general-preanesthetic medication.
- Symptoms and surgical interference in fractures and dislocation.
- Hernia, choking abomasal displacement- Caesarean operations.
- Rumenotomy-Castrations.

2.8 Disease investigation techniques.

- Materials for laboratory investigation
- Establishment of Animal Health Centres
- Disease free zone.

Previous Years UPSC Civil Service Examination Questions from Animal Disease Topics:

2018

a) Clinical manifestations of **vitamin B Complex** deficiency diseases in poultry.
b) Causes and principal ruminants involved in **bacterial zoonotic diseases**
c) Describe in detail the clinical findings and treatment of various types of **ruminal disorders.**
d) Describe **anaesthesia** and procedure of **Caesarean section** in a cow
e) Write in detail etiology, pathogenesis, Clinical symptoms, diagnosis and control of **rabies** in dogs.
f) **Immunisation schedule** for protection against layer bird diseases.
g) Prevention and control steps for **haemorrhagic septicaemia** in cattle
h) Write in detail etiology, symptoms, diagnosis and treatment of **ketosis** in buffaloes.
i) Discuss in detail clinical manifestations of disease of **nervous system** in cattle
j) Describe about **heat stress**, its clinical symptoms and management in buffaloes during summer

2017

a) Management of **"Monday Morning Sickness"** in horses.
b) Discuss in detail **various types of vaccines**. Also enlist the diseases against which vaccines are available in India.
c) Explain in detail the classification and uses of **preanesthetic.** Also discuss the advantages and disadvantages of **inhalation anesthesia.**
d) Write in detail about the collection of biological samples for **laboratory investigation** and their procedure.
e) Etiology and treatment of haemoprotozoan diseases in cattle.
f) Describe the etiology, clinical findings, diagnosis and control of **foot and mouth disease** in ruminants.
g) Describe the clinical manifestations of **vitamin deficiency** in poultry.

2016

a) Identify the **deficiency disease** in a layer flock with the problem of **leathery eggs** and describe the treatment and control of the same
b) What is **Mediterranean fever**? Describe the diagnosis, treatment and prevention of the same
c) Describe the etiology, pathogenesis, symptoms, PM lesions, diagnosis and control of **swine fever**
d) Discuss the modern concepts and **immunization schedule** at an organized poultry layer farm
e) Diagnosis and prevention of **rabies**
f) Describe in detail about symptoms and surgical management of **hip dislocation** in large animals
g) Explain the epidemiological measures in the investigation of **FMD** outbreak
h) Describe the direct impacts of **antibiotic resistance** on health care of animals

2015

a) Disease prevention and **disease-free zones**
b) What are the problems and challenges in the control and **eradication of infectious diseases** of livestock and poultry?
c) Write the etiology, pathogenesis and clinical manifestations of **Equine myoglobinuria.**
d) Differentiate between local, general and regional **anaesthesia**. Indicate the sites of operation and organs involved during castration of dogs.
e) Pathogenesis and control measures of **post-parturient haemoglobinuria** in cows
f) Write about the etiology, epidemiology, pathogenesis, clinical findings, diagnosis and control of **leptospirosis** in livestock.
g) Discuss the management of **fore-stomach disorders** in ruminants
h) Discuss the latest national guidelines on **post-exposure prophylaxis** (PEP) in suspected rabid dog bites in humans

2014

a) Practical approach for controlling spread of disease after floods, in the flood-affected areas in Jammu and Kashmir
b) Discuss the modern concepts and schedule of **immunisation** at an organised dairy farm
c) **"Zero disease" concept** and chemoprophylaxis
d) Describe in detail the important biochemical, biotechnological and immunological tests for diagnosis of **viral diseases**
e) Explain the current advances in the **production of newer vaccines** in poultry
f) Describe the surgical intervention as regards **Caesarean operation** in large animal
g) Give an account of the biochemical tests and their importance in the diagnosis of **neurological disorders**
h) Discuss the modern concepts of diagnosis and treatment of **production diseases** of dairy livestock

2013

a) Risk factors for diseases: BEINGS model
b) Write about the etiology, epidemiology, clinical findings, symptoms, lesions, diagnosis and control of **swine influenza**
c) Discuss the etiology, pathogenesis, symptoms and lesions of **secondary immunity deficiency** in young animals
d) What is **fracture**? Give the types of fracture (long bones). Discuss the factors influencing fracture union and management and treatment of fracture
e) Describe the strategies in **vaccine production**

f) Discuss the metabolism and physic-nutritional role of **biotin and choline** with
particular reference to growing animals
g) Discuss the etiology, pathogenesis, symptoms and lesions in **Failure of Passive Transfer (FPT}** in calves

2012

a) Control of **Bovine tuberculosis** & reason for its failure
b) Diagnosis & treatment of **ruminal impaction** in cattle
c) Control strategy for **F.M.D.** in India along with its limitation
d) Surgical sites for **exploratory laparotomy & caesarean section**
e) Collection of laboratory material for confirmation of **Rabies, Theilerioses & Newcastle disease**
f) Etiology, pathogenesis, clinical sign, treatment and control of **Hemorrhagic Septicaemia** in buffalo

2011

a) Etiology, epidemiology, clinical sign, clinicopathology & treatment of **acetonemia/ketosis** in cattle
b) What is recent **development in immunisation** methods in poultry ?
c) Why Rabies in human called as **hydrophobia** ? Explain reasons for recent high incidence of death due to **rabies** in humans in India
d) Epidemiology, diagnosis, prophylaxis & control of **Rabies** in canine
e) **Mucosal immunity** & its role in protection against infectious diseases

2010

a) **MMA syndrome** / Farrowing fever, occurrence and clinical
b) Describe diagnosis of **oesophagus choke**, & **hernia** & suggest surgical management in cattle-30
c) Reason for failure of vaccination-20
d) Role of extrinsic & intrinsic regulation of **immune-modulation** -20
e) Technique adopted in investigation of **neurological disorder**-15
f) Epidemiology, etiology, P.M. findings, diagnosis and prevention of **avian influence**-30
g) Describe various modern gadget & biochemical test used in diagnosis of animal disease -30
h) Etiology, pathogenesis clinical finding, treatment and control of **Bacillus Anthracis** in cattle. -30

2009

a) **Zero disease** concept and chemoprophylaxis
b) Difference between primary & secondary **tympany** in cattle. Discuss etiology, predisposing factor symptoms diagnosis & treatment of bloat/ ruminal tympany -60
c) Etiology, transmission & epidemiology, clinical Sign, lesion, diagnosis treatment & control of **swine influenza**.
d) Role of Hyaluronidase & epinephrine in induction of local Anaesthesia in introduction of **local Anaesthesia** -20
e) **Luxation** – type, predisposing factor & Treatment

2007

a) Describe etiology, transmission, diagnosis, prevention and control of **rabies.** Discuss its public-health significance/importance.
b) In spite of advancement in diagnostic techniques due to development in the field of biotechnology and molecular biology why are diseases like **Tuberculosis, 'Jhone's disease' Brucellosis** etc. Still threatening to the Indian Live-Stock Economy/Industry

c) Enumerate **viral diseases of poultry**. Discuss different vaccines and vaccination schedules used for **Ranikhet Disease (RD) and Infectious Bursal Disease (IBD).** In spite of regular vaccination why are outbreaks of both the above diseases observed

d) Discuss indications and surgical interferences/interventions of **hernia** in cow, caesarean in buffalo and **choking** in horse

Animal Diseases

Let's start some study now. But first of all, **promise me** that you have already completed analysis of above questions.

I hope you have understood the strategy I have explained in the beginning of our book. These 2 things, analysis and strategy, will help you throughout this book. I will be suggesting some more tips as we move forward.

I will start with the **core region** of this sub part of paper 2 i.e. the most important topics. For example, rabies, swine influenza, ketosis, immunisation, anaesthesia, zero disease concept etc. But for now, focus on key words of topics that I am going to explain. Don't try to learn everything written down here.

1.Anthrax

Synonyms: Splenic Fever

Etiology: Bacillus anthracis is a gram, positive, non-motile spore.

Transmission:
By ingestion inhalation or through the skin

Inhalation infection is thought to be of minor importance in animals although "Wool sorter's disease" in man is due to the inhalation of anthrax spores by workers in the wool and hair industries.

Clinical findings:

The disease occurs in following forms
I. Per acute ii. Acute iii. Chronic and iv. Cutaneous
form.

Per acute form:

Characterized by its sudden onset and rapidly fatal

I) staggering, difficult breathing, trembling. ii) Collapse after a few convulsive movements.

Acute form:

- Rise in body temperature (1070F)
- Period of excitement followed by depression.
- Respiratory or cardiac distress
  Staggering, convulsion and death
- Bloody discharge from the natural body openings.

Chronic form

Local lesions confined to tongue and throat is absent mostly in pigs but occurs occasionally in cattle, horses.

Cutaneous form (or) Localised form

characterized by swelling in various parts of the body
Anthrax organism lodged in wound (or) abrasions of the skin

Human beings.

1. Man may develop localized lesions (Malignant) from contact with
infected blood (or) tissue.

2. Acquire fatal pneumonia (wool sorters disease) from inhalation when handling animal by products.

3. Occasionally man develops "Acute meningitis". From systemic involvement, (or) intestinal anthrax from consumption of meat.

Necropsy finding:

- A carcass suspected for 'Anthrax' should not be opened
- Striking absence of rigor mortis and the carcass undergoing rapid gaseous decomposition.
- All-natural orifices usually exude dark, blood which does not clot
- Gross enlargement of spleen

Diagnosis

Microscopic examination of blood smears
a. The organisms is stained by "Polychrome methylene blue".

b. Giemsa stain to demonstrate encapsulated bacilli.

c. observation of death of guinea pig or mice (experimental animal within 48 hours following inoculation of blood (or) tissue suspension.

Differential diagnosis:

- Lightning stroke may be confused with anthrax
- Acute leptospirosis,
- Anaplasmosis (Gall sickness)
- Acute poisoning from bracken fern, sweet clover lead.

Treatment

- Antibiotics and anti-anthrax serum are commonly in treatment
- Penicillin - 5 million units twice daily
- Streptomycin - 8 to 10 g daily in 2 doses - cattle
- Oxytetracycline (5 mg/kg) parentally in the treatment of clinical cases after vaccination
  in cattle.

Prevention:
Vaccination - Periodically in endemic area. The vaccine consists of living attenuated strains of the organisms with low virulence but capable of forming spores have been most successful.

Control:

1. Hygiene is the biggest single factor in prevention of spread of the disease.

2. Careful disposal of infected material in most important

a. infected carcasses should not be opened.

b. Burned (or) buried together with bedding and soil contaminated by discharges.

c. Burial should be at least 6 feet deep with an ample supply of quick lime added.

3. All suspected cases and in contact animals must be segregated.
4. Disinfection of premises, hides, bone meals, wool hair requires special care. Disinfection with 5% Lysol require to be in contact with spores for at
least 2 days.

2.Foot & Mouth Disease / FMD

Foot and mouth disease (FMD) is a severe, highly contagious viral disease of livestock that has a significant economic impact. The disease affects cattle, swine, sheep, goats and other cloven-hoofed ruminants. Highly communicable disease of cloven-footed animals

Causative organism: family: Picornaviridae
Genus: Apthovirus
Smallest of the Animal virus: 7 types virus : O,A,C Asia I, SAT 1,2,3

Transmission:
Direct contact Through water, manure, Pasture and cattle attendant

Symptom:

- Incubation period 2 – 5 days
- High Temperature 40oC
  Drooling of saliva, Loss of appetite
- Vesicles in Tongue, gum, inter digital space, udder & teat.
- Rough coat with long hair, panting.
- The animal looses appetite and body weight milk production reduced.
- Lameness on account of painful foot lesions.

Treatment: Nil.

External application of anti septics contributes to the healing of ulcers and wards off attracts by flies

Antibiotics may be administered to counter bacterial infections.

Prevention and control

The implementation of the FMD control strategy varies from country to country and depends on the epidemiological situation of the disease:

Measures that are recommended at the farm level include:

- control over people's access to livestock and equipment;
- controlled introduction of new animals into existing herds;
- regular cleaning and disinfection of livestock pens, buildings, vehicles and equipment;
- monitoring and reporting of illness;
- appropriate disposal of manure and dead carcasses.

Contingency planning for potential outbreaks will identify the elements included in a response effort to eradicate the disease, such as:

- humane destruction of all infected, recovered and FMD-susceptible contact animals;
- appropriate disposal of carcasses and all animal products;
- surveillance and tracing of potentially infected or exposed livestock;
- strict quarantine and controls on movement of livestock, equipment, vehicles, and;
- thorough disinfection of premises and all infected materials (implements, cars, clothes, etc.).

Use of vaccination

Depending on the FMD situation, vaccination strategies can be designed to achieve mass coverage or be targeted to specific animal sub-populations or zones. Vaccination programmes carried out in a target population should meet several critical criteria, mainly:

- coverage should be at least 80%;
- campaigns should be completed in the shortest possible time;
- vaccination should be scheduled to allow for interference from maternal immunity;
- vaccines should be administered in the correct dose and by the correct route.

Vaccination – polyvalent, once in 4months or varies with type of vaccine

3. Rinderpest / Cattle plague

An infectious disease of ruminants, especially cattle, caused by a paramyxovirus. It is characterized by fever, dysentery, and inflammation of the mucous membranes. Most destructive of the virus disease.

Although the rinderpest virus no longer circulates amongst animals, the world remains vulnerable to a reoccurrence of the disease, due to virus stocks, vaccines as well as biologic samples which may contain the virus, still stored in several premises across the world.

Causative organism:

Family, paramyxoviridae, Genus: Morbillivirus

Transmission:

Virus found notably saliva, discharge from eyes, nostrils, urine and faeces.

Incubation period of the disease 3-7 days 4 – 6th day – Temperature 40-41oC

Symptom:

- Loss of Appetite, Lachrymation, dryness of muzzle, arching of back.
- Shooting diarrhoea
- Ulcers in the mouth 7 – 9 day
- ulcers in the lips and Gums
  Death – 10th day after onset of symptom

4. Bovine Tuberculosis

Bovine tuberculosis (bovine TB) is a contagious chronic disease of cattle caused by

Mycobacterium bovis and associated with progressive emaciation and tubercle (granuloma) formation involving most usually the respiratory system but also other organs. As well as being of great economic importance to the livestock industry, because humans can be infected, it is also an important public health issue.

Susceptible species

Cattle and buffaloes are the principal hosts for *Mycobacterium bovis* and are responsible for maintaining the disease. *M. bovis* can also cause disease in deers, pigs and humans and, occasionally, in horses, dogs, cats and sheep.

Distribution

Bovine TB is widespread throughout the world. It is subject to control programs in a number of countries. In the absence of control measures it tends to be more common in colder climates, because housing of animals favours spread.

Transmission

Infection most commonly occurs via the respiratory tract and the alimentary tract with cattle considered to be much more susceptible to infection by inhalation. Pigs on the other hand are more likely to be infected by ingestion of contaminated foodstuffs.

Clinical signs

In the early stages, there are no clinical signs. In advanced stages cattle have:

- Fluctuating temperature
- Anorexia and loss of body condition
- Enlarged lymph nodes
- Persistent cough progressing to dyspnoea and increases respiratory rate if pulmonary tuberculosis
- Induration of the udder

Post-mortem findings

M. bovis mainly enters the body via the respiratory tract or the alimentary tract, with the former being the most common. In the lungs localised bronchiolitis is followed by ‘tubercle’, formation — an abscess with necrotic focus and caseation and sometimes calcification surrounded by a fibrous capsule. Tubercles have a yellowish appearance, and a caseous, caseo-calcareous or calcified consistency.

Findings at post-mortem vary from single small focus usually in the lung to numerous, sometimes confluent lesions in several organs. Tubercles may be found in bronchial, mediastinal, retropharyngeal and portal lymph nodes. Lesions in the lungs, liver, spleen, body cavities and female genitalia can be found in advanced cases.

Differential diagnosis

- Contagious bovine pleuropneumonia
- Bacterial pneumonia caused by Pasteurella or Corynebacterium pyogenes
- Inhalation pneumonia
- Traumatic pericarditis
- Chronic aberrant liver fluke infestation

Control / vaccines

- Vaccination with BCG confers poor protection in animal and interferes with tuberculin test and therefore is not practiced.

Some treatments (e.g. isoniazid, streptomycin) have been shown to have some efficacy, however it is limited and include risks of zoonotic transmission (by non-removal of infective animals) and drug resistance. Consequently, treatment of infected animals is not recommended and is illegal in a number of countries.

The preferred option is to eradicate the disease by test and slaughter. This involves, on a herd basis, repeat tuberculin testing and removal of reactors until the whole herd has passed ‘clean’ at two successive tests. Tests in infected herds should be conducted every 3 months. Herds should be considered free of TB after two negative tests distant from 6 months. Hygienic measures on the farm (cleaning and disinfecting) and control of movement of infected cattle are very important.

From the public health perspective, pasteurisation of milk is essential to inactivate tubercle bacilli.

5. Black Quarter

Acute infectious disease but not contagious inflammation of muscle, severe toxaemia.

Etiology: Clostridium chauvoei – gram positive, Anaerobic spore.

Epidemiology:
Young stock mostly affected – 6months – 2 years disease outbreak which the onset of rainy season.

Symptom:

- Animals may die without showing symptom
- Crepitant swelling in hind and fore quarters which crackles when rubbed due to gas in the muscle.
- Lameness
- Fever
- Twitching of muscle
- Affected region is hot and painful but becomes cold and painless
- Skin over affected area – dry, hard and dark

Diagnosis: affected part is black or dark red - characteristic rancid smell.

Control: Hygiene and prophylaxis control.

Prevention: vaccination – before onset of rainy season – 5ml –polyvalent s/c (clostridium sp.).
Antibiotics like penicillin and tetracycline may be given

6. Haemorrhagic septicaemia (HS)

Haemorrhagic septicaemia (HS) is a contagious bacterial disease caused by two serotypes of *Pasteurella multocida*, B2 and E2. It affects cattle (*Bos taurus* and *B. indicus*) and water buffaloes (*Bubalus bubalis*) with a high mortality rate in infected animals. It is regarded as one of the most serious diseases of large ruminants in south east Asia.

Infection is transmitted by:

- Direct contact between animals
- Contaminated feedstuffs or water

Clinical signs

Most cases are acute or peracute. The following signs are seen:

- High fever
- Depression
- Reluctance to move
- Salivation and nasal discharge
- Painful, oedematous swelling of the throat, extending to the brisket
- Congested mucous membranes
- Respiratory distress
- Calves may have a haemorrhagic gastro-enteritis
- Death in 6-48 hours after onset of clinical signs. Recovery is rare.

Post-mortem findings

- Oedematous swellings of the throat-brisket contain a clear, straw-coloured serous fluid
- Blood-tinged fluid in body cavities
- Pharyngeal and cervical lymph nodes are swollen and congested
- Subserosal petechial haemorrhages
- Generalised congestion of the lungs
- Variable congestion of the abomasum and intestinal tract
- Calves may have haemorrhagic gastro-enteritis

Gross lesions will be minimal in animals that have died quickly.

Differential diagnosis:

- Blackleg
- Rinderpest
- Anthrax.

Treatment: Injection of sulphadimidine

Prevention: Vaccination once 1 year – before – rainy season

Control / vaccines

In endemically infected areas, annual immunisation using adjuvant vaccines gives good control. Whether HS can be eradicated from an area by comprehensive vaccination campaigns is unclear.

7. Milk fever/parturient paresis

Cause:
Serum calcium levels fall in cows after calving as a result of failure to mobilize calcium
reserves and of the development of negative calcium balance in late pregnancy.

Symptoms:

- Disease flares up within 72 hours of calving initially the cows show excitement, incoordination of movement muscular tremors in limbs and head, lying in recumbent position with her head directed towards flank.

- In final stages subnormal temperature,
  dilatation of the pupil, impalpable pulse, coma and death.

Diagnosis of the disease is based on the occurrence of milk fever in recently calved animals.

Treatment & Control:

- Dramatic recovery by intravenous administration of 300-400 ml calcium borogluconate with Vitamin D3 injected intramuscularly.

- Continued mixing of ½ litre of supernatant lime water for cow may reduce the incidence.

7. Acetonemia (Ketosis)

Cause:

Ketosis is a metabolic disorder that occurs in cattle when energy demands (e.g. high milk production) exceed energy intake and result in a negative energy balance. Ketotic cows often have low blood glucose (blood sugar) concentrations.

When large amounts of body fat are utilised as an energy source to support production, fat is sometimes mobilised faster than the liver can properly metabolise it. If this situation occurs, ketone production exceeds ketone utilisation by the cow, and ketosis results.

In the dairy cow, the mismatch between input and output usually occurs in the first few weeks of lactation, because the cow is not able to eat enough to match the energy lost in the milk

Symptoms:

Reduced milk yield
Weight loss
Reduced appetite
Dull coat

Acetone (pear drop) smell of breath/ or milk

Fever

Some develop nervous signs including excess salivation, licking, aggression etc.

Diagnosis:

Examination of ketone bodies in the urine helps in diagnosing the disease besides the symptoms noticed.

Treatment:

1. Glucose replacement

Intravenous administration of a dextrose solution. Drenching with propylene glycol or glycerine has longer term effects.

2. Hormonal therapy

Corticosteroids have the ability to break down protein in muscles to produce glucose, which immediately replenishes the depressed blood glucose levels.

Intravenous administration of 500-1000 ml of 40 per cent glucose,
Repeat for 5 days.

Cases not responding to glucose therapy, intramuscular injection of 100-200 mg of hydrocortisone or 50 to 200 mg of prednisolone acetate.

Concentrate feeding with good fodder during dry period in high yielding cows, ½ to one kg maize made as gruel mixed with ¼ kg of jaggery or molasses daily to be given to cows nearing parturition.

Prevention:

1. Prevention depends on adequate feeding and management practices.

2. After calving, the cow has the potential to reach maximum efficiency in milk production, but feed requirements for high production are often greater than the voluntary intake of pasture can provide. Therefore, an energy supplement is required and there is evidence that this will improve production and reproductive performance, and decrease the risk of ketosis.

3. The best supplements are good quality hay, silage, or cereal grains. Supplements should be fed at least until the peak of lactation is reached or longer depending on the quality and quantity of available pasture.

4. In times of feed deficiency because of drought or other reasons, the provision of supplementary feed with adequate amounts of carbohydrate is essential. The best feeds tend to be good quality hay, silage, or cereal grain.

8. Bloat / Tympany

is a disease of ruminants in which rumen and reticulum is over distended with the gases of fermentation

Cause:
Excess intake of fresh legumes and feeding of high grain ration lead to frothy bloat.

Obstruction to normal expulsion of gases from rumen by choking the oesophageal passage by corncob, turnip and sugar beet cause free gas bloat.

Symptoms:

- In acute cases, the distension of the rumen occurs quickly, the flank and the whole abdomen is enlarged.
- On percussion the left flank produces a drum like sound, Initially the animal frequently gets up and lies down, kicks at belly and even rolls.
- Breath becomes difficult and is evidenced by oral breathing, protrusion of tongue and salivation.
- When the distension of abdomen becomes extreme, the animal exhibits uncoordinated movement, inability to stand, falls all of a sudden.
- In chronic tympany, the distension of abdomen and intra-abdominal pressure are not serious.

- The gas is ‘free’ but retained because of obstruction of the passage thereby preventing normal eructation of gases.

Diagnosis –
of tympany is easy by the characteristic symptoms of distension of abdomen and distress by the affected animal.

Control and Treatment:

- In per acute cases puncture the rumen with a sharp knife or with a trocar and canula to expel the gases.
- Administer orally oil of turpentine 60 ml well mixed with one litre of groundnut oil or gingelly oil or coconut oil.
- After six to eight hours administer powdered ginger 30 grams, Asafoetida 30 gram, well mixed to jaggery.
- Fresh legumes should be wilted and then fed to stallfed animals.
- Feed dry roughages before turning the cattle to luxuriant pasture to avoid bloating

Theileriosis - East Coast Fever

Benign theileriosis is a tick-borne disease caused by intracellular blood parasites belonging to the Theileria orientalis group (BATOG). This disease represents no threat to human health.

Although the prevalence of BATOG remains relatively small compared to some cattle health problems, it is becoming more widespread.

This disease results in massive production loss.

Cause

Bush ticks are mainly a cattle parasite, but are able to attach to other mammals including wildlife, birds, livestock (including horses, sheep, goats and poultry) and domestic animals such as dogs and cats. In sheep, bush ticks prefer to attach mainly on body parts not covered by wool.

The most common sites of attachment on cattle are around the tail, on the udder, inside the legs, on the brisket, in the ears, and occasionally on the face and neck.
.

Symptoms:

The disease is known as bovine anaemia. Signs are those associated with severe anaemia and include: lethargy, lack of appetite, exercise intolerance (weak cattle that lag behind the mob if moved).

Pregnant cows may abort and still births are common. In dairy cows a drop in milk production will occur. Death rates are highest in heavily pregnant cows.

Disease is generally seen when calves are 8-12 weeks old. By about six months of age, immunity develops and it is rare to see disease in calves older than six months and adults who have been resident in the area.

Treatment:

Treatment options for benign theileriosis are limited to supportive care and symptomatic treatment.

Blood transfusion has been performed occasionally on valuable animals.

Most importantly, stress and movement of affected cattle should be minimised or their reduced ability to transport oxygen throughout the body may lead to collapse.

They should be rested, nursed and given high quality feed. Handling of affected cattle should be avoided where possible.

A number of chemicals are known to work against the parasite, including buparvaquone (BPQ

Prevention:

In districts where Theileria is commonly found (endemic areas) and most adult cattle are immune, calves should be closely inspected when they are 6-12 weeks old.

Introduced cattle should be examined closely when they have been in the district for three to eight weeks.

Following simple biosecurity procedures is the best action producers can take to help prevent the spread of the disease. Here are some specific preventative steps for producers

Introduced cattle should be examined closely when they have been in the district for three to eight weeks.

Tick control:
Reducing tick numbers using a registered acaricide should reduce the likelihood of cattle becoming infected.

3. Veterinary Public Health:

3.1 Zoonoses –

Classification, definition, role of animals and birds in prevalence and transmission of zoonotic diseases, occupational zoonotic diseases.

3.2 Epidemiology-

Principle, definition of epidemiological terms, application of epidemiological measures in the study of diseases and disease control. Epidemiological features of air, water and food borne infections. OIE regulations, WTO, sanitary and phytosanitary measures.

3.3 Veterinary Jurisprudence-

Rules and Regulations for improvement of animal quality and prevention of animal diseases - State and central rules for prevention of animal and animal product borne diseases- S P C A- Veterolegal cases Certificates -Materials and Methods of collection of samples for vetero-legal investigation.

Zoonoses, its examples & Transmission

A zoonosis is any disease or infection that is naturally transmissible from vertebrate animals to humans. Animals thus play an essential role in maintaining zoonotic infections in nature.

Zoonoses may be bacterial, viral, or parasitic, or may involve unconventional agents. As well as being a public health problem, many of the major zoonotic diseases prevent the efficient production of food of animal origin and create obstacles to international trade in animal products

Common zoonotic illnesses include:

Rabies:

Rabies is a disease that affects the nervous system of mammals. It is usually caused by a virus and is transmitted if an infected animal bites a person or other animal.

Rabies is almost always fatal once symptoms appear. However, rabies vaccines exist and are commonly available.

Lyme disease and Rocky Mountain spotted fever:

Lyme disease is transmitted through tick bites. Symptoms can range from mild to severe, but it can be treated using antibiotics

Dengue, malaria, and chikungunya:

These are mosquito-borne diseases and are more common in certain areas, such as the Caribbean.

Symptoms include fever, vomiting, and headaches. It is vital to treat these conditions as soon as possible, as they can be fatal.

Salmonella infection:

Salmonella is often caused by handling reptiles or amphibians that carry Salmonella, or by handling baby chicks or ducks.

The illness usually lasts for between 4 and 7 days, and symptoms include diarrhea, fever, and abdominal cramps. People can usually recover without medical treatment, although conservative measures are recommended.

E. coli infection:

This infection is often caused by touching infected animals or handling contaminated food. Cows also have E. coli germs on their udders.

Often associated with food poisoning, salmonella can cause vomiting, abdominal cramps, and diarrhoea. It is essential that infected people rest and drink plenty of fluids.

Other well-known types include:

- Anthrax
- avian influenza or bird flu
- bovine tuberculosis
- brucellosis
- cat scratch fever
- Ebola
- West Nile virus
- leprosy
- Zika fever
- trichinosis
- swine influenza
- histoplasmosis

Transmission:

Zoonotic diseases can be transferred from animals to humans in several different ways, including:

Direct contact

Person holding a turtle, one reptile which may spread salmonella.

Direct contact is one potential cause of the spread of zoonotic diseases.

Direct contact involves coming into contact with the bodily fluids of an infected animal, such as saliva, blood, urine, mucus, or feces.

This can happen because of merely touching or petting infected animals, or being bitten or scratched by one.

Water resources that are contaminated by manure can also contain a great variety of zoonotic bacteria and therefore increase the risk of that bacteria transferring to humans.

Indirect contact

Indirect contact involves coming into contact with an area where infected animals live or roam, or by touching an object that has been contaminated by an infected animal.

Common areas where this occurs include:

- aquarium tank
- chicken coops
- pet baskets, cages, or kennels
- pet food and water dishes
- plants and soil where infected animals have been

Farmers, abattoir workers, zoo or pet shop workers, and veterinarians have an increased risk of being exposed to zoonotic diseases. They can also become carriers and pass those diseases on to other people.

Vector-borne

A vector is a living organism that transfers an infection from an animal to a human, or another animal.

They are often arthropods. Common vectors include:

- mosquitoes
- ticks
- fleas
- lice

The vector will bite the infected animal and then bite a human, passing on the zoonotic disease.

Food-borne

Zoonosis can come from contaminated animal food products, improper food handling, or inadequate cooking.

CLASSIFICATION OF ZOONOSES

As per classification adopted by the joint WHO/FAO Expert Group on zoonoses, the

zoonoses have been grouped into three categories:

[A] Based in terms of reservoir host:

1. Anthropozoonoses:
The infections transmitted to man from lower vertebrates are termed as Anthropozoonoses e.g. ascariosis.

2. Zooanthroponoses: The infections transmitted to lower vertebrate animals from man referred as Zooanthroponoses. The infections are primarily of human origin, e.g. schistosomosis, hymenolepiosis.

3.Amphixenoses:
The infection maintained between man and lower vertebrate animals, which may be transmitted in either direction, e.g. salmonellosis.

[B] Based upon the type of life cycle:

1. Direct zoonoses:
The infection transmitted from the infected vertebrate host to a susceptible vertebrate host (e.g. Man) either by direct contact, contact with a fomite or by a mechanical vector. During transmission the agent undergoes no developmental and little or no propagative changes e.g. trichinellosis.

2. Cyclozoonoses:

The infection requires more than one vertebrate host species in order to complete the life cycle of the agent. No invertebrate hosts are required.

Type I
Obligatory Cyclozoonoses -Man must be one of the vertebrate hosts in these cycles e.g. Taenia saginata and T. solium infections.

Type II
Non-obligatory Cyclozoonoses -Man is sometime involved, but the human involvement is the exception rather than the rule e.g. hydatid disease.

3. Metazoonoses:

The infection is transmitted biologically by the invertebrate vectors. In the invertebrate, the agent multiplies (Propagative or cyclopropagative transmission), in which case the invertebrate also serves as reservoir of infection or the agent merely develops (developmental transmission). In the metazoonoses there is always an extrinsic incubation period in the invertebrate hosts before transmission to another vertebrate hosts are possible. Depending upon the hosts required, at least four subtypes of metazoonoses may be distinguished:

Subtype I-requiring one vertebrate host an done invertebrate host e.g. yellow fever.

Subtype II-requiring one vertebrate host and two invertebrate hosts e.g. paragonimosis.

Subtype III-requiring two vertebrate hosts and one invertebrate host e.g. clonorchiosis.

Subtype IV-representing transovarian transmission e.g. tick-borne encephalitis.

4. Saprozoonoses
:
Saprozoonoses are those zoonoses which require a non-animal site to serve either as a true reservoir of infection or as a site for an essential phase of development. Considered as nonanimal are organic matter (including food), soil and plants e.g. various forms of larva migrans. (Special cases of zoonoses are given in table).

[C] Based upon etiological agent:

1. Bacterial zoonoses:

Zoonoses caused by bacterial agents e.g. brucellosis, plague, salmonellosis, anthrax.

2. Viral zoonoses:

Zoonoses caused by viruses e.g. rabies, influenza, yellow fever.

3. Rickettsial zoonoses:

Zoonoses caused by rickettsia e.g. Q fever, tick typhus.

4. Protozoan zoonoses:

Zoonoses caused by protozoans e.g. toxoplasmosis, trypanosomosis, leishmaniosis.

5. Helminthic zoonoses:

Zoonoses caused by helminthes e.g. hydatidosis, taeniosis, schistosomosis, trichinellosis.

6. Fungal zoonoses:

Zoonoses caused by fungal agents e.g. histoplasmosis, cryptococcosis.

7. Ectoparasitic zoonoses:

Zoonoses caused by ectoparasites e.g. scabies, myiasis

FACTORS RESPONSIBLE FOR EMERGENCE / RE-EMERGENCE OF ZOONOTIC DISEASES

- Population explosion
- Exploitation of newer Geographical areas
- Construction of pipe lines, roads, rivers, dams, new colonies, mining and similar ecology damaging activities
- Change in foods and food technology etc.

ROLE OF WILD ANIMALS & BIRDS IN THE TRANSMISSION OF ZOONOTIC DISEASES

1. Wild animals are the known host to the wide range of different microorganisms.
2. Wild animal diseases may be expressed as frank diseases or silent infection. But, many infections of man and domestic animals exist silently in wild animal species as infections which are not apparent.
3. Many emerging and sylvatic zoonoses are being reported with increasing frequency in man and animals like the orphan viruses (enterovirus, myxovirus, herpesvirus).
4. Infections present in wildlife form **'enzootic foci'**.
5. Alteration in the environment for the human welfare such as construction of dams, canals, deforestation and tilling of the grass lands for agricultural development may enhance the chances of human contact with the foci of infection.

Rats, mice, monkeys, bats, foxes, wolves, skunks, migratory water fowls, ducks involve with epidemiology of zoonotic diseases.

Examples

- **Monkeys:** Deforestation in Shimoga district near Mysore (Karnataka), India resulted in the outbreaks of Kyasanur forest disease (KFD) in humans due to migration of carrier monkeys through an epidemiological cycle of 'Monkey-Tick - Migratory birds'.
- **Arthropod-borne/tick-borne zoonoses:** Monkeys are the reservoirs for yellow fever in humans, tick typhus, Crimean haemorrhagic fever, Q-fever, tularaemia.
- **Migratory birds:** Avian influenza, West Nile virus, EEE, WEE
- **Skunks, ferrets, bats, foxes, wild dogs and cats:** Rabies

Role of Birds

A poultry farm worker who works on a farm where domestic fowl are bred and raised for eggs and/or meat.

Poultry Farm Workers may contract, from the fowl in their care, infectious diseases that are common to fowl and man.

The atmosphere in poultry farms usually contains significant levels of agricultural dust and toxic gases, which put the workers at a health risk.

Some chemicals used at poultry farms (for disinfection) may cause harm to workers' health.

The Poultry Farm Worker's work is often physically difficult and involves handling

heavy loads, uncomfortable postures and movements. This may cause traumas (including falls), back, arms and hands pains.

Preventive measures

- Wear safety shoes with non-skid soles
- Wear appropriate eye protection; consult a safety supervisor or a supplier
- Protect hands with chemical-resistant gloves; if impractical, use a barrier cream
- Install effective exhaust ventilation and air conditioning to prevent air contamination and heat or cold stress
- Wear a respirator to avoid inhalation of dust or aerosols
- Replace formaldehyde as a disinfectant with less harmful substitutes available on the market
- Maintain a high level of personal hygiene. At the end of work, shower and change clothes
- Do not take work-soiled clothing home
- Learn and use safe lifting and moving techniques for heavy or awkward loads; use mechanical aids to assist in lifting

Occupational Zoonotic diseases

Infections which are transmitted from animals to human beings by nature of their occupation are described as occupational zoonotic diseases.

Examples: Wool sorter's disease, Sugarcane worker's disease, Rice field worker's disease.

Based on occupation and demography, it may be classified as either urban zoonoses or rural zoonoses

Urban zoonoses

Infections which are commonly prevalent in urban areas and transmitted from animals to human beings.

Examples: Rabies, Abattoir's infections, Anthrax, Leptospirosis, Tuberculosis.

Rural zoonoses

Infections which are commonly prevalent in rural areas and transmitted from animals to human beings.

Examples: Brucellosis, Schistosomiosis, Rabies, Worm infestations.

Epidemiology: Principle & Definitions of Epidemiological terms

The definition of epidemiology is "the study of disease in populations and of factors that determine its occurrence over time." The purpose is to describe and identify opportunities for intervention. Epidemiology is concerned with the distribution and determinants of health and disease, morbidity, injury, disability, and mortality in populations.

Distribution implies that diseases and other health outcomes do not occur randomly in populations; determinants are any factors that cause a change in a health condition or other defined characteristic; morbidity is illness due to a specific disease or health condition; mortality is death due to a specific disease or health condition; and the population at risk can be people, animals, or plants.

Aim of Epidemiology:

To minimize or eradicate the disease or health problems and their consequences

To minimize the chances of disease occurrence in future

To define the magnitude and occurrence of disease conditions in animals

To identify the etiological factors responsible for the disease conditions

To provide data necessary for planning, implementation and evaluation of

programmes aimed at preventing, controlling and treating the diseases.

Principles in Epidemiology:

Describes basic epidemiology principles, concepts, and procedures

Provides a solid foundation for the study and teaching of applied epidemiology

Explains how to calculate and interpret frequency measures (rations, proportions and rates) and measures of central tendency

Uses tables, graphs, and charts to organize, summarize, and display data

Definition of Epidemiological terms:

Endemic

A disease is considered endemic when it is constantly present within a given geographic area. For instance, animal rabies is endemic in the USA.

Epidemic

An epidemic occurs when a disease occurs in larger numbers than expected in a given population and geographic area. Raccoon rabies was epidemic throughout the eastern USA for much of the 1980s and 1990s. A subset of an epidemic is an outbreak, when the higher disease occurrence occurs in a smaller geographic area and shorter period of time.

Pandemic

Finally, a pandemic occurs when an epidemic becomes global in scope (eg, influenza, HIV/AIDS).

The population at risk is an extremely important concept in epidemiology and includes members of the overall population who are capable of developing the disease or condition being studied.

Incidence is a measure of the new occurrence of a disease event (eg, illness or death) within a defined time period in a specified population.

A similar concept to incidence is prevalence. Prevalence (synonymous with “point prevalence”) is the total number of cases that exist at a particular point in time in a particular population at risk.

Measures of disease burden typically describe illness and death outcomes as morbidity and mortality, respectively. Morbidity is the measure of illness in a population, and numbers and rates are calculated in a similar fashion as with incidence and prevalence. Mortality is the corresponding measure of death in a population and can be applied to death from general (nonspecific) causes or from a specific disease. In the latter case, cause-specific mortality is expressed as the case fatality rate (CFR), which is the number of deaths due to a particular disease occurring among individuals afflicted with that disease in a given time period.

5. Meat Hygiene and Technology Syllabus

5.1 Meat Hygiene

5.1.1 Ante mortem care and management of food animals, stunning, slaughter and dressing operations; abattoir requirements and designs; Meat inspection procedures and judgment of carcass meat cuts- grading of carcass meat cuts- duties and functions of Veterinarians in wholesome meat production.

5.1.2 Hygienic methods of handling production of meat- Spoilage of meat and control measures, Post - slaughter physicochemical changes in meat and factors that influence them- Quality improvement methods - Adulteration of meat and detection - Regulatory provisions in Meat trade and Industry.

5.2 Meat Technology

5.2.1 Physical and chemical characteristics of meat- Meat emulsions- Methods of preservation of meat- Curing, canning, irradiation, packaging of meat and meat products, processing and formulations.

5.3 By- products- Slaughter house byproducts and their utilization- Edible and inedible by products- Social and economic implications of proper utilization of slaughter house by-products- Organ products for food and pharmaceuticals.

5.4 Poultry Products Technology Chemical composition and nutritive value of poultry meat, pre - slaughter care and management. Slaughtering techniques, inspection, preservation of poultry meat and products. Legal and BIS standards. Structure, composition and nutritive value of eggs. Microbial spoilage. Preservation and maintenance. Marketing of poultry meat, eggs and products. Value added meat products.

5.5 Rabbit/Fur Animal farming - Rabbit meat production. Disposal and utilization of fur and wool and recycling of waste by products. Grading of wool.

Previous Years Papers

2018

a) Give holistic picture of the types of slaughter house by-products and their potential utilization including the social and economic implications
b) Write in detail the ante-mortem inspection procedure in a slaughter House
c) Briefly describe the physical changes that occur preserved meat
d) Sources of contamination of meat in a slaughter house
e) Give a brief outline of the chemical composition and nutritional content of poultry meat

2017

a) Scalding technique in poultry and pig slaughtering.
b) Discuss the methods for preservation of meat and meat products.
c) Pharmaceutical uses of glandular parts of slaughtered animals.
d) Describe in detail the structure, composition and nutritive value of egg.
e) Write down the methods of stunning and explain electrical stunning in small and large animals.

2016

a) What are satellite slaughterhouses? Give your suggestion on improving the distribution of safe meat in the Indian context
b) Explain in detail about the important building components in abattoir for wholesome meat production and discuss about the significance of automation in meat processing
c) OlE regulations on food-borne infections of animal origin
d) Adulteration in meat Trade and techniques to identify it.
e) Explain in detail the merits and demerits in the system of egg price fixation in India

f) Describe in detail the slaughtering techniques, meat inspection and preservation of poultry meat and products

2015

a) Irradiation Preservation of meat.
b) What are advantages of value addition in meat? Describe the steps involved in the processing of cooked sausages.
c) Organ products for food and pharmaceuticals
d) What are advantages of canning of meat products? Detail the various steps in traditional canning.
e) Explain the role of public health veterinarian in relation to meat hygiene.
f) Describe the various quality characteristics and storage conditions of fresh meat

2014

a) Various uses of horn and hoof of slaughter animals
b) How can chicken meat compensate for human health?
c) What is adulteration of meat? Describe in detail about the methods of detecting adulteration of beef.
d) Discuss the regulations for improvement of animal quality in maintaining human health.
e) Discuss the characteristics that determine the purchase of apparel wool
f) Discuss the importance of ante-mortem care of animals in controlling health hazards.
g) What is curing? How does it protect spoilage of meat, specially pork?

2013

a) Write the importance of antemortem inspection of meat animals. List the most
common diseases encountered during AM examination. Also write the procedure to conduct the AM inspection

b) Write the etiology, gross lesions and judgment in respect of viral diseases during post-mortem inspection of meat animals' carcasses.

c) Write about the social and economic implications of proper utilization of slaughterhouse by-products
d) Describe about the pesticides, veterinary drugs and mycotoxin residues in the
edible tissues of the animals and their effects on consumer health. Also mention the Maximum Residue Levels (MRLs) of different pesticides as per legal standards.

e) Describe the legal requirements for setting up a modem abattoir and meat plant

f) Describe the processing technology for manufacture of glue and gelatine.

2012

a) Scientific disposal of animal carcass

b) Humane slaughter method and application of HACCP, GMP & ISO 9000 in meat processing industry

c) Meat adulteration and techniques to differentiate meat from different species

d) Nutrient value of emu meat in comparison to chicken and goat meat

e) Physio-chemical characteristic of hide & skin and factors affecting its quality

2011

a) HACCP and its role in preventing/ reducing food borne zoonotic diseases
b) Structure of Avian egg along with a labelled diagram
c) Wholesale cut of lamb carcass

d) Write briefly about various provision of meat food product order M.T.P.O.
e) What do you understand by term Rigor Mortis? Write about changes that take place during conversion of muscle to meat after slaughter
f) How will you proceed to collect gland /organ from slaughtered animal for pharmaceutical purpose? What is the pharmaceutical use of intestine, liver and pituitary gland collected from slaughtered animal?

2010

a) Extrinsic & intrinsic factors are responsible for spoilage of meat
b) Rules observed in conduction of P.M. examination of Veterolegal cases
c) What is meant by meat emulsion? How is it prepared? discuss advantage of meat extension.
d) Modified atmosphere packaging (MAP)of meat and meat products
e) what is meant by thermostabilisation & oil treatment techniques of meat preservation

2009

a) The flow diagram with a brief mention of salient features for producing ready-to-cook chicken carcass from live bird (20)

b) What do you mean by value added meat products, give examples? Give classification of different types of sausage. Using a typical flow diagram describe various processing step for manufacture of cooked sausage (60)

c) What is antimicrobial defense system of egg? Comment on fungal spoilage of egg (25)

d) Write down function of salt, sugar, nitrite, sodium ascorbate, polyphosphate, glucono delta lactone and spices in developing cured meat product (20)

e) What are different techniques in meat speciation? (15)

f) Distinguish between redurization, redicidation & radaperization. Describe principles, procedure and application of ionizing radiation of meat products. Briefly comment on safety perception with regard to irradiated meat (40)

2007

a) Regulatory provision in meat trade industry (30)

2006

a) Rabbit wool production (20)

b) Meat preservation (20)

c) Explain channel for marketing of poultry meat, egg and their products (30)

d) Suggest how they can be improved (30)

2005

a) Slaughter house byproduct for pharmaceutical use. (20
b) Cured meat product

2004

a) Utilization of slaughter house byproduct

b) Meat adulteration and it's detection

c) Describe duties and function of veterinarian of slaughter house for production of standard meat (60)

2003

a) Canning of meat products (20)

b) Grading of wool (20)

c) Grading of pig carcass

d) Discuss modern methods of preservation and packaging of meat product (60)

Section 1: Topics Covered

Ante mortem care and management of food animals, stunning, slaughter and dressing operations; abattoir requirements and designs; Meat inspection procedures and judgment of carcass meat cuts- grading of carcass meat cuts- duties and functions of Veterinarians in wholesome meat production.

Stunning, slaughter and dressing operation:

Stunning is a process employed to create a state of immortality or unconscious at the time of slaughter.

Methods

1.) Mechanical

By captive bolt pistol

Pithing thin steel rod is inserted into hole made in skull by captive bolt pistol

2.) Electric stunning:

Ether apparatus high frequency current 250mA, low voltage 75 volt for 10 sec

3.) Chemical stunning:

CO_2 is suitable for Swine (65%CO_2)

Slaughter refers to putting the food animals to death thereafter preparing the carcass for human consumption and its types are

a) scientific or humane slaughter
b) ritual slaughter

Humane slaughter

a) stunning
b) sticking or bleeding

Severing of blood vessel on neck to bleed the animal to death

Dressing Operations

Live animal
|
Stunning
|
Bleeding (blood)
|
Washing
|
Scalding (burning with hot water)
|
Dehairing
|
Singing (burn hairs with flame)
|
Evisceration
a) offal (inspection, chilling)
b) carcass splitting (inspection, wash and dispatch)
3°C for offal

Essential requirements and design of an Abattoir

Size of abattoir will depend on:

1.) Number of animals of each species to be slaughter

2.) Range of operations to be undertaken slaughter, dressing, deboning packaging & by-product processing

3.) Availability of carcass

Requirements or Essential facilities in an Abattoir:

1. Resting place / lairage
2. Antemortem examination room
3. Dressing, washing facility
4. Carcass hanging facility
5. By-product handling
6. Meat inspection room
7. Disposal of condemned carcass
8. Slaughter hall
9. Chill room
10. Offal room
11. Clean and Unclean section

Design:

1.) Abattoir should face either east or west

2.) Clear demarcation between clean (edible meat & offal) and unclean section (inedible waste, by-product waste)

3.) Floor should be made up of concrete easily cleanable and non - slippery

4.) efficient drainage, adequate ventilation

5.) Adequate natural light and provision of artificial light throughout

6.) boiler to generate steam

a) Clean-up operation

b) sterilization

c) Rendering by-product

7.) Chilling room

a) 7°C for carcass

b) 3°C for offal

Meat Inspection procedure

- to detect and eliminate abnormalities from carcass
- to check efficiency of slaughter & carcass dressing
- Disease diagnosis
- Detecting Drug residue.

Principles

1) lymph node examination is of paramount

2) Abdomen and thoracic cavity incised and organs allowed to fall in front of meat inspector

Procedure & Observation of Organs

- Palpation
- Incision
- Laboratory test

P. M. Judgement

1. Passed
2. Total condemnation
3. Partial condemnation
4. Conditionally passed

Grading and Judgement of carcass meat cuts

Evaluation / judgement

It is attempt to predict yield. Processing palatability characteristic and overall quality of meat

Methods

1) Visual judging

2) score card appraisal

3) Fleshing index & related carcass Weight & length

Grading

Segregation of carcass into standardised groups with minimum common characteristic on the basis of different Parameters

Grade

1) prime grade, 2) choice grade, 3) utility grade, 4) commercial grade, 5) X grade.

Duties and function of veterinarian in wholesome meat production:

1) At Farm Level:

Assist and advice farmers in use of antibiotics to contain Antibiotic Resistance & Avoid feeding of toxic or contaminated feed & Diagnosis and control zoonotic diseases.

2) At market level

routinely inspect livestock auction markets

3) At Slaughter House

- A.M. Examination
- P.M. Examination
- Drug and chemical residual checks

4) Food processing level

5) Overall strategy and Advice in matter concerning food safety

6) Issue health certificate of food animal of origin which is useful in facilitating international trade

7) Help in efficient surveillance systems, Risk assessment and management system

8) investigation of outbreak, all the way back to farm and formulate and implement remedial measure

9) Audit the standards of animal health, animal welfare and public health

10) develop standards, guidelines and recommendations in collaboration with Govt.

11) Implementation of HACCP

Section 2: Topics Covered:

Hygienic methods of handling production of meat- Spoilage of meat and control measures, Post - slaughter physicochemical changes in meat and factors that influence them- Quality improvement methods - Adulteration of meat and detection - Regulatory provisions in Meat trade and Industry.

Hygienic Methods for handling of meat production

1) Through meat inspection has to be mode a compulsory routine.

2) The number of slaughtering hr. Should be limited. After working hrs., premises should be sufficiently cleaned

3) All doors, window should be covered with wire net to check flies

4) Provide clean apron & head gear daily for workers. Avoid smoking. Within premises.

5) Proper disposal of waste

7) Effluent treatment

8) Check unauthorised slaughter by the unscrupulous traders.

Spoilage of meat:

1) putrefaction of protein

2) Formation of slime on surface

3) Discoloration

due to oxidising agents

4) Proteolysis and lipolysis

5) Souring & due to accumulation of organic acid

6) Rancidity & breakdown of fat

Identification of meat spoilage

Physical parameters

Determine H2S, ammonia, indole

Decreased Extract Reserve volume

Dye reduction test

Rise of PH, bacterial count & water holding capacity

Factor affecting microbial growth

Intrinsic

- Water activity
- PH (neutral PH)
- Redox potential
- Bone taint.
- Initial microbial load
- Nutrients

Extrinsic

- Temperature
- Oxygen
- Physical state of meat
- Contamination
-

Control of meat spoilage:

Muscle of living animal is free of microorganism's

Sources of contamination are:

- Body surface, GIT, Instruments
- water, air borne infection
- Hands and clothing of personnel
- During processing and packaging.

Control Measures:

1) Avoid mixing of clean and unclean section

2) Regular sanitation program at abattoir

3) Sterilisation of all instrument

4) Use of on rail system

5) Regular health check-up of workers

6) separation of suspected material

7) proper Post Mortem Examination

8) Appropriate chilling facilities

9) Avoid dressing on floor

10) Automatic packaging or modified atmosphere packaging.

11) Meat Preservation methods

Post Slaughter Physiochemical changes in Meat

Meat generally differs from the muscle in the sense its structural and physicochemical nature as it (muscle) has undergone certain chemical and biochemical changes following death of an animal which is a postmortem aspect. A series of biochemical and physico-chemical changes takes place which lead to conversion of muscle into meat. The composition of muscle is highly variable depending upon specie, type of muscle, animals' maturity and the treatments given to the animal before its slaughtering.

Conversion of Muscle into Meat (Rigor Mortis)

Rigor mortis means stiffness of the muscle. The primary cause of onset of rigor is post mortem decline in the level of ATP. The process takes from 7-24 hrs depending on the species; however, it is linked with the rate of depletion of ATP in muscle.

Prior to harvesting (slaughter), animals are vulnerable to stresses that can and do alter their **pH (potential hydrogen)**. pH is measured on a scale of 0 to 14

These changes can cause discolouration that is visible in the finished product. Therefore, it is important to understand how these changes occur and how they may affect product presentation, colour, and flavour.

The amount of stress animals suffer depends on how they are handled before harvesting. For example, when animals are selected for harvesting, they may be separated from the herd, rested overnight, then loaded on a truck to be driven to the harvesting plant. Sometimes the animals have to be transported vast distances. Once unloaded at the plant, they are rested, hopefully with the same group of animals they have been transported with. All these sudden changes are stressful to the animals, and each step of the process must be carefully handled. Excessive heat, dehydration, cramped conditions, and strange surroundings have a negative effect on most animals, with some finding the process more arduous than others.

At the time of slaughter, animals are moved from their holding pens into a specially designed S-shaped approach chute that helps to keep the animals calm. This then leads the animal into a tight holding box where it is stunned, bled, then winched up for skinning, eviscerating, splitting, and washing followed by rapid cooling in a special holding cooler.

The key to minimizing stress is to handle the animals as quickly and gently as possible to ensure that their pH remains stable prior to death—around 6.5 (neutral) and dropping to about 5.6 to 5.2 **post mortem** (after death) during the first 24 hours of cooling, when the carcass temperature is forced down to 4°C (40°F).

All the factors outlined above have some effect on the animal's pH. As the animal ceases to breathe, and as blood leaves the animal with the heart still pumping, about 50% of the blood is removed. It takes about four to six minutes before the heart ceases to beat. As the pH begins to drop below 6.5, **lactic acid** is produced, increasing the **acidity.** Lactic acid serves as a preservative, lessening deterioration of the carcass until the temperature of the muscles reaches 4°C (40°F).

At this point, **rigor mortis** (the stiffening of the muscles in death) begins to set in. This usually takes between 12 and 24 hours depending on the size of the carcass and amount of exterior fat covering.

There are three stages to rigor mortis:

1. **Pre-rigor:** The muscle fibres begin to shorten due to the depletion of adenosine triphosphate (ATP), causing the muscles to become less extendable while hanging under load. With less oxygen available, the myosin and actin proteins form actomyosin after death occurs. The actomyosin produces a **cross bridge** between the actin and

myosin filaments. In the living animal, these cross bridges are broken during the relaxation phase of a normal contraction cycle (e.g., movement such as walking). However, after death (post mortem), cross bridges are formed permanently as the muscles shorten.

2. **Rigor maximum:** The muscle fibres reach maximum shortening, resulting in stiff muscles. The cross bridges are now firmly in place.
3. **Rigor resolution:** The now stiff muscle fibres begin to extend again and stretch out to almost their original length. As this extension occurs, the cross bridges create a tearing effect. This phase results in **tenderization** during **dry aging** (hanging) or **wet aging** (storing in **vacuum packaging**) of carcass meat and is most noticeable in prime meat cuts from the short loin, sirloin, and 7-bone rib (prime rib) of beef. Another chemical process develops during this phase in which the still-living cells begin to produce lactic acid. Lactic acid is normally removed by the circulatory system of living animals; however, in rigor resolution it remains in the muscles, causing the pH to drop until the core temperature of the carcass reaches 4°C (40°F).

If the ultimate pH (5.60) falls too quickly, carcass would still be warm adversely affecting water holding capacity and prevailing partial denaturation of protein resulting into pale, soft and exudative (PSE) muscle ultimately leading to lower yield of the meat. This is often encountered in pigs having sufficient reserves of glycogen.

On the other hand, if inadequately feed or fasting animal having minimum reserve of glycogen is subjected for slaughtering; dark, firm and dry (DFD) meat conditions. DFD meat is having pH not below 6.0 and is darker in colour and susceptible for microbial growth.

Post rigor (conditioning/ageing)

During post rigor stage meat become tenderizes and organoleptically acceptable when it is kept cold for some time after rigor mortis.

Factors affecting contraction of muscle or Rigor mortis

Intrinsic factors

- Species of animal
- Horse>cattle>pig
- Types of muscles
- Amount of glycogen directly proportional to R.M.
- Initial level of ATP

Extrinsic factor

- Atmospheric temperature
- Drug administration

Change in pH

Decrease in pH due to lactic acid formation is accompanied by various exothermic reactions such as anaerobic glycolysis. pH changes from physiological pH i.e. 7.2-7.4 to ultimately post-mortem pH i.e. 5.3-5.5 in 24 hrs. This has profound effect on muscle portion of meat. Usually glycolysis ceases even before the glycogen is depleted.

Change in temperature

Temperature of animal increases from 37.6 to 39.0 C initially and later on temperature falls down.

Change in proteins

Due to the change in pH and high temperature, colour of meat changes and water holding capacity (WHC) also decreases. Sarcoplasmic proteins get denatured and attached to the surface of myofilament, which produces change in meat colour which becomes light. Water

holding capacity of myofibril proteins decreases resulting in exudation of fluid.

Change in water holding capacity

Water holding capacity is the function of respective proteins which binds with water. In pre-rigor stage meat possesses a high-water holding capacity but later it decreases during first hour following death of animals. Lowest water holding capacity is found at its iso-electric pH i.e. 5.3-5.5. After post-rigor aging water holding capacity is found to be increased

Post mortem glycolysis

After the death of animal, blood circulation stops, thus oxygen supply to muscles tissues decreases hence anaerobic conditions prevails in the muscle. The glycogen present in tissues is no longer converted into CO2 and water instead, converted in to lactic acid through anaerobic glycolysis. The conversion of glycogen takes place through two different pathways.

(a) Amyloytic pathway i.e. hydrolytic
(b) Phosphorolytic pathway

Due to this glycolysis pH changes from physiological pH i.e. 7.2-7.4 to ultimately post- mortem pH i.e. 5.3-5.5. This pH is attained within 24 hours and being related to ATP production, which falls in this pathway. The net fall in ATP is responsible for onset of rigor mortis. The pH 5.3-5.5 is ideal pH which can be obtained by well rested and well-fed animal before slaughter.

QUALITY IMPROVEMENT METHODS:

Aging/conditioning/ripening of meat

- ✓ Increase flavor, tenderness, juiciness due to the dissolution of rigor mortis by proteolytic enzyme, proteolysis enhanced WHC
- ✓ Tenderness of meat produced by- Autolysis by enzyme
- ✓ Softening and swelling of collagen fibres of muscle protein

Methods of tenderization:

- ✓ Mechanical
- ✓ Electrical
- ✓ Chemical-by salt and weak acid
- ✓ Enzymatic
- ✓ Tender stretch method

Post rigor (conditioning/ageing)

During post rigor stage meat become tenderizes and organoleptically acceptable when it is kept cold for some time after rigor mortis. The muscle again becomes soft and pliable with improved flavour and juiciness. The post rigor meat provides lesser problems in toughness, when cooked compared to with that cooked in rigor. Meat gradually reaches to an optimum tenderness period after an ageing period of 10-18 days stored at 0- 5 C following the dissolution of rigor. However, prolonged storage of meat in some species may results in some problems viz. microbial spoilage, desiccation of proteins, and development of off flavours. Thus, it is recommended to consume meat before it gets spoiled. The ageing which also called as conditioning or ripening of meat is sometime accelerated by raising storage temperature for e.g. holding meat at 15C for 3 days period in UV to control the microbial growth at surface. While in the case of pork, ageing is not recommended rather to eat fresh as it develops rapid onset of fat rancidity even at low temperature. On the other hand, beef is generally aged and lamb & mutton are occasionally aged.

Ageing is considered as very important aspect of meat processing as it imparts desirable flavour, textural and other sensory attributes to the finished product. The responsible factors for this desirable changes are still been researchable issue, however it is now a fact that in post- rigor state actomyosin complex does not dissociate but other subtle changes occur like, increase in the water holding capacity due to increase osmotic pressure in the muscle fibre due to net inside movement of cations and breakdown of proteins by liberated proteolytic enzymes, the cathepsins may lead to tenderness. While cooking of meat tenderizing agents such as enzyme calpain etc are added which breaks down the stiff muscle protein to yield a soft and organoleptically acceptable meat.

Adulteration of meat & its detection

Falsification or Adulteration of meat & substitution or mixing of flesh of cheaper variety which is objectionable for the reasons of

- Health, religion and economics.
- Cause allergic reaction
- Hurts religious sentiment of various communities

It is Punishable under PFA, 1973 (1960) (1954)

Meat specification or Identification method:

1. Anatomical methods

   colour, odour, distribution fat (marbling) bone structure

2. Physical methods
   - Refractive index of fat
     horse > pig > cattle
   - Iodine value

3. Chemical methods

   Glycogen content & linolenic acid
   Highest in horse fat and flesh

4. Biochemical method

   Separation of species-specific protein by electrophoresis

Isoelectric focusing

- Precipitation of protein of different species at a specific PH result in formation of diff. band of protein.

SDF Poly acryl amide gel (PAGE) technique

- Charge on protein become zero when treated with sodium dodecyl sulphate due to denaturation
- Separation on the basic of molecule weight forming specific band

5. Immunological / serological method

   Specific antisera containing Ab are used to precipitate homologues antigen for meat speciation

6. DNA analysis
7. PCR

Regulatory provision in meat trade & Industry

Objectives

- Quality control
- Trade
- Public health
- Extension of product shelf life
- Compliance of regulatory legislation

General principles

- Raw material control – Animal
- Control of processing operations
- Finished product inspection & control g

Indicator organism of sanitary quality of food / water

1) Total viable counts
2) Coliform, E coli, Aerobacter Enterobacter, aerogenes
3) Enterococci & streptococcus
4) Staphylococcus aureus
5) Salmonella

Standards in meat industry

Standard refers to specifications with respect to food products to ensure correct and reliable process control

1) Bureau of Indian standard (B1S), established in 1947 as “Indian standard Institution (S)” responsible for preparing and promoting the general adoption of standards in country.

2) ISO – 9000 & 12000 standards International organization of standards Geneva & issued ISO -9000 & 12000 series of quality standards to facilitate world trade & it has 20 element for compliance by i.e. management responsibility / manufacturers design control, process control

   ISO:20000 series

3) Meat food product order/MFPO, 1773

   Exclusively deals with quality control of “processed meat product”

   Aim

   - Maintenance of sanitary condition in
   - Ensure proper AM and PM examination.
   - Final product checking Provision
   - Licence will be granted to manufacturers & all meat processing unit will come under its preview.
   - Order does not apply for raw meat

Powers of MFPO officers

To enter and inspect premises of meat food product manufacturers

Categories of manufacturers

- Possess their own slaughter house
- Purchase meat from approved abattoir
- Purchase raw meat from any other source

4) Microbiological standards

   - Ensure safety of product
   - Prevent losses due to microbial spoilage

1. Codex alimentaris
2. F.S.S.A.I
3. APEDA
4. FPEDA
5. BIS
6. ISO

H.A.C.C.P. System

It is a comprehensive food safety system right from the “point of production to the point of consumption”
Analyses hazard of raw material Identify point of potential contemn Monitor processing operation

Steps

1) Assessment of hazards & risk associated with raw material, processing, packaging consumption.
2) Identification of CCP (potential contemn and their source) to control a hazard.
3) Establishment of tolerance level
4) Defining corrective action
5) Proper Documentation
6) Verification of method, procedure & test

Section 3: Topics Covered

Physical and chemical characteristics of meat- Meat emulsions- Methods of preservation of meat- Curing, canning, irradiation, packaging of meat and meat products, processing and formulations.

Meat Technology

Physical characteristic of meat

1) Meat colour

   Depend upon myoglobin & its chemical state, 80-90% of total meat pigment
   Upon cutting or exposure to air oxidised i.e. Myoglobin converts into Oxymyoglobin which gives bright red color and it is highly desirable. But if there is less O2 Metmyoglobin brown colour thus meat is packed in film with very good O2 concentration

2) Water holding capacity

   Capacity of meat to retain its water
   Contribute to juiciness of cooked meat and influence texture & color

3) Marbling

   Refers to intramuscular fat, contribute to firmness of meat after chilling

4) Quantum of Connective Tissue
   Affect texture of meat

5) Firmness

Chemical characteristic of meat tissue

Nutritive value:

Protein

- Rich in essential amino acid
- High biological value 19%

Fat

- 2.5% of all
- Most abundant F.A are oleic acid, palmitic acid and stearic acid
- Pork is good source of linoleic and linolenic acid.

Minerals

- Good source of iron and other mineral except calcium

Vitamin

- Good source of B complex but less traces of fat-soluble vitamins
- Vit C is absent

Characteristics of Protein

PH neutral (low acid food)
Myofibrillar protein & actin & myosin
Sarcoplasmic protein
    Myoglobin
    Creatine kinase
Stroma protein
    Collagen & influence meat toughness

Water 75%

Meat Emulsion

It is a two-phase system comprises of a dispersed phase of solid or liquid fat droplet and continuous phase of water, water soluble protein i.e. sarcoplasmic and salt soluble protein i.e. myofibrillar protein

- Meat emulsion is an oil – in – water emulsion
- Solubilised meat protein act as emulsifiers
- Fat droplet are larger than 50 un
- Low temperature is maintained during emulsion formation to avoid melting of fat and denaturation of soluble protein

Preservation method of meat and meat products

Curing

- By heavy salt
- By sodium nitrite and sodium nitrate

- Curing agent- sodium nitrite, sodium nitrate, salt as NaCl and sugar
- Mode of action of salt (2.5%)
  - ✓ Dehydration and alteration of osmotic pressure that inhibit bacterial growth
  - ✓ Slow down action of proteolytic enzyme action
  - ✓ Enhance flavor and tenderness

- Mode of action of nitrate and nitrite (200 and 500 ppm res.)
  - ✓ Impart favourable pink colour by reacting with myoglobin
  - ✓ Characteristic cured meat flavor
  - ✓ Retard rancidity
  - ✓ Inhibit clostridium botulinum growth

- Mode of action of sugar
  - ✓ Counteract harsh effect of salt
  - ✓ Energy source for nitrate reducing bacteria
  - ✓ Flavor e.g. sucrose or dextrose
- Mode of action of phosphate
  - ✓ Improve texture by increasing water holding capacity
  - ✓ Raise Ph

Nitrite and ascorbic acid act as antioxidant

2. Glucono Delta lactone

- ✓ Act as sugar source
- ✓ Maintain low Ph by slow acid release as acidifier

3.Lactate

- ✓ Sodium lactate have antimicrobial activity

4. Sorbate

- ✓ Mold and yeast inhibitor

5.Organic acid (vinegar acid 4%, citric acid, lactic acid)

- ✓ Sour taste
- ✓ antimicrobial

SMOKING

- ✓ It provides Specific colour
- ✓ It have Preservative effect due to formaldehyde acting as biocidal and phenol having biostatic effect, and also it have acids and carbonyl
- ✓ Benzopyrene of smoke and nitrosamine formed by nitrite act as carcinogenic

Canning

- ✓ Thermal sterilization of product held in thematically sealed container
- ✓ 2 years shelf life

Traditional Steps

Cooking meat chunks 60%

40% curry by cooked out juices

Sterilized can

Exhausting and 85^{0}C removal of air from can

Seaming

Autoclaving at 121^{0}C

Cooling in running water

Labelling

Storage at 20^{0}C

IRRADIATION

- ✓ Antimicrobial effect by destruction of **DNA fragmentation of microbes** by X and *Y* rays
- ✓ Very low raise of temperature. Thus, commonly known as **cold sterilization**
- ✓ **Ascorbate** increases sensitivity of microorganism to radiation
- ✓ **10kGy are acceptable** dose because causes no toxicological effect
- ✓ 1kGy= 100 rad

Sources of Ionising Radiation

1.**Gamma** radiation from **CO** $_{60}$

2. X rays from x ray tube or cathode tube

Different level of irradiation used in practice

Radurization (pasteurisation)

- ✓ Utilize low doses (< 1Mrad) of irradiation
- ✓ Enhance keeping quality
- ✓ Used along with refrigeration

Radicidation (Bactericidal)

- ✓ Reduce the non-spore and viable microbes
- ✓ Dose 2 to8 KGy

Radappertization or cold sterilization

- ✓ Similar to canning
- ✓ Shelf stable by reducing activities of microorganism
- ✓ Doses 10KGy TO 4545KGy
- ✓ Application
  Fresh meat cut and poultry product @ 50-100Krad
  Pork and fishes @ 4-5 Mrad

OTHER METHODS

- Chilling
- Freezing
- Thermal processing
- dehydration

Packaging of meat and meat product

Packaging refers to the method of containing food under optimum protection till it reaches ultimate consumer

Aim

- Prevent moisture loss
- Prevent microbial contamination
- Prevent lipid oxidation

Technique and material

1) Over wraps
   Using thermoplastic films
   Polyethylene, nylon & PVC are used
2) Tray with overwrap
3) Shrink film overwrap

- Shrink on exposure to hot air or water
- Good water vapour barrier

4) Vacuum packaging
   - Ensure shelf life of 10 wk. at 0^0 c
   - Aluminium foil polyester laminates

5) Modified Atmospheric packaging

   Packaging air can be suitably replaced by gases usually N2, O2, or Co2 alone or in combination

Examples:

Buffalo meat
High O2to maintain Bright red colour
Pork
less O2 due to due to high fat content

N2 serve as an insert tiller to balance a gas mixture.

Types
Hypobaric
Low O2, reduce fat oxidation
Modified Atmospheric Pressure
High Co2
Controlled Atmospheric Pressure

Section 4 Topics Covered

By- products- Slaughter house by-products and their utilization- Edible and inedible by products- Social and economic implications of proper utilization of slaughter house by-products- Organ products for food and pharmaceuticals.

GLANDULAR BYPRODUCTS:

- Gland should be excised within 15 mins and chilled immediately without any contact with ice
- Acetone dried powder of gland is prepared for gland preservation
- enzymes are inactivated and shelf life increased

1.Pancrease

Insulin, glucagon, trypsin, amylase

2.Adrenal

Corticosteroid and adrenaline

3.Thyroid

Thyroxine, parathormone

4.Pituitary

GH, SH, LH, ACTH, MSH, Oxytocin

5.Gall bladder

Dried bile juice

6.Ovaries

Oestrogen and progesterone

7.Testies

Hyaluronic acid

8.liver

Liver Extract, prothrombin, thrombin, lactic dehydrogenase, bilirubin,

9.Heparin from lung

Section 5: Topics Covered

5.4 Poultry Products Technology Chemical composition and nutritive value of poultry meat, pre - slaughter care and management. Slaughtering techniques, inspection, preservation of poultry meat and products. Legal and BIS standards. Structure, composition and nutritive value of eggs. Microbial spoilage. Preservation and maintenance. Marketing of poultry meat, eggs and products. Value added meat products.

5.5 Rabbit/Fur Animal farming - Rabbit meat production. Disposal and utilization of fur and wool and recycling of waste by products. Grading of wool.