DISPOSAL AND TREATMENT OF ABATTOIR EFFLUENT

Abattoir Effluent

- the outgoing water from the abattoir environment containing waste materials
- are highly nitrogenous, biologically degradable
- with relatively high concentrations of suspended and dissolved solids, fats, scraps, blood, gut contents, detergents, hair and hide scraps.
- some of these materials can be recovered and may eventually be useful materials.

The load or concentration of organic matter is measured in terms of *biochemical oxygen demand* (BOD) and is expresses as ppm or mg/litre.

- The BOD is the amount of oxygen required to decompose the organic matter completely by aerobic biological action in certain period at $20^{o}C$.
- While the BOD of normal domestic sewage is 250 – 300 ppm (mg/litre),
- that of abattoir effluent is between 1600 and 2000ppm (about 5 to 6 times the BOD of normal domestic waste).
- abattoir effluent thus has a high potential for polluting the water courses,
- it is then important that on-site treatment of the effluent is carried out before the effluent is connected to the municipal sewer line.

General Principles of Treatment

Although there are several systems of effluent treatment, the basic principle involves

- screening of solids, removal of fat particles
- decomposition of organic matter by bacteria either aerobically or anaerobically in the tanks or ponds.
- The entire process can be carried out in two stages.
    - In the first stage, gross solid particles suspended solids and fat particles are separated (physical process/treatment).
    - In the second stage, remaining organic matter is subjected to biodegradation (biochemical process).

In general, abattoir effluent treatment involves the following steps:

i. Physical Processes

- *Screening.*
- *Sedimentation*

ii. Biological Process

The aim of the biological process is to remove the organic component in the effluent where it cannot be removed by physical methods.

- *Aerobic Pond System.*
- *Anaerobic System.*

iii. Chemical Process

iv. Treatment of Manure Laden Effluent

UTILIZATION OF ANIMAL BY-PRODUCTS

Animal by-products refer to the parts of the food animal not used for food by man. In liberal terms, animal by-products include every part of a slaughtered animal except the dressed carcass.

A. Classification of Animal By-products

Animal by-products can be classified as follows:

(i) Edible by-products.

(ii) Inedible by-products.

This classification is not rigid the basic criterion of division between edible and inedible by-products is governed by a number of factors such as

- purchasing power of the consumer,
- the custom and traditions of the people,
- the food habits, religious belief etc.

By-products can also be classified according to ultimate use as follows:

a) Agricultural by-products: meat meal, bone meal and fertilizer

b) Industrial by-products: gelatine, glue and casings

c) Pharmaceutical by-products: insulin, pepsin, bio-chemicals and hormones

B. Classification according to origin

- *principal by-products*,

- *secondary by-products*

Principal and Secondary Animal By-products

Item No.	Principal by-product	Secondary by-products and Uses
1.	Hides and skin	Leather products such as shoes, gloves, belts, bags etc
2.	Hair, bristles and wool	Brush, fabrics and yarn, blanket, carpet, pillow, lanolin and fertilizer
3.	Blood	Blood pudding, sausage mix, serum and plasma, albumen, fibrin, haemoglobin, glue, textile, coagulated blood products, dye setting, stock feed, fertilizer, liquid blood products
4.	Bones	Bone meal, fat, gelatine, glue, mineral supplement, buttons, cutlery handles and bone articles, osteocalcium tablets from bones
5.	Hoof and horns	Buttons, combs, hair pins, toys, hoof and horn meal, fertilizer, pith used for gelatine and glue etc.
6.	Intestines	Casings, catgut (suturing material), tennis strips, musical instrument strings, tallow etc.
7.	Condemned meat, inedible offal and trimmings	Tallow for soap, machine oil, leather dressing, candles, meat and bone meal
8.	Glands and tissues	Gall bladder – Bile salts Liver – liver extract Lungs – heparin, peptone Pineal gland – melatonin hormone Pituitary gland – Anterior (GH, LH, FSH, prolactin) and post-pituitary lobe hormone (oxytocin, vasopressin) Thyroid gland – Thyroxine Stomach – pepsin, rennin, heparin

		Parathyroid – parathormone Suprarenal gland – cortex and medullary hormones Trypsin – insulin, pancreatin, glucagons Testes – testosterone, hyaluronidase
9.	Ruminal and intestinal ingesta	Recycling as stock feed, compost manure, production of methane for light, heat and power

Utilization of Hides and Skin

Hides and skins are one of the most important by-products of the animals, and serve as raw materials for leather industries. Hides and skins can be classified into:

(a) Those which are processed with the external covering (fur and wool) intact processed for use as articles of clothing. These are got mainly from animals living in the wild e.g. Fox, milk etc.

(b) Those from which the external covering is removed before processing into leather. These are got from ox, sheep, goats, pigs, horses and aquatic animals like seal.

Processing of Hides and Skin

- *Flaying and Trimming*
- *Preservation*
- *Hide Curing*
- *Tanning of Hides and Skin*

Utilization of Blood

Animal blood is used in several ways and its collection method also depends on the specific end use. Some of the uses of blood are as follows:

1. Industrial
2. Livestock feed
3. Fertilizer
4. Biochemical and Pharmaceuticals
5. Laboratory and Bacteriological Media – blood agar, tissue culture media, albumin and globulin, sphingomyelin, catalase.

Utilization of Horn and Hoof

- raw material for the production of gelatine
- bone meal production.
- used for the manufacture of buttons, comb and decorative pieces.
- fertilizer

Utilization of Organic Waste

Wastes from the animal include dung, droppings, urine etc. These can be subjected to rendering processes and utilized as products such as biogas and compost manure.

Utilization of Intestines

- food containers such as casings.
- production of surgical ligatures (catgut),
- production of strings for tennis rackets and musical instruments etc.

Utilization of Bones

- Bones can be processed as a source of gelatine and glue;
- Bone meal and fertilizer

FOOD MICROFLORA AND SPOILAGE

Bacteria are everywhere, the most common ways in which bacteria and other micro-organisms spread are in the air, by contact and via insects and other creatures. In meat processing, the common way of spread of micro-organisms to meat is through cross contamination from dirty equipment, personal gear, hands and hides and skins, fleece and feathers or the digestive tract. Food microbiology is important in meat hygiene for the purposes of protection of the consumer against food-borne microbial diseases and the prevention of meat spoilage due to microbial activities.

Food micro-flora are basically moulds, and bacteria.

Moulds.

- are multicellular, filamentous fungi that grow on foods
- they have cottony appearance and may sometimes be coloured
- while some are useful (e.g. in the production of cheese)
- others cause spoilage of food thus making such food unfit for human consumption.

- some in addition to spoilage produce various toxic metabolites such as *mycotoxin* that is toxic.

Bacteria.

- Bacteria growth in and on foods is often extensive, this can cause food spoilage and makes food unattractive in appearance.
- pigmented bacteria cause discolouration on the surfaces of foods.
- films may cover the surface of foods and cause it to be slimy.
- bacteria growth in liquid such as milk may result in cloudiness or sedimentation.

The following are the bacteria commonly associated with food spoilage and are important in meat hygiene:

Pseudomonas, Vibrio, Escherichia, Salmonella, Enterobacter, Shigella, Klebsiella, Yersinia, Streptococcus, Staphyllococcus and Lactobacilli.

Contamination of Food

- Food contamination is the physical presence of impurities and micro-organisms in food.
- this can lead to food poisoning, intoxication and spoilage.
- Food contaminating flora originates from three main sources :
    - Soil,
    - Water
    - Human –Animal reservoir.

Prevention of Food Contamination by Food Microflora

Food can be prevented from contamination with microflora by:

a) Inspection of meat and other meat products before releasing such for human consumption
b) Keeping edible meat from offals
c) All equipment used in the processing of meat and meat products must be kept clean and disinfected from time to time.
d) Use of clean potable water for all operations in the meat processing plant

e) Personal hygiene must always be observed throughout the period that meat will be handled

Food Spoilage

- disagreeable change in food's normal state
- such changes can be detected by smell, taste, touch or sight
- food decays or spoils due to the metabolic activities of micro-organisms that are present in the food therein
- the micro-organisms use the food as substrate or medium of growth and sustenance.

Conditions for Spoilage

- Availability of Oxygen
- Moisture
- Water Activity
- Temperature
- pH

Decomposition

This is the process of breaking up of organic matter of food (meat) by the action of bacteria. Gram negative organisms that can grow at low temperature and low humidity (such as *Pseudomonas*) mainly cause the surface spoilage of meat, while spoilage of deep tissues is mainly due to anaerobes (such as *Clostridia).* The organisms excrete coagulase, which hydrolyses the connective tissues leading to tissue liquefaction, gas and acid production. The acids produced are the cause of bad flavour and foul smell of spoilt meat.

The signs of decomposition include changes in colour; grey, yellow or green, softening of meat, production of slime and the production of repulsive odour.

The rate of decomposition of meat is determined by the factors affecting bacteria growth (temp. moisture, pH). Other factors include the type of bacteria present and its initial load, and the condition of the animal prior to slaughter. Delay in evisceration of the carcase can lead to invasion of bacteria from the gut to the tissues and cause spoilage of the meat. The presence of greenish hue on the kidney fat and peritoneal is a strong indication that evisceration has been delayed.

Bacterial food poisoning and intoxication

Bacterial food poisoning results from ingestion of food containing large numbers of living organisms or their toxins. There are three categories of food poisoning bacteria:

(a) Those that grow and produce toxins in foods before they are eaten. E.g. *Staphylococcus aureus* and *Clostridium botulinum*

(b) Those that multiply in the intestinal tract and cause disease by infection of the host. E.g. *Salmonella typhi, S. typhimurium, S. enteritidis, Shigellae*

(c) Those that apparently act through a dual mechanism. E.g. *Clostridium perfringes, Bacillus cereus, Vibrio parahaemolyticus* and enteropathogenic *E. coli.*

Some important Food-borne Infections

- *Staphylococcal food poisoning*
- *Botulism*
- *Vibriosis*
- *Salmonellosis*

MILK HYGIENE

Milk hygiene is the safety and quality assurance programme for milk and diary products that cover the whole diary chain fro farm to table, so that milk and milk products derived thereof are wholesome and fit for human consumption.

Definitions

Milk is the normal lacteal secretion from domesticated animals produced from one or more milking, without either addition thereto or extraction such animals include cow, goat, camel and buffalo.

Milk products are products exclusively derived from milk and other substances necessary for the manufacture of such product, provided that these substances are not intended to take the place in part or in whole of any milk constituent.

Whole milk: milk as is drawn from the cow.

Skimmed milk: milk from which part of the fat has been removed. It may be sweetened with sugar.

Ice cream : this is frozen mixture of various diary products, sweeteners, stabilizer and various flavourings.

Butter: this is fairly solid yellow milk fat brought together by a form of agitation called churning.

Milk composite products: these are milk products in which milk is an essential part added to other food items, but these other food items are not intended to take the place of any milk constituent.

Composition of milk

Water	87.25%
Milk fat	3.75%
Milk sugar (lactose)	4.70%
Protein (casein, lacto albumin)	3.40%
Ash (Nacl, Potassium chloride, Potassium citrate)	0.75%
Vitamins and others	0.15%

Sources of Milk Infection and Contamination

- Infection of milk by disease organisms can be derived from the dairy animal itself, the human handler, or the environment (including the milk utensils).
- these organisms can be excreted through the udder directly into the milk, or originate from the skin and mucous membrane of the animal or milkier and contaminate the milk and milk utensils.
- one of the most important extraneous sources of contamination is water used in the processing plant.

The essential requirements are

- to maintain udders free from infection (mastitis),
- manage cows so that udders and teat are clean,
- milk them in such a way that minimises bacterial contamination,
- store milk in clean containers at temperatures which discourage bacterial growth until cooled.

Hygiene in Milk Production

- Milk should be protected against direct or indirect contact with any source of external contamination during all the steps of milking, collection and transport.
- Particular care should be taken to avoid the direct physical contact of milk with unclean surfaces such as those of milking utensils, udders teats and the hands of milkier.

Milk Pasteurization

- Pasteurization is the process of heating of milk to such temperatures and such periods of time as are required to destroy any pathogen that may be present,
- whilst causing minimal changes in composition, flavour and nutritive value
- Pasteurization helps in destroying pathogenic organisms and a majority of pathogenic organisms and a majority of non-pathogenic ones,
- it also inactivates the enzyme phosphatase, which is abundantly present in raw milk.
- Thus, if a phosphatase test is carried out immediately after pasteurization and it gives a positive result, it is an indication that the milk has not been properly pasteurized.

Processes of Pasteurization

There are several methods of pasteurization of milk and these include:

The holding or Vat method – milk is held at pasteurization temperatures for seconds:

(a) Batch holding	60 - 65^{o}C for 30min
(b) High temperature short time (HTST)	72^{o}C for 15sec
(c) Ultra high temperature (UHT)	80^{o}C for 1 – 40 sec
(d) Bottle pasteurization	70^{o}C for 30min
(e) Flash process	75 – 80^{o}C for 30min

Laboratory tests to determine the quality of milk

- Standard Plate Count Method
- California Mastitis Test (CMT)
- Methylene Blue Reductase Test (MBRT)

PRESERVATION OF MEAT

MEAT PRESERVATION

- The basis for meat preservation is to prevent the meat from microbial attack and prolong the storage life of the meat.

- Basically, preservation methods are designed to make conditions unfavourable for these organisms to grow.
- This is achieved by extreme heat or cold, deprivation of water and oxygen, excess of saltiness and increased acidity of the substrate.
- The methods based on these principles include
    - dehydration,
    - salt curing,
    - chemicals,
    - irradiation,
    - chilling and freezing
    - heat processing