

MEAT INSPECTORS MANUAL

ABATTOIR HYGIENE



DIRECTORATE: VETERINARY SERVICES

VETERINARY PUBLIC HEALTH

NATIONAL DEPARTMENT OF AGRICULTURE

REPUBLIC OF SOUTH AFRICA

JANUARY 2007

FOREWORD

The delivery of meat hygiene services in South Africa has gone through various phases of change since the function was officially made the responsibility of the Department of Agriculture in the early 1960's. Little did we realise when the first Animal Slaughter, Meat and Animal Products Act, 1967 (Act No. 87 of 1967) was published in 1967, what challenges would lie ahead 40 years later. We have seen the third Act related to the delivery of meat hygiene services promulgated by Parliament. The Meat Safety Act 2000 (Act 40 of 2000), has replaced the Abattoir Hygiene Act (Act 121 of 1992) signifying, not only by the change in names of the relevant Acts since 1967 but also in the objectives of the Act, the obligation of Government to react to the needs of its clientele and to address the concerns of consumers.

The emphasis on the delivery of services as reflected in consecutive legislation since 1967, has changed gradually from a structural and process-control approach of service delivery, to a holistic approach with the focus on food safety. Growing international concern that the State should be the custodian on all matters related to food safety and provides the sanitary guarantees required by consumers and our trade partners, necessitated a change of focus on the delivery of these services. We are confident that these manuals will guide and enable all those responsible for the delivery of a meat safety service, to focus on the new challenges and to claim ownership of the initiative to establish a culture of hygiene awareness.

Over the last 40 years many teams and co-workers collected and collated material for training future meat inspection staff. This was made available to all tertiary training institutions free of charge in order to ensure that the minimum standards proposed by this Directorate would be known to all. During 2006 the task of updating, co-ordinating and maintaining this intellectual property of the Department of Agriculture, was given to Dr. T. Bergh from the Limpopo Province. All the persons involved in this work, are congratulated with what eventually emerged after many months of hard and dedicated work.

There is no doubt that this manual, being dynamic and reflecting change, will serve as a benchmark for the future to enable the delivery of meat safety services to be accessible and affordable for all.



DR. M. MAJA

DIRECTOR: VETERINARY SERVICES

DEPARTMENT OF AGRICULTURE

PRETORIA, JANUARY 2007

All rights reserved. Reproduction and dissemination of material in this information manual, for educational or other non-commercial purposes are authorized without any prior written permission from the Department of Agriculture, provided the source is fully acknowledged.

Reproduction of material in this information manual for resale or other commercial purposes is prohibited without prior written permission by the Department of Agriculture. Applications for such permission should be addressed to –
Director: Veterinary Services, Private Bag X 138, Pretoria, 0001, South Africa.

INTRODUCTION

The Directorate Veterinary Services of the National Department of Agriculture was constitutionally tasked ensure that norms and standards concerning abattoir hygiene be implemented uniformly on a national basis.

Since the Department is the custodian of the “Meat Safety Act” (Act 40 of 2000) it is fitting that the Department set the standards required for meat inspection personnel.

It was decided to write a manual containing a minimum norm of required knowledge for all persons involved with meat hygiene in abattoirs as well as doing meat inspection.

With the necessary adaptation, these manuals can thus be used over a wide spectrum of training requirements and should be in the possession of all persons involved with meat inspection and hygiene-control in an abattoir.

The final manuals, after various versions, have now been revised and have been blended in such a way as to enhance a smooth transition from the basic concepts of food safety management systems, applicable to all meat disciplines, to a more specific approach for the specific disciplines.

The manuals are drafted to address the following concepts:

- Abattoir hygiene

This manual highlights the international principles of food safety management systems e.g.

- Basic microbiology
- Building requirements
- Sanitation
- Pest control
- Personnel hygiene
- Waste management & control of condemned material
- Quality control

The follow up manuals in the respective disciplines of red meat, poultry, game, ostrich & crocodile deals with the requirements specific to the trade e.g.

- Specific building requirements
- Process control
- Anatomy
- Pathology
- Diseases
- Meat inspection

A special word of thanks to all who helped redrafting these final manuals and all the hours of hard work put in to have them available for the New Year.

EDITOR:

**DR. TERTIUS BERGH
DEPUTY DIRECTOR
VETERINARY PUBLIC HEALTH
LIMPOPO**

MEAT INSPECTORS MANUAL

PART I ABATTOIR HYGIENE

MODULE 1

MICROBIOLOGY

Index**MICROBIOLOGY**

1. INTRODUCTION
2. TYPES OF ORGANISMS
3. IMPORTANCE OF BACTERIA
4. ELEMENTARY BACTERIOLOGY
5. GROUPS OF BACTERIA
6. BACTERIAL SPORES
7. BACTERIA ISOLATED FROM RED MEAT AND POULTRY MEAT
8. MICROBIOLOGY OF MEAT PRODUCTION
9. MINIMISING BACTERIAL CONTAMINATION DURING SLAUGHTERING
10. SPOILAGE BACTERIA
11. FOODBORNE DISEASES
12. BACTERIA ASSOCIATED WITH FOODBORNE DISEASES
13. MICROBIOLOGICAL EXAMINATION
14. SAMPLING AND SAMPLING METHODS
15. MICROBIOLOGICAL ASSESSMENT OF HYGIENE
16. BACTERIA/ GROUPS OF BACTERIA EVALUATED
17. MEASURING METABOLIC ACTIVITY OF MICRO-ORGANISMS
18. INDICATORS OF POTENTIAL PRESENCE OF PATHOGENS
19. INDICATORS OF POST HEAT PROCESSING CONTAMINATION
20. STANDARD METHOD FOR TOTAL AEROBIC MESOPHYLLIC COUNTS

MICROBIOLOGY

1. INTRODUCTION

The purpose of studying abattoir microbiology is to ensure that the number of micro-organisms on the meat is as low as possible by the time it leaves the abattoir. For this purpose some knowledge of micro-organisms, how they behave and how to control them, is needed.

Definition

Microbiology is the study of micro-organisms that are small living creatures; exist as single cells or cell clusters and that are mostly free-living. (Microbial cells are thus distinct from animals or plant cells that are unable to live free in nature but can exist only as part of organisms consisting of many cells.)

Food microbiology is the study of small living creatures found in foods.

2. TYPES OF ORGANISMS

A number of small organisms are important in foods such as:

- Bacteria
- Yeasts and moulds (fungi)
- Viruses
- Protozoa

3. IMPORTANCE OF BACTERIA

Bacteria are by far the most important group encountered in red meat and poultry production and are of great concern from the standpoint of both food spoilage and foodborne disease. The fungi are less important but do cause some problems. Viruses and protozoa are of concern but more difficult to pick up in routine tests. The emphasis in this overview will be on the bacteria.

4. ELEMENTARY BACTERIOLOGY

4.1 The size, shapes and habits of bacteria

Bacteria are exceedingly small individual single celled organisms that cannot be seen with the unaided eye. They are observed under a microscope. By the time bacterial colonies can be seen with the naked eye, they consist of many (more than a billion) cells per colony. Bacteria are therefore present on surfaces in the abattoir and on the meat without our being aware of them unless they are so many that we can actually see them. By this time meat will be slimy and obviously spoilt.

Different types of bacteria differ in shape and size. They can be round, oval; rod shaped etc. and can be larger or smaller. Usually the shape and size of bacteria tells the non-specialist hardly anything about the type of organism one is dealing with.

Bacteria are everywhere except when they are deliberately excluded or destroyed. By practising good abattoir hygiene and slaughtering techniques, the number of bacteria on carcasses can be kept low or even reduced.

4.2 Requirements for Bacterial Growth

It is important to remember that, like all animals, bacteria require moisture and certain nutrients in order to grow. Meat is rich in nutrients and water and can support good growth of a variety of bacteria. In addition, there are many other environmental factors that influence the ability of bacteria to survive and grow, such as temperature, the gasses in the atmosphere around them (gaseous atmosphere), acidity (pH), etc. It is the manipulation of these growth requirements that helps us to control micro-organisms in the abattoir.

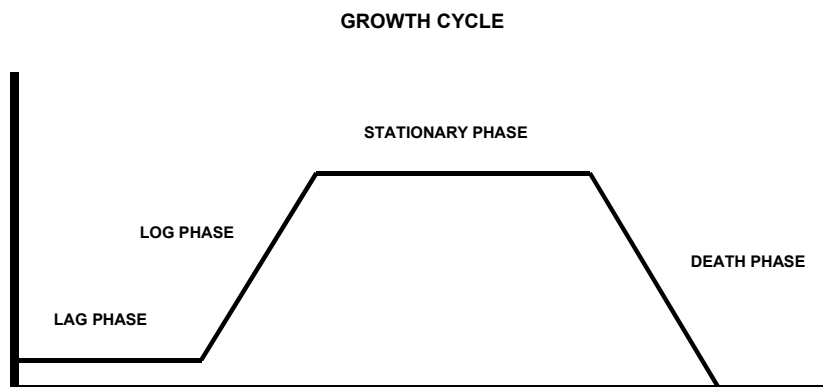
4.2.1 Method of Bacterial Growth (Multiplication)

When we speak of bacterial growth, we are really referring to bacterial multiplication. Bacteria multiply by the process of binary fission, which is 1 parent cell divides to produce 2 daughter cells (one generation); each daughter cell divides to produce 2 additional cells and so on. For example, if we assume that we have 1000 bacteria per gram of meat, and that all the bacteria multiplied as above, they would reach 1 000 000 (also written as 1×10^6) bacteria per gram in 10 generations.... (1 000; 2 000; 4 000; 8 000; 16 000; 32 000; 64 000; 128 000; 256 000; 512 000; 1 024 000). From this follows that both the number of bacteria initially present as well as the number of multiplications they undergo determine the number of bacteria eventually present on the meat. Both initial numbers and growth of bacteria on carcasses must be kept low during abattoir processing.

Generation time, i.e., the time necessary to produce a generation, is an important consideration in abattoirs. Some types of bacteria have a very short generation time; only a matter of minutes, while others have a generation time of hours. An important factor influencing the generation time of bacteria is temperature. The use of refrigeration to lengthen the generation time of unwanted bacteria (e.g. spoilage bacteria) and therefore slow down their multiplication is a common and most important method of extending the shelf-life of perishable products like meat.

4.2.2 Growth Cycle

The growth cycle of bacteria consist of a short period of little or no growth (lag phase), then the population increases rapidly (the phase of logarithmic growth or log phase) toward a maximum and reaches a plateau (stationary phase), and then decreases (death phase). The lag phase is a period of adjustment during which there is considerable cellular activity but little or no cell division. Providing a less than desirable environment for multiplication such as refrigeration usually prolongs the length of the lag phase. During the log phase, cell division occurs rapidly at a fairly constant rate. During the stationary phase, a balance between cell division and cell death maintains the maximum number of live cells. Cell death during the phase of death is caused by many factors, the most prominent of which is the accumulation of the cell's own products. An example would be, in the case of fermented meat products, the accumulation of lactic acid.



4.2.3 Temperature and Bacterial Growth

Most bacterial species have a minimum, maximum, and optimum temperature for growth.

- Psychrotrophic bacteria – capable of growth at commercial refrigeration temperatures. Most psychrotrophic bacteria grow best at 15-25°C (59-77°F) and at slower rates under refrigerated storage. These are especially significant because many of the common red meat and poultry spoilage bacteria are psychrotrophs.
- Mesophylic bacteria – grow best at temperatures between 20°C and 45°C (68-113°F). Bacteria growing in the gastro-intestinal tract of the live animal are mostly mesophiles.
- Thermophilic bacteria – grow best at temperatures above 45°C (113°F). Many will not grow below 40°C (104°F).

- Thermoduric bacteria – capable of surviving mild heat treatments such as pasteurisation.

4.2.4 Gaseous Atmosphere and Bacterial Growth

- Aerobic bacteria grow only in the presence of oxygen.
- Anaerobic bacteria grow only in the absence of oxygen.
- Facultative anaerobic bacteria grow in the presence or absence of oxygen.
- Micro-aerophilic bacteria grow in an atmosphere containing less oxygen than in air.

The fact that bacteria have varying gaseous atmospheric requirements is of great significance in the red meat and poultry industries. Meat is often wrapped in plastic that is readily permeable to oxygen. Here we expect the growth of psychrotrophic aerobes. However, on vacuum packaged meat products other bacteria, such as micro aerophilic bacteria or psychrotrophic facultative anaerobes, will grow better. The special plastic material used for vacuum packaging is not permeable to oxygen.

5. GROUPS OF BACTERIA

As already stated, bacteria are present in all natural environments. We breathe in countless bacteria even in the purest mountain air. Most of those are not harmful, some are used by man and a small minority are undesirable.

5.1 Bacteria used in foodstuff production

Some bacteria are used to produce the desirable body, texture and flavour in foods. Examples of these are fermented sausages, pickles, cheese, yoghurt, sauerkraut, vinegar, souring of sorghum beer and sourdough bread. Yeasts are used to produce ordinary bread and alcoholic beverages such as wine, barley and other beers.

5.2 Spoilage bacteria

This group includes bacteria that will cause deterioration of foods through breakdown of the food constituents and/or accumulation of undesirable end products of bacterial metabolism. Poultry and meat even if produced under hygienic conditions and stored under refrigeration, will ultimately become unacceptable due to the growth of psychrotrophic spoilage bacteria.

5.3 Food-Borne Pathogens

Those bacteria that is capable of causing illness in persons consuming the food. Some of the more important examples from meat include *Salmonella*, *Campylobacter*, *Yersinia enterocolitica*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Clostridium perfringens*, and *Clostridium botulinum* (*Clostridium botulinum* is particularly dangerous because it produces one of the most powerful known toxins).

6. BACTERIAL SPORES

A few bacteria (e.g. the genera *Bacillus* and *Clostridium*) are capable of producing a body called a spore inside the cell (functionally spores resemble plant seeds). Bacterial spores are more resistant to adverse conditions such as heat, chemicals, dehydration, and irradiation than the cell itself. Thus, the cell may be killed but the spore may survive.

Among these spore forming bacteria are:

- Typical spoilage bacteria of heat processed canned foods such as the flat sour bacteria (*Bacillus stearothermophilus*) and
- Some are capable of causing food-borne disease, such as *Clostridium botulinum*, *Clostridium perfringens*, and *Bacillus cereus*.

7. BACTERIA ISOLATED FROM RED MEAT AND POULTRY

Members of the following bacterial genera can with greater or lesser regularity and some only rarely, be recovered from red meat, poultry and their products:

<i>Acinetobacter</i>	<i>Hafnia</i>
<i>Aeromonas</i>	<i>Lactobacillus</i>
<i>Alcaligenes</i>	<i>Listeria</i>
<i>Arthrobacter</i>	<i>Microbacterium</i>
<i>Bacillus</i>	<i>Micrococcus</i>
<i>Bronchothrix</i>	<i>Moraxella/Acinetobacter</i> groep
<i>Brucella</i>	<i>Mycobacterium</i>
<i>Campylobacter</i>	<i>Pediococcus</i>
<i>Clostridium</i>	<i>Pseudomonas</i>
<i>Corynebacterium</i>	<i>Salmonella</i>
<i>Enterobacter</i>	<i>Staphylococcus</i>
<i>Escherichia</i>	<i>Streptococcus</i>
<i>Flavobacterium</i>	<i>Yersinia</i>

8. MICROBIOLOGY OF MEAT PRODUCTION

The deep muscle tissues of healthy, slaughtered livestock contain few, if any, micro-organisms. However, their exterior surfaces (hide, hair, skin, feathers,) are naturally contaminated with a variety of micro-organisms as are their gastro-intestinal tracts. From the moment of slaughter, each processing step subjects the carcass to opportunities for contamination with micro-organisms from the exterior surfaces, utensils and equipment and, most importantly, from the gastro-intestinal tract.

Cutting of carcasses also involves the use of utensils and equipment and transfers micro-organisms to the cut surfaces. Theoretically removal of the skin should expose the sterile surface of the muscle but in practice the extra handling seems to contribute significantly to the bacterial load on the surfaces. This happens with meat production where the skin is removed early in the slaughtering process (e.g. beef, mutton, lamb, ostrich, and goat) or where the skin is removed later on (e.g. some pork cuts, skinned chicken portions).

There is ample opportunity to contaminate the exposed tissues of the carcass with micro-organisms from:

- exterior surface of the animal
- contents of the gastro-intestinal tract
- equipment and utensils
- workers garments and hands
- the abattoir itself (e.g. air, floor drains, water drip from ceiling)
- water (and if used, ice)
- food additives (e.g. spices for value added products)

Therefore, we need to control this opportunity for contamination by:

- Using properly cleaned equipment.
- Ensuring that the abattoir is properly cleaned/sanitised.
- Use hygienic methods of dressing that control contamination.
- Clean utensils at appropriate intervals during the process.
- Apply a high standard of personal hygiene.

Meat with a good shelf-life has 10^2 - 10^4 organisms per cm^2 . To put the numbers of organisms associated with some sources of contamination into perspective: The exterior surfaces (hide, hair, skin, feathers) of healthy, live animals and birds are naturally contaminated with large numbers of a variety of micro-organisms. In a study of live cattle, 10^7 organisms were found per cm^2 of hide. The soil (ground) is also a major source of micro-organisms and has comparable numbers (10^7) of bacteria per gram of soil. Faeces are about 100 x

more contaminated and have an APC and “coli forms” of about 10^9 and 10^8 per gram of faeces, respectively. All of these can therefore serve as sources of microbial contaminants of the meat.

The hide, fleece or skin of the animal is known to be a major source of carcass contamination (pathogens and spoilage bacteria). Special care should be taken to avoid contact with the meat. Removal of hides or fleece should be carried out in a manner that avoids contact between the outside of the skin and the carcass. When the surface of the hide touches the surface of meat during removal, can cause transfer of significant numbers of organisms to the meat surface. Likewise, hands and equipment that touch the outside of the hide can serve to transfer organisms to the meat and should not come into contact with the underlying carcass meat before thorough cleansing.

Since it is extremely difficult to obtain clean meat from dirty animals or birds, it is important that only relatively clean animals are presented for slaughtering. The cleanliness of livestock depends on husbandry, weather and climate (rainy, dry), methods of transport (stress causes defaecation and urination) and holding conditions at the abattoir. Cattle from feedlots may carry more faecal bacteria and less soil organisms than those from pastures. The modern trend is that excessively dirty animals should not be slaughtered until action has been taken to clean them. Also, strategies should be developed to reduce the number of such animals presented for slaughtering.

From the figures quoted above, it is clear that under normal conditions, the heaviest and potentially the most dangerous load of bacteria is in the animal's digestive tract. Already a small volume of material from the intestinal tract can contaminate the carcass with sufficiently high numbers of “coli forms” to cause problems so that rupturing of the intestines or spillage of the intestinal content would cause severe contamination of the carcass. It is essential that great care be taken during evisceration to keep the viscera intact.

In addition to the skin, the gastro-intestinal and respiratory tracts, urine and milk are other important animal sources of contamination. Meat handling and preparation involves contact with knives, hands and clothing of workers, processing equipment, (e.g. saws, hooks, boning tables, conveyers) and water used to wash carcasses, hands and equipment. Airborne spread of particles and aerosols will also occur in the abattoir. All of these factors can lead to the transmission of potentially hazardous organisms and contamination of carcasses. To minimise contamination, it is logical that attention should be paid to sanitation of all equipment (e.g. knife-sterilizers), well-chlorinated water, personal hygiene, hand-washing facilities near worker stations as well as the other methods of hygienic slaughtering.

An important point to remember is that microbes firmly attach to meat and skin. This process is not yet well understood but it appears to become irreversible with time – the longer organisms remain on the meat the more difficult it becomes to remove them. In poultry processing, the contact period between the meat surface and contaminating organisms is reduced by washing carcasses at intermediate points during processing before attachment occurs. The principle should not be applied to larger carcasses because too much wetting spreads rather than removes contamination. In fact, when small volumes of faeces, intestinal contents, mud or soil are spread over the carcass by rinsing, the clean areas of the carcass can become quite heavily contaminated. This is the reason why carcasses should not be rinsed. Wet carcasses also tend to spoil more rapidly - especially if wet and warm. Un-split carcasses should never be washed and split carcasses should only partially washed under lowest pressure possible.

With any delay between consumption or further processing, it is essential to cool the carcass. As far as the microbiological quality of the carcass is concerned, fast chilling is indicated to restrict microbial growth. However, too rapid chilling can lead to cold-shortening of pre-rigor muscle and a loss of tenderness. With these conflicting requirements, optimal conditions for chilling must be a compromise. During chilling, contamination may occur by carcasses touching one another, by contact with dirty floors and walls, by splashing if cleaning is carried out in a loaded chiller and from the air, especially if the filters are not regularly cleaned.

Cutting of carcasses also involves the use of utensils and equipment that transfer micro-organisms to the cut surfaces. This happens with meat production where the skin is removed early in the slaughtering process (e.g. beef, mutton, lamb, ostrich, goat) or where the skin is removed later on (e.g. some pork cuts, skinned chicken portions).

The main challenge to the meat industry in relation to hygiene is to minimise external contamination of meat with micro-organisms during all stages of the production chain.

9. MINIMISING BACTERIAL CONTAMINATION DURING SLAUGHTERING

To summarise: The meat under the skin of a healthy animal is sterile. The slaughtering process must be aimed at keeping the bacterial load on the newly exposed meat surface as low as possible and all efforts should be made to prevent bacteria from being deposited on the carcass. It is necessary to ensure that nothing that touches the exposed meat is contaminated with micro-organisms. By using the correct slaughtering techniques with this aim in mind, a high degree of sterility is indeed possible under commercial conditions. This is shown by the fact that fresh meat when vacuum packed and maintained at 0 °C, as produced for export in Australia, New Zealand and SADC countries, has a microbiological shelf-life of up to 6 months.

10. SPOILAGE BACTERIA

A number of organisms are usually associated with meat spoilage. Some of the more important of these include *Pseudomonas*, *Brochothrix*, the *Moraxella/Acinetobacter* group, lactobacilli, psychrophilic *Enterobacteriaceae* and *Psychrobacter*. Depending on the growth requirements of the particular organism and the particular conditions of packaging and storage, different organisms are able to grow and spoil the meat. For instance, *Pseudomonas* spp need oxygen for growth and are usually the main spoilage bacteria on conventionally packaged meat in oxygen permeable film at refrigeration temperatures (see section 4 above). Lactic acid bacteria can again grow and spoil the meat when the oxygen tension in the package is low (in vacuum packaged meat).

Knowing and predicting which organisms will likely cause spoilage of a particular product in a specific package is a specialised field of study.

11. FOODBORNE DISEASES

A foodborne disease is an illness in humans in which the food is or contains the causative agent. Foodborne disease due to bacteria in the food usually manifests itself in episodes of gastro-intestinal disease (diarrhoea, vomiting etc). In recent times foodborne disease has been on the increase all over the world and even first world countries experience a worrying increase in outbreaks of foodborne disease. In fact, foodborne disease has been described by the World Health Organisation as one of the most widespread public health problems of the contemporary world. It creates an enormous social, cultural and economic burden on communities and their health systems. One of the important reasons why food safety management systems like the Hazard Analysis Critical Control Point System (HACCP) has been so widely introduced is to manage and control foodborne disease.

11.1 Agents of Foodborne Diseases

- *Bacteria* – *Salmonella* spp., *Staphylococcus aureus*, *Clostridium perfringens*, *Campylobacter jejuni/coli*, *Clostridium botulinum*, *Bacillus cereus*, certain strains of *Escherichia coli* and *Listeria monocytogenes*. Probably 20 or so could be listed.
- *Chemical substances* - ciguatera, scrombroid, paralytic shellfish poisoning.
- *Parasites* - *Giardia*, *Trichinella*, Anasakidae.
- *Viruses* - hepatitis A, Norwalk, Snow Mountain agent.

11.2 Food borne Disease Mechanisms

- *Infection* - The food acts as a vehicle to transport the infectious agent into the gastrointestinal tract where the micro-organisms colonise and produce illness. For example: *Salmonella*, *Shigella*.
- *Intoxication* - Microbial growth in the food causes the production of toxin(s) in the food prior to ingestion. For example: *Staphylococcus aureus*, *Clostridium botulinum*, *Bacillus cereus*.
- *In Vivo Intoxication* - The food acts as a vehicle for organisms that form toxin in vivo. For example: *Clostridium perfringens* and some *Escherichia coli*.

11.3 Events Necessary for Food borne Illness to Occur

The causative agent (chemical, physical or biological) must be present in the food. It can originate from the

food itself (plant or animal), from handling the food somewhere in the chain of production, from equipment or utensils and from the processing environment. Bacteria responsible for human illness can be associated with healthy or ill humans, animals or plants and with a normal or contaminated environment. For example, *Staphylococcus aureus* is common in the nasal passages of healthy humans. Pathogens such as *Salmonella*, *Clostridium perfringens*, *Staphylococcus aureus*, *Yersinia enterocolitica*, *Campylobacter jejuni* and *Listeria monocytogenes* are often present in small numbers as part of the micro-organisms on live, healthy animals.

The causative agent must be present in sufficient numbers (e.g. bacteria) or high enough concentration (toxin) to survive normal handling of the food. Some bacteria will not cause foodborne illness unless large numbers are ingested or sufficient toxin is produced. For example, the number of staphylococci must be about 1 000 000 (10^6) per gram of food to produce a sufficient amount of toxin to make people ill. Even for organisms that have the capability to cause illness when ingested in low numbers (for example *Salmonella*), the chance of becoming ill is much greater when large numbers of organisms are present in the food than with smaller numbers of organisms. With some notable exceptions (*Listeria monocytogenes*, *Yersinia enterocolitica*, *Clostridium botulinum E*), the common food pathogens do not grow at the typical commercial refrigeration temperatures.

A sufficient quantity of food containing enough of the agent to exceed a person's resistance must be ingested. The resistance of individuals in a population varies greatly. People most susceptible are those with low resistance like infants, small children, the elderly, pregnant women and people who are ill. More recently it was shown that a severe bout of influenza or the common cold may significantly lower resistance to foodborne pathogens.

11.4 Sources Of Foodborne Disease

Home - 60%
 Food Service Institutions - 35%
 Processing Plants - 5%

Nearly 50% of all foodborne disease cases are associated with temperature abuse (inadequate cooling or heating) such as:

- Leaving foods at room temperature for several hours.
- Storage at too high a refrigeration temperature (keep below 5°C).
- Storage of foods in large containers in refrigerators so that it cools down only slowly (slow cooling gives time for pathogens to grow).
- When cooking meat (especially minced meat), not heating it to a core temperature of at least 70°C for 2 minutes. (Other time-temperature combinations are reaching a core temperature of 60°C for 45 minutes; 65°C for 10 minutes; 75°C for 30 seconds and 80°C for 6 seconds).
- Not keeping cooked food hot at a temperature above 50°C or as some recommend, 60°C (e.g. meat pies).
- Storage of hot food for a long time at too low a temperature (e.g. in ovens that were turned off).

Other causes of foodborne disease have to do with sanitary methods of preparation and storage:

- Wash hands before and after handling raw meat
- Clean raw meat preparation area before and after cooking
- Avoid contact with other foods
- Never allow raw food, used utensils or other surfaces likely to cause contamination to come in contact with cooked or ready-to-eat foods.
- Never use the same unwashed plate that held raw meat to serve the cooked meat (e.g. at a barbeque!)
- Do not handle food if you have diarrhoea/vomiting or uncovered infected sores or cuts.
- Do not smoke while handling food and turn away from food and cover nose/mouth while coughing or sneezing.

12. BACTERIA MOST FREQUENTLY ASSOCIATED WITH FOOD-BORNE DISEASES

12.1 *Staphylococcus aureus*

Source

Sources of *Staphylococcus aureus* are:-

- Nasal passages and skin of food handlers and animals.
- Frequently from wounds and cuts.
- Live chickens often carry *Staphylococcus aureus* and it can contaminate carcasses during abattoir processing (from e.g. defeathering machine, cross contamination during processing).

Mechanism

Frequently heat-processed food is recontaminated by a lack of sanitary practices. Food poisoning from cooked foods often occurs as a result of cross- or recontamination from raw foods. Dressed carcasses often carry *Staphylococcus aureus* so that it should be well cooked and care taken not to cross contaminate other foodstuffs.

Unsanitary practices are often followed by temperature abuse. This allows a large number of organisms to develop with the production of a heat-stable toxin that cannot be inactivated by boiling. Growth and toxin production can occur over a wide range of temperatures (10-40°C, best at 37°C). No sensory changes may be present.

Foods involved

Meats (including poultry), meat-products, salads, dairy products (cheese).

Symptoms

Nausea, vomiting, abdominal cramps, diarrhoea - onset is sudden and 1-6 hours after ingestion of the incriminated food.

Preventive measures

Cook meat, especially chicken, well (avoid cold spots when cooking directly from frozen state). Avoid recontamination of a heat-processed food. Keep susceptible foods refrigerated preferably below 5°C.

12.2 *Clostridium perfringens*

Source

Raw meats; part of the intestinal flora of animals.

Mechanism

Low number of *Clostridium perfringens* often present in raw meats. Some spores may survive cooking procedures. If cooked meat is improperly cooled and not thoroughly reheated, large numbers of the organism will develop in the food and be consumed and grows best at 24-27°C (107-117°F). Toxin is produced in the large intestine during sporulation.

Foods involved

Cooked (cold or reheated) meat, poultry.

Symptoms

Flatulence, cramps, diarrhoea - usually 8-24 hours after ingestion of the food.

Preventive measures

Cooked meat dishes should not be held for long periods between 20°C and 50°C (68-122°F). Prompt and proper cooling coupled with thorough reheating to 71-74°C (160-165°F) should control the problem.

12.3 Salmonella

Source

Gastrointestinal contamination, usually from animal origin. Raw products of animal origin.

Mechanism

Even with the best manufacturing practices, some cross contamination may occur during dressing operations and further handling of carcasses when infected birds are slaughtered. Control of infection at farm level is still a problem. Therefore, we can expect that some raw meat contain low numbers of intestinal bacteria, including Salmonella. Even low numbers can cause illness since the bacteria grow in the intestines. The organisms grow best at 35-37°C (95-98.6°F), but can grow at 5-45°C (41-113°F) although slowly below 10°C (50°F).

Foods involved

Meat, poultry, eggs and egg products.

Symptoms

Abdominal cramps, diarrhoea, nausea, vomiting, headache, fever, chills. Usually 20-48 hours after ingestion of contaminated food. May cause death in infants, elderly or debilitated patients.

Preventive measures

It is usually difficult because of presence of the organism in animal food stuffs. Prevention of recontamination after heating (cutting boards, hands, utensils, etc.) is a better option. Proper chilling, hot-holding, and reheating of food. Microbiological monitoring of problem foods.

12.4 Campylobacter jejuni (Campylobacteriosis)

This organism has become a serious threat to the poultry industry in the USA and will probably also have the same effects when tested for in the RSA.

Source

Intestinal tract of animals.

Mechanism

Similar to Salmonellosis. The organism is psychrotrophic - survives at 4°C for 14 days, but quite sensitive to freezing.

Foods involved

Raw milk, eggs, meat and poultry.

Symptoms

Typical infection: abdominal cramps, diarrhoea, nausea, vomiting, flatulence, fever. Long incubation period - 2 to 5 days. Moderate duration - 3 to 7 days.

Prevention measures

Same as Salmonella.

12.5 *Listeria monocytogenes* (Listeriosis)

Source

One of the new emerging food borne pathogens. Has been isolated from several environmental sources in food processing plants - floor drains, etc., and from a variety of foods including meat and poultry. It grows well at refrigeration temperatures and would be found in cooled areas of the abattoir, packaging and further processing areas.

Foods involved

Milk, soft cheeses, coleslaw, one outbreak associated with processed meat.

Symptoms

The Symptoms are usually expressed as a flu-like syndrome in healthy adults. This may cause serious illness (septicaemia, encephalitis, stillbirth, and death) in immune-compromised individuals and pregnant women.

Preventive measures

Good Manufacturing Practices (GMP), pasteurisation at 77°C. Monitoring program in effect.

12.6 *Yersinia enterocolitica* (Yersiniosis)

Source

Found in the gastro-intestinal tract of mammals and birds and been isolated from faecal material, throats, tongues and lymph nodes of swine.

Mechanism

Typical signs of food poisoning.

Foods involved

Raw milk, seafood, non-chlorinated water, pork products (esp. those containing head meats).

Symptoms

Abdominal cramps, nausea, vomiting, diarrhoea, fever. Fairly short incubation - 24 to 48 hours. Relatively short duration - 1 to 2 days. Large numbers required to cause illness.

Preventive measures

Freezing, pasteurisation, vacuum packaging.

12.7 *Clostridium botulinum* (Botulism)

Source

The organism is a common soil contaminant. Anaerobic Mesophylic spore former.

Mechanism

Production of a potent heat-labile neurotoxin in the food. Optimum temperature for growth and toxin production of the proteolytic strains is 35°C (95°F), that for non-proteolytic strains about 26°C (79°F). Non-proteolytic types B, E and F can grow and produce toxin at refrigeration temperature. Three mechanisms are possible - food botulism, wound botulism, and infant botulism. Only food botulism is discussed.

Foods involved

Home-canned low-acid foods that are improperly processed; also mishandled (temperature abused) dishes such as processed meat sausages (nowadays more rarely than previously), pot pies, meat dishes with vegetables (e.g. turkey loaves with onion and green pepper, stew containing unpeeled potatoes and carrots). Safety record of commercially canned low-acid foods (e.g. canned fish, meat, and vegetables) is extremely good, but the potential for error is high.

Symptoms

Nausea and vomiting in 12-24 hours (not always present), vertigo, double vision, difficulty in swallowing and breathing, respiratory paralysis. Fatality rate about 20% if untreated. Effective antitoxins are available.

Preventive measures

Most common is by destruction of vegetative cells and spores by heat as in the canning of low-acid foods. Acidification to a pH below 4.6. Addition of nitrite to prevent germination of spores. Reduction of the water activity (a_w) to 0.93 or lower. Water activity is the ratio of the food's vapour pressure (p) over the vapour pressure of pure water (p_o) i.e. $a_w = p/p_o$.

12.8 E coli (O157: H7)Source

Intestine of warm-blooded animals.

Mechanism

It can be spread from food handlers usually via the hands, during slaughtering, preparation and service or contamination and cross contamination during slaughtering and processing. Raw milk can also be contaminated by the organism being present on the udders or the equipment.

Foods involved

Meat, especially ground beef, which has not been cooked sufficiently to kill the bacteria. (E. coli forms bio films on stainless steel.)
Coleslaw, sprouts, lettuce, salami, unpasteurised milk or juice and swimming in or drinking sewage contaminated water.

Symptoms

Severe bloody diarrhea, abdominal cramps, little or no fever, resolves in 5 – 10 days
In some persons especially children under 5 and the elderly it can cause a complication called haemolytic uremic syndrome, in which the red blood cells are destroyed and the kidneys fail (2 – 7 % of cases). This is life threatening. Complications of these might be high blood pressure, seizures, blindness, paralysis and the effect of having part of their bowl removed.

Preventive measures

Avoid fecal contamination.
Wash hands and equipment.
Cook food thoroughly.

13. MICROBIOLOGICAL EXAMINATION

Meat must be of a high microbiological quality in order to ensure that the consumer receives a product that is not spoilt or does not carry foodborne disease. An important function of meat related legislation and enforcement is to ensure that meat is indeed prepared under conditions of acceptable hygiene. However, the modern trend is that the abattoir assumes more and more responsibility for the microbiological condition of its product. Apart from visual inspection, it is necessary do microbiological tests to ensure that the hygiene measures that cost money and time are indeed effective. By regular microbiological evaluation of the abattoir and the meat, problems in hygiene and handling etc. can be identified and most importantly, rectified.

Before embarking on microbiological examination of a foodstuff, it is logical that the specific purpose of the examination be clear and made clear to the laboratory technician. It is also logical that before choosing a microbiological test the suitability of the test for the particular purpose be evaluated. Obvious as these observations may appear, these processes are often neglected. Little wonder that many microbiological examinations are not suited to their purpose leading to little assistance towards process improvement.

Counts on solid samples (meat products, etc) are expressed as colony-forming units (CFU) per gram, while counts on liquid samples (water) are expressed as CFU per millilitre. Surface counts are expressed as CFU per 10 square centimetres.

13.1 Microbiological examination of foods and food ingredients can be placed in 3 categories:

- Tests for pathogens and their toxins (for example, *Salmonella*, *Staphylococcus aureus* and its toxin, *Listeria monocytogenes*, *Clostridium botulinum* toxin).
- Tests for organisms/groups of organisms (for example, *Pseudomonas* spp. as spoilage organisms.)
- Tests for sc. indicator organisms (for example indicators of hygiene, indicators for the potential presence of pathogens)

These tests are used by regulatory agencies and the food industry to examine foods for:

- presence or potential presence of pathogens/toxins
- presence of spoilage organisms
- estimation of the bacterial load on the meat
- lack of good manufacturing practices during production and storage
- suitability of a food or ingredient for a particular purpose

13.2 Tests for indicator organisms and agents can be grouped into 4 categories:

a. To assess numbers of micro-organisms and/or microbial activity:

- aerobic plate count
- psychrotrophic count
- mesophyllic count
- *Pseudomonas* spp count
- yeast and mould count
- direct microscopic count
- pH determination (change in the expected pH)
- organoleptic examination

b. Presence and potential presence of pathogens:

- *Staphylococcus aureus*
- *Escherichia coli* (certain strains like *E.coli* O157:H7)
- *Salmonella* spp.,
- *Clostridium perfringens*,
- *Campylobacter jejuni/coli*,
- *Bacillus cereus*,
- *Listeria monocytogenes*

c. Indication of potential faecal contamination:

- Enterobacteriaceae
- coliform bacteria
- faecal coli forms
- enterococci

d. Metabolic products of pathogens that indicate a potential health hazard:

- *Staphylococcus aureus* toxins/thermo nuclease test
- phosphatase test

Microbiological examination usually consists of sampling, transportation and storage of the samples and their evaluation.

14. SAMPLING AND SAMPLING METHODS

The choice of sampling site, sample size and the number of samples to be taken for microbiological examination are probably the most important but problematical of the total microbiological evaluation procedure. It is seldom realised that the position of the sampling site on a carcass or within the abattoir often has far greater impact on the validity of the data than either the specific sampling technique used or the subsequent methods used for evaluation of the sample.

Sampling for microbiological examination must be done aseptically i.e. all organisms except those on the sample must be eliminated. Sterile equipment is needed for sampling.

14.1 Sampling methods

A variety of sampling techniques is in use in the food industry. These can be either destructive or non-destructive. Some non-destructive methods break up the colonies of bacteria (e.g. swabbing, rinsing) and counts are usually higher than with those methods that replicate intact surface colonies (e.g. agar sausage, Petrifilm™ and Rodac plates). With destructive techniques a sample is removed and macerated or blended before counting. This usually gives higher and less variable results than contact plate and swab methods.

14.2 Surface Count Methods

These methods are used to monitor the bacterial load on surfaces. In considering the method of monitoring to be used, cognisance must be taken of the type of surface being sampled, its chemical composition, the expected level and type of organisms on the surface and the object of the test. Some methods are designed to provide only an index of sanitation, whereas others are designed to give an accurate count of the bacteria present. Basic methods described in this manual are direct contact methods (agar sausages, Petrifilm™ and Rodac plates) and the swab and rinse methods. Some of the advantages and disadvantages of each method are given below. A fuller description of each method follows later.

- Agar Sausage Method:

Accuracy is relatively low but the precision of the method is high. It is very effective as a screening test for the efficacy of cleaning and disinfection of equipment and also the level of contamination on carcasses.

- RHODAC Plate Method:

The main advantage of this method is its simplicity of use and the fact that many samples can be taken in a short time. As in the case of the agar sausage method, the accuracy is also relatively low. A major drawback of this method is the high cost of the RHODAC plates.

- The Petrifilm™ Plate Method

The main advantage of this method is its simplicity of use and the fact that many samples can be taken in a short time. The prepared medium is bought and only needs rehydration before use. It also occupies little space e.g. in the incubator. Since the film is flexible, it can be used on a wider variety of surfaces than the previous agar contact techniques. A drawback of this method is the high cost of the Petrifilm™ plates.

- Swab Method:

This method is also effective as a screening test. It can also be used to sample areas inaccessible to the direct methods. Although this method usually yields more bacteria per sample than the direct contact methods, the recovery rate of bacteria by swabs is variable. This is because it is dependent on various factors such as the pressure used and the speed with which the swab is moved over the area. Large carcasses are often sampled using a swab made from specially purchased plastic or other material that does not contain bacteriostatic substances. There is also more labour involved when compared to the direct contact methods.

- Carcass Rinse Technique

The advantage of the method is that bacteria are rinsed off the inside and outside surfaces of the carcass

and the organisms in the rinse medium come from all areas of the carcass. It is useful when recovery of pathogens like Salmonella is attempted. The carcass rinse technique can only be used on a small carcass like a chicken carcass.

- Destructive methods

Destructive methods are the more reliable methods for estimation of surface contamination. Such methods include the excision method used for surface counts on red meat carcasses, chicken portions and processed products or the removal of a portion of the neck-skin of chicken for evaluation. For the excision method a sample (cork) cutter of a known surface area is used. A cork cutter with a diameter of 25,2 mm, shall give a surface area of 5 square cm. The sample is then macerated or homogenised using a stomacher or blender. Destructive methods are usually followed in suitably equipped laboratories and are not further discussed.

14.3 Sampling of carcasses

Different methods can be used for the sampling of red meat carcasses. Apart from destructive testing mentioned above, non destructive techniques such as the agar sausage method, the Petrifilm™ plate method, the RHODAC plate method, the swab method as well as carcass rinse techniques are all used. Direct contact methods are relatively easy and fast. However, they are only accurate with counts $<10^4$ organisms/cm². With higher numbers present on the carcass, the colonies that grow out will coalesce and cannot be counted.

14.4 Storage of Samples

- The storing of samples to be used in total counts must be avoided as far as possible.
- Bacteria present in the sample may start multiplying under favourable conditions and this could lead to false high counts.
- If storage is unavoidable, the sample may be kept in a refrigerator or on ice at 0 to 2°C.
- Frozen samples must be allowed to thaw in a refrigerator between 1°C and 5°C for 18 to 24 hours.

14.5 Incubators and the temperature of incubation

Since samples are usually placed in an incubator during the evaluation phase, incubators and the temperature of incubation warrant some discussion.

In pathology laboratories, the temperature of incubation is usually 37°C (or between 35 and 44 °C) because animal pathogens are adapted to grow well at body temperature. However, many of the non-pathogenic bacteria that are important on meat and in poultry processing do not grow well at these high temperatures. For instance, many spoilage bacteria have a maximal growth temperature of 32 - 35°C. It makes little sense to count bacteria growing at 37°C on a product that is slowly spoiling in the refrigerator at 0-5°C!

Another reason why 37°C is used as incubation temperature is that incubators operating at 20 to 25°C need to be cooled or have to stand in an air-conditioned area where ambient temperature is sufficiently low. This adds to the outlay costs. However, microbiological evaluation is expensive and the maximal amount of (correct) information needs to be gathered through microbiological testing.

14.6 The Agar Sausage Method

This is a direct contact method used to determine total counts on flat, dry surfaces. It is most commonly used in the testing of plant equipment and utensils for efficacy of cleaning and disinfection and also to obtain total aerobic counts on slaughtered carcasses.

Principle of the method

An agar medium is solidified in a container such as a big syringe (50 - 60 ml) with a known diameter and with the front end cut off. Using the plunger of the syringe, about 5 mm of the agar is pushed out and the front surface of the agar is pressed firmly against the surface to be tested. A slice (2-3 mm thick) is cut off, placed in a Petri dish, and incubated. After incubation the number of colonies that have grown on the slice is counted and corrected to an area of 10 cm². The result is then expressed as the number of cfu/10 cm². It must be stressed, however, that this method is only used as a screening test. The result obtained are not a

reliable indication of the actual number of bacteria present on the tested surface, especially irregular surfaces such as carcasses, because the agar is not able to pick up all the bacteria.

Sampling procedures

- Remove the aluminium cover and using the plunger, press out about 5 mm of the agar.
- Sterilise the knife by immersing it in the sterilising fluid and then flaming it. Repeat this process between each item. It is not normally necessary to sterilise the knife between successive slices taken from the same item or area. Sterility controls may be made and incubating them.
- Cut off a 2 - 3 mm thick slice and discard it.
- Press out another 5 mm of agar with the plunger and press the surface of the agar firmly against the surface to be sampled, taking care not to wipe the agar over the surface. Remove immediately.
- With the sterilised knife, cut off a 2-3 mm thick slice and transfer it, inoculated side uppermost, to an empty Petri-dish with the blade of the knife.
- Up to 5 slices may be sampled from one item and placed into one Petri-dish. However, three slices per item usually give a good idea of the efficacy of cleaning and disinfection, depending on the size of item.

Incubation

The Petri-dishes containing the slices are not inverted during incubation which is for 24 - 48 hours at 30°C. Samples from carcasses should be incubated for 48 hours.

Counting and interpretation of the results

After incubation the colonies on all the slices per Petri dish are counted by using a colony counter and then totalled. Regard this figure as the number of viable cfu on the test area. Correct this figure to an area of 10cm².

Example

The square surface of one slice is 8 cm. If three slices per item were used, the total area sampled is therefore $8 \times 3 = 24 \text{ cm}^2$. The number of colonies counted on all three slices totalled for instance 252 colonies. Correct this figure to an area of 10 cm² by dividing $252 \text{ by } 2,4 = 105 \text{ cfu} / 10 \text{ cm}^2$.

14.7 RHODAC Plate Method

This method is also a direct contact method. It is used to determine the total counts on flat, dry surfaces. It is also suitable for testing plant equipment and utensils for efficacy of cleaning and sterilisation.

Principle of the method

A special disposable dish (RHODAC plate) containing a solid medium in the base, is used. The lid is removed and the agar surface pressed against the surface to be tested. The lid is then replaced and the plate incubated in an inverted position. After incubation the number of colonies grown on the surface of the medium is counted and the figure corrected to a surface of 10 cm². The back of the plate has a grid to facilitate counting of colonies. By using this simple method a great number of items can be sampled in a short period of time.

Sampling procedures

The RHODAC plate is one of the simpler methods to use. Just remove the lid, firmly press the exposed agar surface against the surface to be sampled, remove and then replace the lid. Care must be taken not to wipe the agar surface over the surface to be sampled.

Incubation:

The plates are inverted and incubated at 30°C for 24 – 48 hours to obtain a total aerobic, mesophyllic count.

Counting and interpretation of results:

- After incubation, the colonies are counted with the aid of a colony counter or by hand.
- The figure thus obtained is regarded as the number of cfu on the sampled area.
- Correct this figure to an area of 10 cm²: For the 55 mm RHODAC plate, divide the figure by 1,73 and for the 84 mm Rodac plate, divide the figure by 2,64.
- Express the final result as the number of cfu / 10 cm².

14.8 Petrifilm™ Method used for surface sampling

Petrifilm™ plates replace conventional agar media in Petri dishes, RHODAC plates and syringes with agar. They can also be used for traditional counts of a variety of bacteria. Petrifilm™ plates are films coated with (dry) nutrients and gelling agents. The Petrifilm™ plate consists of 2 rectangular films that are joined at one side. An area of the top polypropylene film is covered on the inside with a layer of adhesive with indicator dye and a second layer with cold soluble gels. These folds over a polyethylene coated paper printed with a grid onto which nutrients mixed with cold water soluble gels are glued in such a way that the coatings on the 2 films match and form a "sandwich". Use requires rehydration before surface contact sampling or, for traditional counts, with the diluted sample. The whole plate is thin (slightly thicker than a double layer of plastic film), takes up little space and is easily transported. They are especially convenient for use where facilities for agar preparation do not exist. Like all other types of bacterial counts, they do require incubation in an incubator. Colony counts are easy to perform since special indicator dyes in the plates stain colonies providing a contrast that makes them easy to see and a built-in grid facilitates counting colonies.

A variety of Petrifilm™ plates with different media designed to test for different organisms/groups of organisms is available. The Petrifilm™ plates come with full instruction and good illustrations for their use. Although they are relatively expensive compared to the conventional agar plates, the suppliers/manufacturers (3M Microbiological Products) are confident that savings through their use (such as costs involved with laboratory outlay and media preparation time) will soon make up for their cost per plate. Petrifilm™ plates can be used as a direct contact method. It is used to determine bacteria (aerobic counts or counts of other organisms/groups of organisms) on surfaces. Since the plate is flexible, it is also suitable for testing uneven surfaces provided that close contact can be made with the surface to be tested. It is particularly suitable to test plant equipment and utensils for efficacy of cleaning and sterilisation.

Principle of the method:

Petrifilm™ plates are plastic films coated with (dry) nutrients and gelling agents. Use requires rehydration with sterile water a minimum of 30 minutes (Aerobic Count) or 1-2 hours (coliform and *E coli* plates) at room temperature before surface contact sampling and incubation. Detailed instructions on use and evaluation are supplied by the suppliers/ manufacturers (3M Microbiological Products).

As with RHODAC plates, by using this simple method a great number of items can be sampled in a short period of time. Since no media preparation is involved it is indeed a simple and versatile system.

Sampling procedures:

When the gel on the film is solid, carefully lift top film portion of the hydrated plate. Avoid touching the circular growth area. The gel will adhere to the top film. Allow the circular gel portion of the top film to touch the surface being tested. Rub finger over the outer film side of the gelled area to ensure good contact with surface. Lift film from surface and rejoin the top and bottom sheets of Petrifilm™ plate. Care must be taken not to wipe the agar surface over the surface to be sampled.

Incubation, Counting and interpretation of results:

Incubate and count as directed in the package inserts.

- Results are given as count / 20 cm²
- Express the final result as the number of cfu / 10 cm².

14.9 The Swab Method

This method is suitable for the testing of a wide variety of surfaces, including wet surfaces. Its advantage over direct contact methods is that areas that cannot be reached by either the agar sausage or the RHODAC plate methods, can easily be sampled with the swab method. A major disadvantage is that it involves the preparation of serial dilutions from which aliquots have to be transferred to agar plates.

(A variation of the method is used to obtain an idea of the contamination of the whole carcass. The carcass is rubbed all over with a swab made from specially purchased plastic or other material that does not contain bacteriostatic substances. Serial dilutions are made in the conventional way. The surface area of the animal is determined with a special technique and the number of microbes expressed as cfu per cm² of carcass surface.)

Principle of the method

A wooden swab-stick fitted with a cotton wool- or calcium alginate wool tip is used to pick up bacteria from a known surface area with the aid of a metal template with a square cut out of it. The inoculated swab is transferred to a tube containing 9 ml of a suitable dilution medium. Serial dilutions are prepared and one of the plate count methods is used to obtain a total count. The figure is then corrected to an area of 10 cm².

Sampling procedures

- Remove a sterile swab from its container. Ensure that throughout the handling of the swabs, the fingers do not touch the cotton tip or the adjacent part of the stem.
- Press the sterile template against the surface to be sampled.
- Vigorously rub the swab over the area to be sampled. While doing this, so rotate the swab as to bring the whole area of the cotton tip into contact with the surface.
- Break off the tip of the swab into the bottle containing the dilutant by using the neck of the bottle for leverage.
- If the swabs are sterilised individually in test tubes, the inoculated swab may be replaced into the tube and returned to the laboratory as soon as possible where it must be placed into a bottle containing the dilutant.
- If commercially available sterile swabs in disposable containers are used, a bottle containing sterile inactivator solution and/or wetting agent, must also be taken with the apparatus and materials to the area to be sampled. Before the swab is used, the tip is moistened with one of the solutions.
- Shake the bottle containing the broken off swab tip, well.

Inoculation and incubation:

Under aseptic conditions, transfer two separate 1ml volumes of the inoculated diluents into two sterile empty Petri-dishes. To each Petri-dish add 15 ml of a suitable molten agar (cooled to 45°C) and mix well. Allow the agar to solidify, invert the Petri-dishes and incubate at 35°C for 48 hours.

Counting and interpretation of the results:

- After incubation, count and record the number of colonies on both plates to obtain a mesophilic count.
- Add the number of colonies counted on each of the two plates together and multiply the total number with 5.
- This figure represents the number of viable bacteria on the test area sampled and, if necessary, corrects this figure to an area of 10 cm².
- Express this figure as the total cfu / 10 cm² (if a template with a 10 cm² hole has been used): Total number of colonies on both plates x 5 = cfu /10 cm².

15. MICROBIOLOGICAL ASSESSMENT OF HYGIENE

Before expending the effort and funds to do microbiological testing, we should first insist that equipment is clean - it must look clean, feel clean, and smell clean.

Several microbiological testing procedures may be used to help verify the effectiveness of the cleaning and sanitising programme. The most important consideration in any assessment program is to consistently evaluate a given area using the same appropriate technique so that a history may be obtained for any given pieces of equipment over a period of time.

A summary of the techniques used for hygiene assessment are:

- Direct or contact methods – These previously described methods include the agar sausage method, the RODAC plate and Petrifilm™ plate methods. The agar is brought in contact with the surface to be tested. Following incubation, the colonies on the plate are simply counted.

- Swab or rinse method – The swab method was previously described. With the traditional rinse method the object to be evaluated (meat, container or equipment) is placed into a sterile receptacle and rinsed with a measured volume (usually 90 ml) of sterile buffered neutraliser solution for the sanitizer-(or buffered peptone broth), followed by determining the bacterial population of the rinse solution. It is only practical for small objects.
- ATP Bioluminescence – The ATP bioluminescence procedure is referred to as a “real time” procedure because an incubation period is not required and cleanliness can be determined in 1 or 2 minutes. This technology thus allows processors to determine the effectiveness of their sanitation procedure immediately and to make corrections before production begins. The technique measures the adenosine triphosphate (ATP) present in a swab from an equipment surface. It uses an enzyme and its substrate (sc. luciferin – luciferase system) from fireflies in the determination. In the presence of ATP a reaction takes place and light is produced. The intensity of the light is a measure of the ATP in the swab sample and thus of the cleanliness of the surface. The method measures all ATP whether from micro-organisms or from meat residues or exudate. Since all these sources of ATP are undesirable on thoroughly clean and sanitised surfaces, it is a most useful procedure. (There are special techniques to determine whether the source of ATP is microbiological or animal with the instrument). The instrument is portable and extremely handy. At present it is rather expensive to buy and operate.

16. BACTERIA/GROUPS OF BACTERIA EVALUATED

16.1 Aerobic plate count (APC)

This is the most widely used microbiological test on foods. Its purpose is to determine the number of living micro-organisms per unit of food. In fact, it does estimate only a portion of the total viable micro-organisms because only those that can grow under the conditions of the procedure (nutrient medium, temperature, time, gaseous atmosphere, etc) will manifest themselves as colonies. Procedures must be standardised and rigidly followed if APC's are to be used for regulatory purposes or if we want to be able to compare results,

In addition, APC's of foods are often misinterpreted and it often requires interpretation by an expert. APC's of perishable refrigerated foods such as milk, red meat, poultry and fish may reflect:

- the microbiological condition of the raw food
- the effectiveness of the processing method(s)
- the sanitary condition of equipment and utensils
- the temperature/time profile of storage.

Thus it is extremely important to know the origin and have as much as possible other information about the sample. Unusually high or low APC's may have different causes. To pinpoint the source(s) of a problem when unusual high counts are observed in a product, we may have to examine the product at various points in the process. With refrigerated perishable products, even if the raw material was of excellent quality and it was processed and stored under the best of conditions, these products will with time, ultimately decrease in quality and spoil. A high APC of the final product under such conditions simply reflects continued growth of psychrotrophic bacteria and may have little to do with the original quality of the raw material, processing methods or storage conditions. In this case, spoilage of a perishable food after a certain time lapse is an expected event but the necessary background information is required to pinpoint this fact.

Several other important points need to be made to avoid misinterpretation.

- APC's (and all other techniques that depend on bacterial growth for evaluation) estimate only living bacteria. Processing such as heat may have destroyed a significant part of a large microbial population. Other steps such as freezing, dehydration or lowering of pH may stress or kill bacteria.
- APC's do not furnish information on microbial type. Some micro-organisms are biochemical very active and break down proteins, fats or carbohydrates - others produce fewer defects.
- Perceptible sensory defects usually do not occur until the level of micro-organisms reaches 10^6 to 10^7 per gram. To assess safety, knowledge of microbial types is of major importance.

16.2 Psychotropic Count

Minor modifications in the APC procedure allow it to be applied for the determination of psychrotrophic counts. Psychrotrophic counts are often used because major perishable foods such as milk products, meats, poultry and seafood are stored for extended periods of time under refrigeration.

Psychrotrophic bacteria are capable of growth, although slowly, at refrigeration temperature and in foods. They are usually gram-negative, aerobic rods. Many psychrotrophs produce defects because they are capable of breaking down proteins and/ or fats. Several *Pseudomonas* species are in this category. Common procedures for estimating psychrotrophic bacteria employ plate incubation at 7°C for 10 days or at 15-25°C for 2-3 days.

16.3 Direct Microscopic Count (DMC)

The DMC provides an estimate of both living and dead micro-organisms by examination of a small quantity of food (stained with a dye) under the microscope. Because the individual cells can be seen, some information about the morphology of the micro-organisms is available. Limitations of the procedure include (1) the small amount of sample used, (2) it is useful only when very large numbers of bacteria are present in the food.

16.4 Yeast and Mould Count

This count is particularly applicable to foods where the physical-chemical characteristics of the food (a_w , pH, flavour or select the outgrowth of yeasts and moulds).

17. MEASURING METABOLIC ACTIVITIES OF MICRO-ORGANISMS

Sensory (organoleptic) examinations (taste, odour, body, texture, colour)

Although useful for milk, meat, poultry, fish, cultured dairy products of limited general use because the result of microbial activities varies with differences in food composition. Different organism, although at the same level, may give different metabolites (aerobic packaged meats versus vacuum packaging).

The type of pH change in a food resulting from microbial activity depends upon the nature of the food, the type of micro-organism and the packaging system (O_2 permeable film, gaseous atmosphere). Some important applications of pH measurements include production of fermented sausages, cultured milk products and cheeses, manufacture of mayonnaise and salad dressings, and acidified canned foods.

18. INDICATORS OF POTENTIAL PRESENCE OF PATHOGENS

18.1 Staphylococci In foods

Staphylococci represent contamination with bacteria from the nasal passages, skin and lesions of humans. They are usually destroyed by heat processing. Thus their presence in heat-processed foods usually indicates recontamination after processing. Large number (about 10^6 per gram) is needed to cause foodborne illness. Hence, when a problem occurs, we have recontamination of a heat-processed food coupled with temperature abuse. Small numbers of staphylococci can be expected in foods that are handled by employees. Larger numbers indicate growth. One must understand that small numbers of staphylococci in food may represent the survivors of a much larger population and that toxins are still present.

18.2 *Escherichia coli* (*E. coli*)

Belongs to the family *Enterobacteriaceae*. It is present in the intestinal tract of vertebrate animals; in humans it forms about 1% of the total bacterial biomass. The presence of *E.coli* in a food is traditionally taken to indicate that faecal contamination may have occurred. If *E. coli* is present in a food, it is considered possible that other enteric organisms, including pathogens that occur with *E. coli* in intestines, may be present. However, it is frequently found in the complete absence of any possible faecal contamination, e.g. it can multiply in pristine natural waters, occurs on plants, in soil and even as a (growing) contaminant in an industrial fermentation such as yeast production.

In a heat-processed food, *E.coli* should have been destroyed because it is heat sensitive. The presence of this organism in such food indicates post-processing contamination from some source (equipment, people,

raw foods) or, but less likely, process failure.

E. coli was formerly taken to be only indicative of possible faecal contamination and was not considered to be a potential pathogen. However, since it became clear that *E. coli* is a pathogen in its own right and moreover, that pathogenic strains can occur on meat, the presence of *E. coli* on meat is to be avoided. Although the presence of small numbers of *E. coli* in raw animal foods is not surprising since these foods are closely associated with the surface and intestinal contaminants of animals, international pressure is mounting to keep *E. coli* on meat and meat products as low as possible or to eliminate it. Lower and lower counts of *E. coli* on red meat and poultry are becoming the norm.

New methods (direct plate counts, Petrifilm™ plates, impedance) that allow counting of *E. coli* directly exist. This supersedes the somewhat lengthy Most Probable Number (MPN) technique. A rapid fluorogenic detection method is widely used. The method is based on the cleavage of a substance 4-methylumbelliferyl- β -D-glucuronide (MUG) that gives off a readily detected fluorescent substance when split by *E. coli*. Unfortunately, some strains of *Salmonella*, *Shigella* and *Yersinia* also split MUG so that the method is not entirely specific for *E. coli*. More importantly, some enterohaemorrhagic strains of *E. coli* (e.g. *E. coli* O157:H7) are not detected by this method. Excellent test kits exist to confirm that the organism is indeed *E. coli* should it be required.

18.3 Faecal coliform test

The faecal coliform procedure was established with the objective to establish the presence of *Escherichia coli* without having to go through the rather lengthy MPN procedure and IMViC testing. It is an old and cumbersome procedure and has been superseded by direct detection and counting of *E. coli*. For the determination an inoculum derived from coliform enrichment broth is placed in EC broth at a high temperature (44-45°C) to select a group of organisms in which we usually have a high proportion of *E. coli*. A positive faecal coliform test is taken to indicate a higher probability of potential faecal contamination than a positive coliform test. Since other bacteria such as *Enterobacter* and *Klebsiella* may be part of the coliform group, it is advisable to check that *E. coli* indeed does constitute a significant part of this group for the type of food under examination.

18.4 Coliform Test

Coliform constitute a group of bacteria that are capable of fermenting lactose with the production of acid and gas at 35°C within 48 hours. *Escherichia coli*, a member of the coliform group is common in the faeces of man and animals. Others such as *Enterobacter* are found widespread in nature such as soil, water, and plants. It is not surprising those coliforms are found in many raw foods. They are, however, easily destroyed by heat.

There are a few important, observations to be made relative to the presence of coliform in foods.

- The mere presence of coli forms in a food does not mean faecal contamination - the type must be established. Perfectly sound food may be rejected on account of an unconfirmed coliform test.
- The presence of faecal coliform or *E. coli* constitutes a much greater potential for faecal contamination and hence for the presence of enteric pathogens. Since many good procedures for the determination of pathogens themselves are available and new ones are described it may be advantageous to do some confirmatory tests for expected pathogens.
- Presence of coli forms in a heat-processed food most likely indicates post-processing contamination from equipment, utensils, people, raw foods, etc. Process failure is also a possibility, but much less likely.
- Caution needs to be expressed in enumerating coliform bacteria from processed foods because they are easily stressed by freezing.

18.5 Enterococci

Streptococcus faecium and *Streptococcus faecalis* are common enterococci of foods. Most enterococci are salt resistant, facultative anaerobes, grow at 45°C and with some exceptions grow at 7 to 10°C. *Streptococcus faecium* and *Streptococcus faecalis* may survive pasteurisation. Enterococci may originate from the intestinal tract, but frequently are associated with plants and insects. Thus, natural foods can have low populations of enterococci. The literature indicates that enterococci counts are not a reliable index of faecal contamination of foods.

19. INDICATORS OF POST-HEAT PROCESSING CONTAMINATION

19.1 Coliform Bacteria

The ‘coliform’ test is a test that was devised when no suitable alternative tests existed. In spite of the fact that little real value can be attached to the ‘coliform’ test, that the results are often misleading and that superior tests for contamination exist (e.g. determining *Escherichia coli* directly instead of establishing that it might perhaps be present), the ‘coliform’ test is still required by many agencies. The ‘coli forms’ constitute a group of bacteria that are capable of fermenting lactose with the production of acid and gas at 35°C within 48 hours. The rationale for the test was that *Escherichia coli*, a member of the ‘coliform’ group, are common in the faeces of man and animals. Other ‘coli forms’ such as *Enterobacter* are found widespread in nature such as soil, water, and plants. It is not surprising that coli forms are found in many raw foods. They are, however, easily destroyed by heat and are therefore used to indicate post processing contamination or less likely process failure.

There are a few important observations to be made relative to the presence of coliform in foods.

- The mere presence of coli forms in a food does not mean faecal contamination had taken place – as pointed out above, the type needs to be established. The presence of faecal coli forms or *E.coli* constitute a much greater potential for faecal contamination and hence for the presence of enteric pathogens.
- Their presence in a heat-processed food most likely indicates post-processing contamination from equipment, utensils, people, raw foods, etc. Process failure is also a possibility, but much less likely.
- Caution needs to be expressed in enumerating coliform bacteria from processed foods because they are easily stressed by freezing and special methods to resuscitate them are required.

19.2 Enterobacteriaceae Count

This count is used extensively and allows enumeration of a greater variety of members of the Enterobacteriaceae. It is used for the same purpose as the coliform count.

19.3 Other Tests

19.3.1 Determination of *Staphylococcus aureus* toxins and the *Thermonuclease* Test

Staphylococcus aureus produces a number of thermo stable toxins. Methods exist for the direct determination of these toxins in foodstuffs. These can be purchased from some suppliers of microbiological media. Careful instructions for their use are supplied by the manufacturers. This direct method of determining the toxins is preferred to a method to determine thermo stable deoxyribonuclease (TNase), which is employed as a screening test for extensive growth of *Staphylococcus aureus* in a food, and therefore for only the *potential* presence of toxin. Not all strains of *Staphylococcus aureus* produce toxins.

19.3.2 Phosphatase Test

This is a test used for milk and some milk products to test for proper pasteurisation, potential leakage of raw product into the pasteurised supply or other post pasteurisation contamination.

20. STANDARD METHODS FOR TOTAL AEROBIC MESOPHYLLIC COUNTS

To obtain a total, aerobic, mesophyllic count of viable organisms in meat products, by-products, water, etc., the laboratory technician may use any one of the three methods described below, depending on the type of sample and personal preference.

For a total surface count, the technician may either use a direct count method (agar sausage or RHODAC plate) or the swab method (cotton or calcium alginate swabs). Total counts are used for monitoring surfaces in abattoirs to determine hygiene levels e.g. after a cleaning action.

No one method can give a complete picture of the microbial contamination on a surface. However, the swab and direct contact methods when used routinely and regularly can give a great deal of useful information provided all factors are taken into account when assessing the results.

MEAT INSPECTORS MANUAL

PART I ABATTOIR HYGIENE

MODULE 2

GENERAL LAYOUT AND CONSTRUCTION FOR ABATTOIRS AND CUTTING PLANTS

Index**ABATTOIR LAYOUT AND CONSTRUCTION**

1. INTRODUCTION
2. LAYOUT
3. CLEAN AND DIRTY PRODUCTS
4. BUILDING AN ABATTOIR
5. PREMISES
6. FACTORS AFFECTING ABATTOIR WORK AREAS
7. FACILITIES FOR STAFF
8. GENERAL REQUIREMENTS FOR PREMISES, STRUCTURES AND EQUIPMENT
9. THE USE OF WATER IN THE ABATTOIR
10. DISPOSAL OF ABATTOIR EFFLUENT

ABATTOIR LAYOUT AND CONSTRUCTION

1. INTRODUCTION

“**abattoir**” in terms of The Meat Safety Act, 2000 (Act 40 of 2000) means a slaughter facility in respect of which a registration certificate has been issued in terms of section 8(1) and in respect of which a grading has been determined in terms of section 8(2); (i)

A well-designed and constructed structure is needed to systematically process the animal that is slaughtered. The further the process progress, the greater the risk of contaminating the product. Prevention thereof is determined by the layout and the flow patterns, which the product follows.

Hygiene is the prevention of contamination of the product.

Each function in the slaughter process has a fixed status in terms of “Clean” or “Dirty”. In choosing the premises, this important aspect must be taken into consideration. “Clean” and “Dirty” areas are separated by distance, physical barriers and in certain cases by time.

2. LAYOUT

The layout of the premises and building must be designed so that the production process moves in one direction without any cross flow of products, which may adversely affect the hygiene of the product. Live slaughter animals are received at the “dirty” end of the abattoir and meat is dispatched from the clean side of the abattoir.

2.1 “Dirty” area (pre-evisceration process)

- Livestock entrance.
- Vehicle wash bay for trucks that transported animals.
- Offloading platforms and facilities for marking animals.
- Lairage where animals are kept until they are slaughtered where applicable (shade for pigs, sheep & poultry).
- Ante mortem inspection.
- Isolation lairage for animals/birds that are or might be sick.
- Emergency slaughter facilities for hurt animals/birds.
- A post mortem inspection area for animals/birds which arrive dead or die in the lairage.
- Facilities where animals/birds can be restricted and efficiently stunned.
- Bleeding area.
- Area for electrical stimulation of ruminant carcasses.
- Facilities where condemned products are handled.
- Areas/rooms where inedible products are handled e.g. hides/pelts, horns, feathers etc.
- Including facilities for sorting grading and weigh.
- Room for the cleaning and sometimes processing of rough offal.
- Disposal of solid waste such as paunch and intestinal contents.
- Areas where rough offal is packed and cartoned.
- Chiller or freezer facilities for rough offal.
- Dispatch area for rough offal.
- Effluent pre-purification plant and holding tanks.
- Facilities for the processing of condemned products to by-products such as blood/carcass meal and tallow
- Cloakrooms, toilets, showers, washing facilities and dining room where only workers of the dirty areas have access.
- Store rooms for dirty area.
- Maintenance workshops.

2.2 “Clean” area (post evisceration process)

- Slaughter hall for the dressing of animals/birds under hygienic conditions with facilities for separating the different components.
- Area for inspection of the carcass and other edible portions in order to determine in fitness for human consumption and to prevent the spread of disease to humans and animals.
- Facilities for the retention for secondary inspection of carcasses which are suspect.
- Grading and weighing of carcasses as part of the marketing function.
- Chilling of carcasses to ensure that the quality of the product is maintained and the optimal shelf life ensured.
- Freezer facilities for storing provisionally approved carcasses with slight measles contamination.
- Sorting and loading of carcasses in a cooled area to ensure that the cold chain is not broken.
- Dispatch facilities.
- Washing bay for meat trucks.
- Office accommodation and ablution facilities for meat inspectors.
- Office for management.
- Laundry facilities.
- Laboratories.
- Cloakrooms, toilets, showers, wash facilities and dining room where only workers in the clean area have access.
- Store rooms.

3. CLEAN AND DIRTY PRODUCTS

3.1 Clean products:

Dressed carcass (includes head and feet in pigs & skin in poultry)

Red offal may be the following, depending on the species:

Lungs	Pancreas
Kidneys if removed	Clean fat (omentum)
Heart	Diaphragm if removed
Tongues	Heifer udders if removed
Liver	Sweetbreads (Thymus)
Tail	Testes
Spleen	

3.2 Dirty products:

Edible:

Rough offal:

- Paunch and oesophagus
- Intestines
- Head – skin on (ruminants)
- Feet – skin on (ruminants)

Inedible:

- Hides skins
- Horns
- Hair, hooves, snout
- Feathers

Condemned products:

Blood

Male/female reproductive organs including lactating udders/penis

Gall bladder

Bladder.

Carcasses and portions of meat condemned by the meat inspector/veterinarian which poses a possible health threat. Such material must be held under secure conditions until disposed of in accordance with

legislation.
Crop in case of chickens
Rectum/cloaca in chickens

4. BUILDING AN ABATTOIR

4.1 Approval

Anyone intending to erect an abattoir must contact the Provincial Directorate of Veterinary Services.

4.2. Factors to be considered when building an abattoir

The choice of a suitable site for an abattoir is most important. The factors listed below must therefore be taken into account when selecting a premise:

4.2.1 Environmental factors

- (a) Drainage is affected by geological structure, nature of the soil (sandy or loam), the water table and the natural slope of the surface.
- (b) Natural slope – Rainwater and runoff from the dirty area must not flow into the abattoir, nor must they flow from the dirty to the clean side of the premises. Tanks for the collection of effluent and pre-purification plants must be situated at the lowest point of the site, on the dirty side. Liairages must not be situated on higher ground than the buildings, nor must they be closer than six metres to them.
- (c) Water supply – An adequate supply of potable water must be available. Consideration should also be given to the storage (storage tanks, chlorination tanks and pressure tanks) which must be on the clean side, preferably at the highest point, and treatment of water should this be necessary.
- (d) Water pollution – can occur due to slaughtering and other processes and therefore the abattoir should be a reasonable distance away from any river – no process water may flow into any river.
- (e) Prevailing winds – Must blow from the "clean" side (dispatch) to the "dirty" side (liairages).
- (f) No source of contamination should occur in the environment in which we place an abattoir: Examples are a paint factory, foundry, sewage farm, river or residential area.
- (g) Abattoirs are classified as light industries. Because water pollution does occur, the abattoir should be a reasonable distance away from any river.
- (h) The site must be large enough to allow the abattoir and allied activities to be correctly situated and oriented. Provide also for future extensions.

4.2.2 Services

- (a) **Effluent disposal** – An effective system for the disposal or removal of effluent must be provided where necessary.
- (b) **Electricity** – There must be a reliable source of power for heating water as well as to provide for the partial or total mechanisation of the abattoir.
- (c) **Transport** – There must be sufficient facilities for the reception of animals as well as for the removal of products.
- (d) **Labour** – The proximity of a labour pool or reasonable access to public transport is also important.
- (e) **Access roads and staff separation** – If this is required for the relevant grade, the "clean" and "dirty" areas of the premises must be physically separated. Vehicles which offload live animals, loads intestines heads and feet as well as vehicles removing paunch contents, condemned material

and refuse are restricted to the "dirty" area and may not enter areas where meat vehicles and staff who handle meat are to be found.

5. REQUIREMENTS FOR PREMISES

- (a) Must be fenced with lockable gates in order to control the unauthorised entry of vehicles, persons and animals.
- (b) The layout of the site should be such that a linear flow pattern can be maintained with live animal reception on one side and the removal of products on the other.
- (c) "Clean" and "dirty" areas must be separated according to their functions as previously mentioned.
- (d) Surfaces on the site must be paved or grassed. Traffic areas in the smaller abattoirs must have a surface that is dust and mud free, readily cleanable and well drained. The traffic zones of larger abattoirs must have a permanent surface. The planting of grass and shrubs creates a pleasant environment and gives the impression that the premises are well managed and cared for.
- (e) From the point of view of industrial psychology it has been found that the more attractively a site is maintained, the easier it is for the workers to accept and adjust to the high standards of hygiene expected of them; they are also more likely to do so.
- (f) All paved areas must provide for storm water drainage.
- (g) Vehicle parking areas where carcasses are offloaded or meat is loaded under roof must have kerbstones and be drained so that they can be cleaned every day. Dirt that is washed onto grass is impossible to remove.
- (h) Walkways for staff between the ablution block and the abattoir must preferably be roofed.
- (i) Specific areas such as collection points for manure from holding pens and containers of paunch contents to be removed, must also be paved, drained and provided with kerbstones.

6. FACTORS AFFECTING ABATTOIR WORK AREAS

Progressive procedures to prevent the contamination of meat by organisms and other contaminants during the slaughter process must be taken.

This aim can be achieved by correct internal abattoir design. The layout must eliminate cross-flow patterns of people and products.

In designing the abattoir it is important to refer once again to the principle of a linear flow pattern.

General guidelines:

- (a) During processing, product flow must be from dirtier to cleaner areas, zones or rooms. These products must not come into contact with the floor or walls, or even with equipment like platforms, and must remain within the building until dispatched.
- (b) Drainage must be from clean to dirty.
- (c) The airflow must be from clean to dirty.
- (d) Product flow lines must not intersect or cross.
- (e) Backtracking must be avoided.
- (f) Unclean products derived from slaughtering and dressing must be removed from the slaughter area as quickly as possible. Heads and skins must not be carried or passed under or around dressed carcasses on route to the exit point.

- (g) "Warm" and "cold" working areas must be distinguished.
- (h) Staff must take the shortest routes when moving to their workstations.
- (i) Hand washbasins must:
 - Be readily accessible to all workers
 - Be at a distance not exceeding three metres from any workstation where products are handled.
 - Be available at raised platforms.
 - Be available in combination with sterilizers where manual equipment is in use.
 - Have taps which are operated with the foot or knee.

7. FACILITIES FOR STAFF

- (a) Change rooms, toilets, showers and canteen facilities sufficient for the number of workers on the premises must be provided in terms of the Occupational Health and Safety Act 1993.
 - In High throughput abattoirs physical separation is required for "clean" and "dirty" workers.
 - In low throughput abattoirs where separate facilities are required, they must be situated in the "clean" and the "dirty" areas respectively.
 - In low throughput abattoirs where separate facilities are not required for "clean" and "dirty" workers, the facilities must be situated on the cleaner side of the premises.
- (b) Staff facilities may:
 - Be in a free standing building connected to the abattoir by means of a covered walkway.
 - Form part of the main structure with a ventilated lobby provided between the slaughtering area and the facilities.
- (c) Staff facilities must be planned so that:
 - Total separation is achieved between cloakroom/ shower and toilet/ urinal areas.
 - Hand wash basins with foot or knee operated taps are provided at the exit to the facilities. (Numbers will depend on the number of workers.)
- (d) At high throughput abattoirs there must also be separate facilities for inspection staff.
- (e) An office for the person in charge should be provided.
- (f) A storeroom for overalls and clean equipment normally required for the work must be provided.
- (g) A separately storeroom for cleaning agents, soap and chemicals must be provided.
- (h) Lockers must be provided. The basket system, as used at swimming baths, is highly recommended as an alternative to the usual lockers. It allows for greater freedom of movement in the change area as well as for easier cleaning and stricter control over the contents of the baskets, e.g. food, empty bottles etc. which might be stored together with the overalls.

8. GENERAL REQUIREMENTS FOR PREMISES, STRUCTURES AND EQUIPMENT

Structural requirements

Requirements for all abattoirs as well as export approved cutting plants and cold storage units

1. General

Premises must be of such design, construction and finish and must be so equipped, in such condition and so located that they can be used at all times for the purpose for which they were designed, equipped and appointed –

- (a) without creating a health hazard; and
- (b) in such a manner that meat –
 - (i) can be handled hygienically on these premises or with equipment on the premises; and
 - (ii) can be protected by the best available method against contamination or spoilage by poisons, offensive gasses, vapours, odours, smoke, soot deposits, dust, moisture, insects or other vectors or by other physical, chemical or biological contamination or pollution.

2. Premises

- (1) All areas on the premises must be rendered dust and mud free.
- (2) Provision must be made for storm water drainage.
- (3) The abattoir must be equipped with an enclosed drainage system for the disposal of effluent and sewerage.
- (4) Vehicle loading and off loading areas for dispatching and receiving of meat must be curbed, paved, drained and roofed.

3. Cross flow

The premises and buildings must be designed to ensure that –

- (a) clean and dirty areas and functions are separated;
- (b) no cross flow between clean and dirty areas and functions, occurs;
- (c) inedible or condemned material can easily be removed on a continuous basis from areas where edible material is handled; and
- (d) detained meat can be kept and examined without contaminating passed meat.

4. Requirements for interior of building and rooms

In the abattoir where meat and animal products are handled and in toilets, change rooms and dining facilities –

- (a) all rooms must be of such sizes as not to compromise hygiene;

- (b) floors and stairways must be –
 - (i) smooth, impervious, resistant to wear and corrosion and not slippery; and
 - (ii) free of cracks and open joints;
- (c) floor drainage design and construction –
 - (i) must ensure that floors are sloped at a gradient of not less than 1:60 towards drainage points or channels;
 - (ii) must ensure that channels drain from clean to dirty areas;
 - (iii) must be such that drainage channels are smooth, impervious, washable and provided with grates or covers; and
 - (iv) must provide all drain inlets with solid traps as well as mechanisms to prevent access of vermin and obnoxious odours into the abattoir;
- (d) interior wall surfaces, partitions and pillars must be –
 - (i) smooth, impervious, washable and light coloured;
 - (ii) rounded at floor to wall, as well as wall to wall, junctions with a minimum radius of 50 mm; and
 - (iii) rounded on top in case of walls and partitions which are not ceiling height;
- (e) interior roof structures or ceilings, must be smooth, impervious, light coloured and washable;
- (f) doors and doorframes must be smooth, impervious, vermin proof, light coloured and corrosion resistant;
- (g) personnel entrances must have self-closing doors and be provided with hand wash-basins, boot wash and apron wash facilities and apron hooks;
- (h) hatches, where provided, must have an inclined bottom edge sloping towards the dirtier side, and self closing flaps must be provided when applicable;
- (i) chutes must –
 - (i) be smooth, light coloured and corrosion resistant;
 - (ii) open at least 300 mm above the floor;
 - (iii) be sanitizable along its entire length; and
 - (iv) be separate for meat, inedible material and condemned material, respectively;
- (j) windows –
 - (i) must have light coloured, corrosion resistant frames and must be glazed;
 - (ii) must be fitted with fly screens when used for ventilation;
 - (iii) must have window sills that slope at 45°; and
 - (iv) may not be opened if it interconnects clean and dirty areas;

- (k) all working areas must –
 - (i) be well ventilated; and
 - (ii) have artificial or natural lighting at an intensity of at least –
 - (aa) 540 Lux where meat is inspected; and
 - (bb) 220 Lux in work areas;
- (l) all light fittings must be equipped with covers or splinter protectors;
- (m) all electrical fittings must be waterproof; and
- (n) all wall mounted equipment, structures and fittings must have a clearance of at least 50 mm from the wall.

5. Requirements for equipment

- (1) Equipment –
 - (a) must be corrosion resistant and non-toxic and may not taint or stain meat;
 - (b) must have surfaces which are smooth, impervious and free of holes, cracks and sharp corners, and must be sterilizable; and
 - (c) may not contaminate meat with lubricants.
- (2) Containers used to hold meat must comply with sub regulation (1) and if the sides and bottoms are constructed with openings they must be designed so that meat cannot protrude through the openings or make contact with the floor.

6. Requirements for toilets and change rooms

- (1) Toilets and urinals must be situated in a separate room with separate entrances from the change rooms.
- (2) All toilets must be provided with toilet paper holders and toilet paper, hand wash-basins, soap dispensers with germicidal liquid soap and hand drying facilities.
- (3) Change rooms and toilets may not have direct access into an area or room where meat is handled.
- (4) Workers must be provided with clothing lockers in which to store private clothes separately from protective clothing, ensuring that private clothes and clean protective work clothes do not make contact.
- (5) Workers must be provided with separate fly proof facilities in which to keep food.

7. Sterilizers

- (1) Sterilizers must be readily accessible and must–
 - (a) be placed on dressing platforms and within three meters of workstations, adjacent to hand wash-basins in rooms and areas where –
 - (i) animals/birds are slaughtered;
 - (ii) carcasses, meat and offal are detained;

- (iii) condemned material is handled; or
 - (iv) meat is otherwise handled;
- (b) be corrosion resistant and capable of sterilizing hand utensils and equipment, such as cutters and saws, at a minimum water temperature of 82°C during slaughter; and
- (c) have an inlet, overflow and outlet and must drain through a down pipe directly into a closed drainage system or into an open channel, but such drainage water may not flow over the floor across areas where traffic occurs.

(2) Any other method of sterilization must be approved by the provincial executive officer.

8. Hand wash-basins

Hand wash-basins must be readily accessible and be –

- (a) placed on dressing platforms and within three meters of workstations in rooms and areas where –
 - (i) animals/birds are slaughtered;
 - (ii) carcasses, meat and offal are detained;
 - (iii) condemned material is handled; or
 - (iv) meat is otherwise handled;
- (b) corrosion resistant;
- (c) provided with taps that are not hand or elbow operated;
- (d) supplied with warm running water at not less than 40 °C;
- (e) provided with an inlet, overflow and outlet and must drain through a down pipe directly into a closed drainage system or into an open channel, but such drainage water may not flow over the floor across areas where traffic occurs; and
- (f) fitted with a dispenser for liquid germicidal soap as well as hand drying facilities, unless the drying of hands is not necessary in the area where the basin is situated.

9. Apron-on wash-cabinets

Apron-on wash-cabinets, required in low and high throughput abattoirs, must be installed near work stations and be constructed so as to contain splashing from personnel washing their aprons while wearing it and must drain directly into a drainage system.

10. Water supply

- (1) Water must be under pressure, and must conform to at least Class II according to the SANS 241 standard for drinking water.
- (2) Water points must be provided with –
 - (a) cold water;
 - (b) water at not less than 40°C and equipped with hose pipes for sanitizing all areas of the abattoir; and
 - (c) hose reels to store hoses away from the floor unless vertical (drop) hoses are provided.

11. Containers for inedible, condemned and refuse material

- (1) Sufficient theft and leak proof containers with tight fitting lids, complying with regulation 14, must be provided to keep and transport condemned material and they must be clearly marked "CONDEMNED".
- (2) Containers must be provided to collect and hold inedible material until disposal.
- (3) Facilities to collect and hold blood prior to disposal must be provided.
- (4) Refuse containers must be provided for the collection of general refuse at various points on the premises.
- (5) Areas where waste or refuse containers are kept prior to removal must be impervious, curbed and drained and the containers must be enclosed or fitted with tight fitting lids.

9. THE USE OF WATER IN THE ABATTOIR

1. Water use and volume waste water

The average water consumption of a high throughput red meat abattoir can be analysed as follows:

1.	Lairage	10%
2.	Slaughter and dressing	20%
3.	Offal processing	25%
4.	Heating water	25%
5.	Creating steam	5%
6.	Cooling	8%
7.	Ablution, laundry, etc.	7%

The estimated average water consumption of a high throughput poultry abattoir can be roughly analysed as follows:

<u>Dirty side:</u>				
	Receiving		}	
	Killing	42%		▶
	Scalding			
	Defeathering			
<u>Clean side:</u>				
	Evisceration		}	
	Chilling	35%		▶
	Portioning			
	Packing			
	Rendering		6%	
	Boilers	8%		
	Ablution, laundry etc..	7%		
	Vacuum pumps for transporting material			

2. Legal aspects regarding the use of water in abattoirs

Three Acts in particular have relevance to the application of water in an abattoir:

- (a) The Meat Safety Act 2000 (Act 40 of 2000) and the Standing Regulations in terms of the Abattoir Hygiene Act 1992 (Act 121 of 1992).

The Act and Regulations prescribe the availability and quality of the water used in abattoirs: Regulations 2 and 6 of Part III of the Standing Regulations prescribe the following:

A water supply of at least 900 litres per slaughter unit in a red meat abattoir and at least 15 litres in a poultry abattoir must be available under pressure and protected against contamination.

The water must be clean, potable and free of suspended material and substances that could put health at risk.

The water must be subjected to flocculation, filtration, chlorination or other treatment to ensure that:

- Total bacterial count: < 100/ ml (30°C/ 48 hours)
- Coliform count: 0/ 100 ml
- Faecal coli: 0/ 100 ml

An adequate supply of hot water at 40 °C – 45 °C and of cold water under pressure must be available during working hours in convenient places.

The water must also meet any other standards and conditions which the Director: Veterinary Services may lay down from time to time.

(b) The Water Act 1956 (Act 54 of 1956), as amended by the Water Amendment Act 1984 (Act 96 of 1984):

This Act and its Amendment regulate the use of water for industrial purposes, and abattoir owners are advised to obtain a copy of this Act and to study it carefully, especially the Amendment.

Bye-laws issued by local authorities

Abattoir owners must familiarise themselves with the bye-laws issued by their local authority.

(c) By-laws issued by local authorities

Abattoir owners must familiarise themselves with the by-laws issued by the relevant local authority.

3. Guidelines for the testing of water

The following guidelines have been laid down by the National Executive Officer in respect of bacteriological and chemical tests on water used in abattoirs.

High throughput

- (a) Bacteriological testing every month.
- (b) Chemical testing every six months.

Low throughput

- (a) Bacteriological testing once a year.
- (b) Chemical testing once a year, except where water comes from a borehole in which case it must be tested twice a year, in the wet and the dry season.

The aim of regular water testing is to ensure that water used in abattoirs complies with the requirements laid down in Regulation 2 of Part III of the Standing Regulations.

MEAT INSPECTORS MANUAL

PART I

ABATTOIR HYGIENE

MODULE 3

PERSONAL HYGIENE

Index

PERSONAL HYGIENE

1. Introduction
2. Health requirements for workers
3. Some practical ways to improve personal hygiene and neatness
4. Protective clothing
5. Personal equipment
6. Cleaning of hand equipment
7. How to sharpen a knife

PERSONAL HYGIENE

1. INTRODUCTION

Personal hygiene and health of food handlers is of the utmost importance when an effort is made to deliver a safe product of high quality to the consumer. Workers should be medically examined before employment in order to determine if they are physically fit to perform the work and also if they do not suffer from transmissible diseases, which can be transmitted through the food they handle to the consumer. They must also undergo daily fitness checks for different signs of illness. Workers must be issued daily with clean clothes in a good condition in order to protect the food from contamination and also to protect the workers against potential dangers. Each worker can contribute to good personal hygiene standards.

2. HEALTH REQUIREMENTS OF WORKERS

2.1 Food Handlers and Food borne Diseases

Meat can transfer pathogenic organisms to the people (or animals) that eat or handle it. These organisms can originate from the slaughtered bird – in other words a sick bird, or one that is a carrier of the organism – or from other sources. These sources include food handlers (people who work with food) at the abattoir, wholesalers or retailers – even the housewife in her kitchen. This discussion focuses on people employed at an abattoir. The principles can however also be applied elsewhere. Where we refer to meat handlers the same can be said of any food handler.

2.2 Legal requirements regarding the health and hygiene of workers

Visitors entering an abattoir

All persons entering an abattoir including management, visitors and maintenance personnel must be issued, by the owner, with clean suitable protective clothing complying to sub regulation 59(1).

Medical records of employees

- (1) Before employment at an abattoir or its cutting plant, medical certification must confirm that a person is –
 - (a) healthy and physically able to work as a meat handler; and
 - (b) not a carrier of, or suffering from, a communicable disease.
- (2) all medical records pertaining to medical examinations and daily fitness checks must be available to the provincial executive officer or the registered inspector.

Health checks

The owner must ensure that all personnel –

- (a) are examined daily, before starting work, for adverse health conditions such as suppurating abscesses, sores, cuts and abrasions which may pose a food safety risk, and persons so affected may not work with edible products unless such conditions are covered with a firmly secured waterproof dressing so that the risk of contamination is excluded; and
- (b) who were ill for three days or longer, present medical certificates to indicate that they are now fit to handle foodstuffs.

Protective clothing

- (1) Protective clothing must be light coloured, clean, in good repair and must include safety hats, hair nets, beard nets, head and shoulder capes, white gumboots and safety boots compliant with hygiene requirements and waterproof aprons as required by the work situation.
- (2) At the start of each working day or shift, the owner must provide personnel with protective clothing.
- (3) The owner must ensure that such clean protective clothing is stored and handled so that it does not make contact with private clothes.
- (4) Private clothes must be kept in a locker that is reserved for that purpose only.
- (5) Protective clothing must be changed or cleaned when it becomes contaminated by obnoxious matter or becomes dirty.
- (6) The workers in the clean and dirty areas must wear distinctive protective clothing, respectively.
- (7) Protective clothing must completely cover all personal clothing.
- (8) Personnel may change into protective clothing only in appropriate change rooms and items of protective clothing left in the abattoir working areas may only be placed or hung in areas designated for these items.
- (9) Personnel may not sit or lie on the ground in their protective clothing during rest periods and may never wear protective clothing outside the premises.
- (10) The abattoir owner must provide laundry facilities or make use of a laundry service and personnel must not be allowed to take protective clothing home to be washed.

Injuries

- (1) All cuts and minor injuries must be covered with a durable waterproof dressing, surgical gloves or rubber finger guards.
- (2) Personnel must immediately report any injury to the owner.

Showering and washing of hands

Personnel who handle foodstuffs must –

- (a) shower before assuming duties; and
- (b) wash hands and forearms with a liquid germicidal soap and running water immediately after they become soiled or after having used a toilet or when entering a working area.

Prohibitions

- (1) Jewellery, including traditional objects, may not be worn in an area where edible products are handled.
- (2) Fingernails must be short, clean and free of nail varnish.
- (3) Eating, drinking or using or handling tobacco are not allowed in any area where meat is handled.

- (4) Drugs, liquor or any intoxicating substance may not be brought into any part of the premises and a drugged or intoxicated person may not be allowed to enter any part of a meat handling plant.
- (5) Personnel must refrain from any actions that could contaminated the product.

Training

All personnel must be trained in hygiene procedures and personal hygiene matters by the owner, and training records must be kept.

2.3 Personnel hygiene

1. General

The daily provision of clean, appropriate protective clothing as well as the necessary infrastructure in respect of cloakroom and toilet facilities, the provision of water, soap, toilet paper, hand wash basins etc. are all basic hygiene requirements. There are however various other regulations which affect the personal hygiene of workers as well as health aspects relating to all staff working with meat and edible products.

Some of these requirements are discussed in full for the sake of completeness, although they may seem obvious to the average person.

- 1.) People who are suffering from a contagious disease or are carriers of an infectious condition, or who have even been in contact with a source of contagion, may not work in any part of the abattoir where edible products are handled. This includes the slaughtering area, rough offal processing areas, storage facilities, cold storage, de-boning areas, offloading areas etc.
- 2.) Workers with suppurating sores on any part of the head, neck, arms or hands may not come into contact with edible products.
- 3.) The owner or his designated representative (hygiene manager) must ensure that the workers referred to above are not employed in areas where edible products are handled.

2.4 Health Of Workers

Personnel who work in abattoirs and meat handling establishments must not be carriers of any disease which can be transmitted via the meat.

Pre-employment medical examination

Persons who come in contact with fresh meat in the course of their work should have a medical examination prior to their employment. The manager must maintain the medical records of employees in such a manner that it is available for inspection. Medical examination of personnel must be conducted at least once a year and must be repeated when clinically or epidemiologically indicated or as prescribed by the controlling authority.

If the pre-employment examination indicates that the person is suffering from tuberculosis, or if there is any suspicion that he is suffering from it or has a history of the symptoms of TB (coughing for longer than three weeks, coughing blood, weight loss, loss of appetite, shortness of breath, pains in the chest, cold sweats and constant tiredness), then such a person must be referred immediately to the nearest tuberculosis clinic, hospital or district surgeon for examination and treatment. Such a person can only be employed as a meat handler on production of a certificate or letter from the tuberculosis clinic, hospital or district surgeon which indicates that, that person is receiving treatment for the condition and is in no danger of transmitting the disease.

Daily fitness checks

Care should be taken to ensure that no person, knowing to be suffering from, or is a carrier of a disease likely to be transmitted through the meat, or while afflicted with infected wounds, skin infections, sores or with diarrhea, is permitted to work or be present in any meat handling area of an abattoir or establishment in any capacity in which there is any likelihood of such a person directly or indirectly contaminating meat with pathogenic micro-organisms. Any person so affected should immediately report that illness to the manager. Such a person should then be withdrawn from his/her task as a meat handler and utilised at a position, which cannot result in contamination of the product.

All high throughput abattoirs should provide some kind of medical service (doctor, sister etc) or at least have access to such.

Export abattoirs may be forced by the importing country to comply with stricter health requirements.

The costs of any examination or test must be borne by the employer of the person concerned. Where an infectious or contagious disease has been confirmed or suspected, the Department of Health must be contacted for further action or treatment, which may be undertaken at government expense.

Apart from medical services and ongoing health control, the abattoir management must ensure that all illnesses and disease conditions are reported to higher authority (superintendent, manager etc.).

The employer must provide meat handlers with the necessary information and training in personal hygiene, and must carry out daily observations of their conditions of health. The meat handler must present himself for examination or testing if he has any suspicion that he may be unfit to handle meat.

3. SOME PRACTICAL WAYS TO IMPROVE PERSONAL HYGIENE AND NEATNESS

- Keep fingernails short and clean.
- Cover long hair with a hair net.
- Wash hands and arms thoroughly and frequently with an anti-bacterial liquid soap and warm water. The importance of clean hands and arms cannot be over emphasised.
- Do not wipe hands clean with linen roller towels, paper towels or rags.
- Wash hands immediately after using a toilet.
- Wash hands and arms immediately after contact with diseased meat, offal, blood or dirt and change contaminated clothing.
- Do not pick your nose.
- Never spit cough or sneeze near meat – always use a clean (disposable) handkerchief, which must be deposited in a refuse bin after use. Do not sneeze into your hands.
- Report any case of illness or injury immediately.
- Do not smoke, take snuff or eat and drink in any area where meat and meat products are handled.

- Use showers daily before and after work.
- Work with either meat or livestock, not both at the same time.
- Don't be a "litter bug" use the refuse bin.
- Work only in the dirty or clean areas and do not move to and fro.
- Maintain your protective clothing as clean as you can; do not sit on grass, ground, dirty walls etc.
- Cover cuts and abrasions with waterproof dressings and protective gloves or finger guards if only finger is cut.

4. PROTECTIVE CLOTHING

1. All protective clothing must be light in colour. This does not necessarily apply to workers in lairages/receiving areas and dirty areas.
2. Protective clothing comprises of the following:
 - Head covering – (hard hat – to comply with the terms of the Factory Act)
 - Long hair – (longer than the overall's collar) must be covered by a hairnet.
 - Washable, strong and waterproof head and neck covers for workers dispatching meat.
 - Aprons – made of strong durable impervious material and may not be removed from the room in which they are utilised, and must be washed and hung on hooks during breaks.
 - Gumboots – White gumboots are required. They stain easily and therefore must be washed frequently at the boot washing facilities, which are compulsory at the entrances to the slaughter floor where meat is handled or processed. Gumboots must be cleaned before removal and stored in the change room. Care must be taken not to damage the outer shiny surface of the boots by using coarse scouring agents. Black gumboots may be worn in dirty areas
 - Clean one or two piece overalls – Regulations stipulate that the abattoir owner will issue a clean protective overall to every worker at the start of every working day. The overall must cover all private clothing.
3. When protective clothing become contaminated with pus, bile, milk, faeces, urine etc. it must be changed immediately.
4. No private clothing may hang out under the protective clothing.
5. In cases where long-sleeved overalls can become wet, plastic forearm sleeves can be worn to keep the sleeves dry. Short sleeve overalls are preferred.
6. At larger abattoirs clean/dirty area separation must be strictly adhered to. Different coloured overalls are worn to identify the workers in the different areas, e.g. red or blue in dirty areas white in clean areas.
7. In certain situations it may be necessary for workers to make use of impervious plastic overalls (yellow rain-suits).
8. Maintenance personnel, visitors and management must also wear protective clothing while slaughtering is in process.

5. PERSONAL EQUIPMENT

- Knives
- Scabbard with chain
- Sharpening steel
- Meat-hook
- Stainless steel safety glove
- Ear protectors

Knives

Some abattoirs may issue personal knives to relevant workers. Depending however what type of abattoir and the specific arrangements at abattoirs, a valet system for the sterilizing of knives may exist. In this case the knife, scabbard, sharpening steel, hook etc. may not be a personal issue but will be issued on a daily basis by the management.

- Throat cutting or bleeding knife for cattle, sheep and horses, chickens, ostridges game or crocodiles
- Sticking/bleeding knife for pigs
- Skinning knife
- Dressing or evisceration knife
- Meat Inspection knife
- De-boning knife

Workers doing skinning and evisceration as well as meat inspection personnel must be issued with two knives to be used alternatively.

- Use one while the other is sterilised
- Dirty knives must be thoroughly washed and even scrubbed before sterilisation especially the handle and where the blade and handle meet.
- Only clean knives can be sterilised

Knife scabbards

This should only be used if workers do not stand at a particular spot (working station). In other word if they move around.

NB Must only be used for clean sterilised knives
The use of scabbards is generally discouraged.

Sharpening steel

Must be cleansed regularly by rinsing it off under running water and preferably not placed in a sterilizer. In cases where workers remain at a workstation the steel can be placed in a metal ring provided.

Meat hook

The meat hook is a hook provided with a handle for meat inspection purposes or used by workers pulling carcasses on the dressing line in case of red meat.

Stainless steel safety glove (Stainless steel mesh)

A stainless steel safety glove is required by the Factory Act, where workers operate dangerous equipment.

6. CLEANING OF HAND EQUIPMENT

Protein coagulates when it gets into contact with sterilizer water at 82°C and then it is very difficult to get rid of it. For this reason it is important that any equipment be rinsed before it is emerged into the hot water. Sometimes it might be difficult to get rid of fat that accumulated on the knife and the only way to get it off will be to rinse it under hot water at 45° C where after the procedure for washing and sterilising must be followed.

The cleaning of hand equipment can be divided into cleaning at the end of the day and continuous cleaning.

Continuous cleaning occurs during the day while working on the process line. All hand equipment must be rinsed, washed and sterilised after each carcass in the case of red meat and as often as possible in the case of poultry or if it gets contaminated. Once the equipment is rinsed it needs to be sterilised in water at 82°C. It is important to remember that sterilising can only be effective if the equipment gets emerged for at least 2 min. at a time. Remember that clean equipment only stays clean as long as it does not come into contact with dirty surfaces – so it needs to be put down on clean surfaces or rather start using the equipment immediately before it accidentally gets re-contaminated.

Cleaning at the end of the day often does not get the attention it deserves. Not only should knives and steels, aprons, hard hats, steel gloves and boots be scrubbed with a good disinfectant and a good brush but scabbards (where equipment are stored in) must be cleaned very thoroughly in order to prevent re-contamination of equipment. When cleaning knives it is important to think of safety and be careful not to cut one self. Handles of knives tend to trap fat and pieces of meat at the part where the handle and the blade meets. Therefore it is important to scrub at this point until all visible material has been removed.

Aprons must never be hung on hooks without cleaning them first.

Personnel must be motivated to keep their personal lockers in a clean and hygienic condition in order to keep out cockroaches and flies. Hand equipment must not be stored in the same locker where private clothes are kept.

Bacteriological samples (usually taken by means of the agar sausage or other direct contact method) must regularly be taken of personal equipment in order to ascertain the hygiene status of this equipment.

7. HOW TO SHARPEN A KNIFE

Grindstone or whetstone

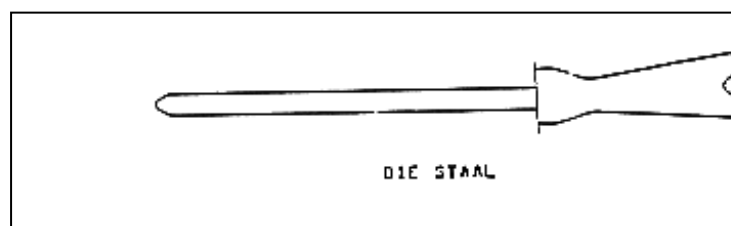
The first step to sharpen a knife is to use an oil grindstone or whetstone. The grindstone usually has a rough and smooth side. If the knife is very blunt then the rough side will be used to sharpen the knife and thereafter the smooth side. The reason for this is that the rough side sharpens a knife quicker and that the smooth side is basically used to finalise the sharpness. The knife can be sharpened flatly or at an angle (depending on the functions for which it is required). If the knife is sharpened flatly, cutting bone in meat can be done more effectively without the knife becoming blunt rapidly and/or the cutting edge being damaged.

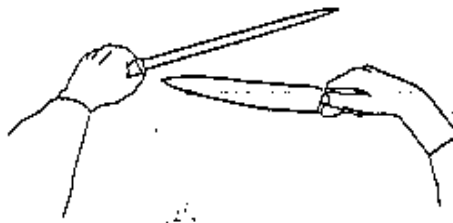
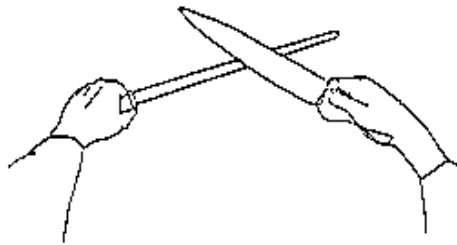
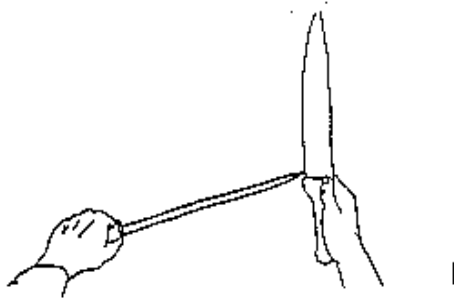
Knife sharpening steel

It can be described as an elongated, magnetic, round file with a handle. The objective with the steel is to keep the knife sharp during the course of the day's activities.

In order to use the steel correctly, hold the steel in your left hand and the knife in your right hand (the opposite is applicable with left-handed people). Now move the sharp side of the blade on both sides of the steel in turn so that the back of the knife is sharpened to the front point with an easy arm action. The movement can be as with the grindstone, a flat action or with a slight angle, depending on the bevel required. Always make sure that the knife makes reasonably soft contact with the steel and never chop the knife against the steel

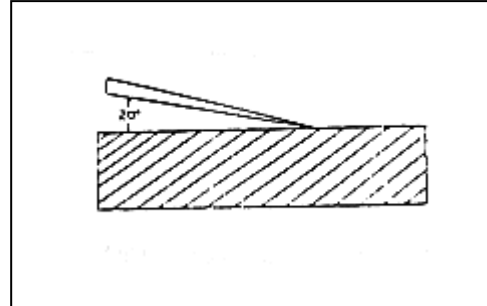
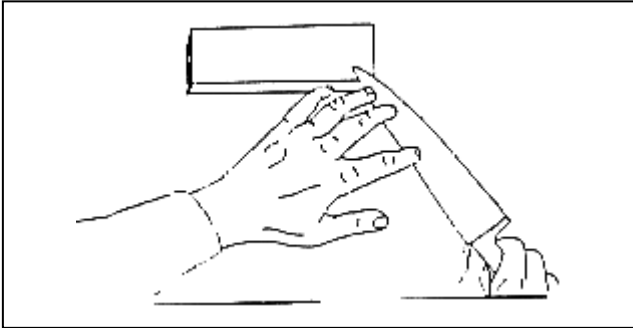
The steel



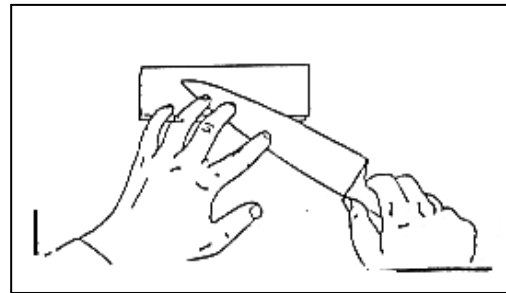
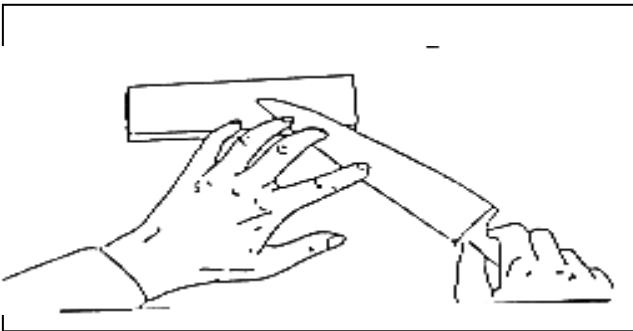


Grindstone or Whetstone

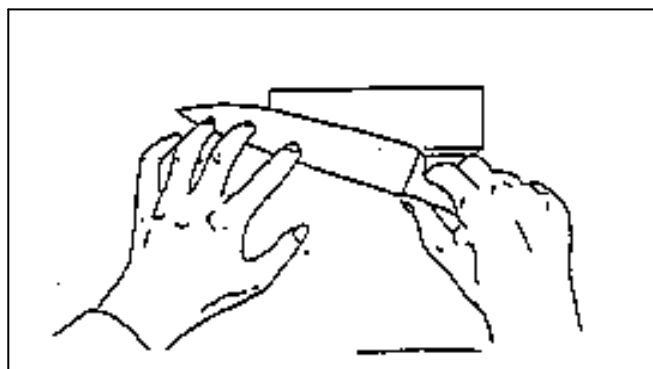
Start by pressing down the knife lightly onto the whetstone and moving it over the surface of the stone. Keep the movement smooth and use even strokes



Start by pressing down the knife lightly onto the whetstone and moving it over the surface of the stone. Keep the movement smooth and use even strokes.



Sharpen the whole blade from the point to the heel as indicated on the sketch.



The following guidelines should be taken into consideration when a whetstone is used:

1. Keep the blade at a 20° angle with the whetstone.
2. Use light, evenly strokes with the same amount of strokes on both sides.
3. Sharpen in one direction.
4. Do not over sharpen the knife.
5. End the process with a few strokes against the steel and wipe clean.
6. Wash and sterilise knife and steel before use.

MEAT INSPECTORS MANUAL

PART I ABATTOIR HYGIENE

MODULE 4

HANDLING OF WASTE & CONDEMNED MATERIAL

Index**HANDLING OF WASTE & CONDEMNED MATERIAL**

1. INTRODUCTION
2. LEGAL ASPECTS REGARDING CONDEMNED MATERIAL
3. METHOD OF PREPARING ANIMAL FEED
4. RENDERING
5. COLLECTION OF RENDERING BLOOD
6. CONDEMNED MEAT APPROVED FOR ANIMAL FEED
7. MANURE, PAUCH & VICERA CONTENT
8. FLOW DIAGRAM OF STERILISATION PLANT
9. DISPOSAL OF ABATTOIR EFFLUENT

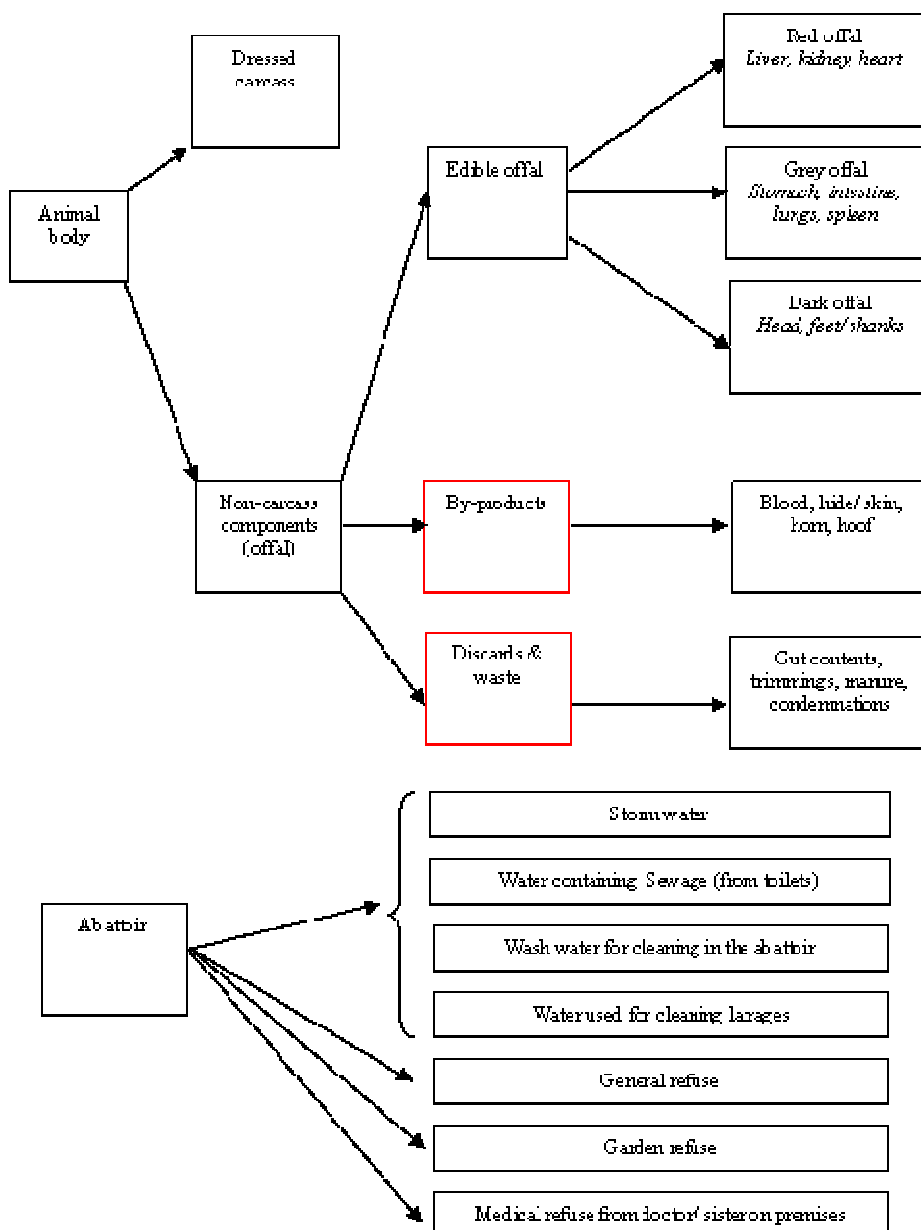
1. INTRODUCTION

An ever-growing problem, especially in the case of smaller abattoirs, which are upgrading and handling greater volumes, is the increasing volumes of condemned products, not to mention paunch dung and other offal products.

Although this section has been compiled from the point of the "Meat Safety Act" (Act 40 Of 2000) it must be realised that the handling of any condemned material is regulated under "The Environmental Management act" and before any attempt is made to handle this material it should be clarified with the relevant authorities which are custodians of this act.

Schematic diagram indicating the different categories of waste and by-products derived at abattoirs:

(Much of the information in this section was obtained from the document "Waste Management for the Abattoir Industry RMAA Feb 2006")



2. LEGAL ASPECTS REGARDING CONDEMNED MATERIAL

1. *Handling of condemned material*

- (1) Carcasses, portions thereof or any edible products in an abattoir, which cannot be passed for human or animal consumption, must be –
 - (a) portioned and placed in a theft proof container which has been clearly marked "CONDEMNED", in letters not less than 10 cm high, or conspicuously marked with a stamp bearing the word "CONDEMNED", using green ink;
 - (b) kept in a holding area or a room or dedicated chiller provided for the purpose, except if removed on a continuous basis; and
 - (c) removed from the abattoir at the end of the working day or be secured in a dedicated chiller or freezer at an air temperature of not more than minus 2 °C.
- (2) No person may remove a carcass, part thereof or any edible product which has been detained or condemned from an abattoir, except with the permission of a registered inspector who is a veterinarian and subject to such conditions as he or she may impose.
- (3) The abattoir owner is responsible for complying with the legal requirements or conditions relating to the safeguarding and disposal of any carcass, part thereof or any edible product which cannot be passed for human or animal consumption.

2. *Disposal of condemned material*

Any condemned material must be disposed of by –

- (a) Total incineration;
- (b) Denaturing and burial of condemned material at a secure site, approved by the provincial executive officer and local government, by –
 - (i) Slashing and then spraying with, or immersion in, an obnoxious colorant approved for the purpose; and
 - (ii) Burial (After the site has been approved by Department of Environmental Affairs) and immediate covering to a depth of at least 60 cm and not less than 100 m from the abattoir, providing such material may not deleteriously affect the hygiene of the abattoir; or
- (c) Processing at a registered sterilizing plant.
- (d) With special approval from the Provincial Executive Officer of Veterinary Services certain of the condemned material can be made available for carnivorous animals, crocodiles and for vulture restaurants.

3. *Requirements for sterilizing plants*

(See regulations pertaining to the structural requirements of Sterilizing plants)

- (1) A sterilizing plant must comply with the general requirements for premises, structures and equipment set out in regulations 8 to 18, which apply with the necessary changes.
- (2) The premises of a sterilizing plant must be fenced and secured so as to prevent the entry of unauthorized persons, vehicles and animals, and must include-
 - (a) unclean areas, comprising the rooms in which material is received, stored or prepared for sterilizing as well as the entrance to the sterilizing apparatus; and

- (b) clean areas, comprising the rooms in which the sterilized material is dried, milled or otherwise prepared, packed, stored or dispatched.
- (3) A solid wall must separate the unclean and clean areas, and there may be no direct contact between these areas.

4. Unclean area

- (1) Material of animal origin may only be received in the unclean area of a sterilizing plant and no such material may be removed from this area otherwise than through the operations of the sterilizing equipment.
- (2) Foot-baths with disinfectants must be provided at all exits, as well as a wheel bath for vehicles at the unclean receiving area.
- (3) The floors, walls and equipment of the unclean area of a sterilizing plant must be sanitized daily after the cessation of operations.
- (4) Workers employed in the unclean area must –
 - (a) wear distinctively marked overalls and rubber boots;
 - (b) wash their hands and disinfect their boots before leaving the unclean area; and
 - (c) change from their soiled protective clothing and footwear and clean themselves with soap and water before leaving the premises.
- (5) A person who has entered the unclean area may not enter the clean area or any area where any edible products are handled in the abattoir unless he or she has cleaned and changed as contemplated in sub regulation (4)(c).

5. Product

- (1) A person may not sell the products of a sterilizing plant unless they conform with the specifications set by the Registrar in terms of the Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947).
- (2) Any material produced by processing or treatment under the provisions of this Part and intended for animal consumption or as a fertilizer must be subjected to such examination and tests as the said Registrar may specify.

6. Vehicles for condemned material

- (1) A vehicle used for the transport of condemned material may not be used for any other purpose, but after cleaning and disinfection the vehicle may be used for the transport of inedible material.
- (2) A vehicle may only be used for the transport of condemned material if the –
 - (a) load space is lockable, theft proof and sealable;
 - (b) internal surface is leak proof and constructed of durable material; and
 - (c) floor is provided at its lowest point with a drain pipe capable of being securely closed by a screw valve.

- (3) The load space of a vehicle used for transporting material to a sterilizing plant must be cleaned and disinfected to the satisfaction of a registered inspector at the end of each delivery, at a place specially constructed for the purpose.

7. Specimens

- (1) The registered inspector may authorise, in writing, the removal of specimens of condemned material and animal parasites from an abattoir for research and teaching purposes, and must state in the authorisation –
- (a) the name of the organisation or individual conducting the research, or making the collection;
 - (b) the name of the abattoir of origin;
 - (c) the kind and amount of material removed;
 - (d) the purpose of collection; and
 - (e) how the material must be disposed of after the intended use, where applicable.
- (2) The approval of the owner of the plant is required for the arrangements for the collection of specimens.

3. Methods of preparing animal

1. Condemned Meat Product Approved for Animal Food

Operators may harvest or salvage certain condemned meat products for animal food with the consent of an official veterinarian. These products may be intended for fish, pets, zoo animals and fur animals. Condemned meat products may be used for animal food provided:

- (a) They are derived from carcasses, portions or organs that are not affected with a disease transmittable to the abovementioned animals.
- (b) They are derived from carcasses, portions or organs that are not affected with a disease that is a potential cause of zoonoses for handlers of this material;
- (c) They are derived from carcasses, portions or organs where lesions or conditions mentioned above are removed.

Operators wishing to engage in the harvesting or salvaging of meat products for animal food must provide adequate facilities for the separation, chilling, packing, marking, storage and, if needed, denaturing of the product. An approved protocol must be provided which guarantees for the secure handling of such products.

High-risk material must be heated to a core temperature of at least 133 °C for 20 minutes at a pressure of 3 bar. The particle size of the raw material prior to processing must be reduced to at least 50 mm by means of a pre-breaker or grinder. Recording thermographs must be provided at the critical points of the heating process to monitor the heat treatment. Other systems of heat treatment may be used provided that they are approved for microbiological safety. Installations and equipment must be kept in a good state of repair and measuring equipment must be calibrated at regular intervals. The finished products must be handled and stored at the processing plant in such a way as to preclude re-contamination.

The animal feed must be free from pathogenic organisms including *Bacillus anthracis* and gas gangrene (*clostridium*) bacteria, and must not contain putrefactive or other organisms which might affect the health of animals, and all such animal feed must show no signs of decay.

Animal feed must be sold in containers, which are clean and undamaged, and which have been sealed in a way permitted by the nature of the feed and of the containers.

4. Rendering Technology

Rendering of raw animal waste involves a series of drying and separating processes by which the material is sterilised and the fats and proteins are extracted to produce tallow and meat-and-bone meal. At the start of the process, the waste material has a water content of up to 70%; its removal involves relatively high-energy costs. The water effluent produced also needs to be treated to avoid pollution. The organic nature of the material creates further problems of odour pollution, requiring additional pollution abatement technology.

Technical Alternatives to Rendering

Only small amounts of animal waste are currently disposed of to landfill because only a few sites are licensed to take it and because abattoir waste is legally required to be adequately sterilised before disposal to landfill.

Incineration appears to be more suitable for dealing with whole carcasses than for waste offal, which has high water content and a low calorific value. The costs of incineration are also relatively high.

Anaerobic digestion is a process whereby organic material such as animal waste is broken down or degraded by micro-organisms operating in an oxygen-free environment. The capital and other costs of anaerobic digestion are more uncertain than for other forms of waste treatment and disposal and the technology is still in the process of development. Developments in this area show considerable promise as both a low-cost and low-pollution means of dealing with raw animal and other waste, although these newer technologies have yet to be fully tested and commercially proven.

The Markets for End Products

The principal end products from the rendering process are tallow and meat-and-bone meal.

Tallow is widely used in the manufacture of soap where coconut oil is a close substitute and in oleo chemicals where, in contrast, there is no very suitable substitute for it. Meat-and bone meal is sold as a protein source to animal feed manufacturers. The principal source of protein used, however, is Soya bean meal and cereals provide the main ingredient of animal feed.

5. Collection and rendering of blood

After stunning, animals are bled. Facilities for the collection and storage of blood in closed containers prior to removal and disposal must be provided. An emergency entrance should be available to the slaughter area for livestock who is for example unable to walk. A paved and drained area will have to be provided in front of the entrance for the bleeding of these animals.

The minimum time allowed for bleeding and the amount of blood per species is:

Cattle:	6 minutes	13–15 litres blood
Calf:	5 minutes	2–7 litres blood
Sheep:	5 minutes	1,3–2 litres blood
Pig:	6 minutes	2–4 litres blood

Blood is rich in nutrients, especially protein, but being liquid, it readily collects dirt once it leaves the animal body. Dirt starts putrefaction which lowers the blood's usefulness, and if drained outside on the slaughterhouse grounds sanitation problems arise by virtue of its clotting property. Other nuisances created by clotted blood are stench, filth, attraction of rodents and the breeding of flies. It is of utmost importance that when blood is collected that it be handled in a hygienic manner and processed with minimum delay. The regulation of certain local authorities effectively prohibits the disposal of blood in the drainage system, which is still a common practice in smaller abattoirs in South Africa. If blood is disposed of in the drainage system it overloads the purification works, while unpleasant odours emanate from septic tanks into which it is drained. Abattoirs normally pay municipal levies if blood is disposed in this manner. Larger abattoirs in particular experience problems with the burying of blood.

The following different disposal methods are used:

- Municipal drainage
- Oxidation dams
- Buried
- Run off or spraying onto fields
- By products

Small-Scale Processing of blood

Where only a few animals are slaughtered per day, small-scale low-technology processing can be undertaken rather than to spill the blood to waste and create sanitation problems. Thus from say 10 cows and 3 sheep, approximately 64 kg of fresh blood can be obtained which can yield at least 12 kg of dried blood. To process this, the blood is cooked in a tank to coagulate it and is drained of liquids that collect on top after cooling. The coagulum is then broken up and spread on a tarpaulin or plastic sheeting for drying. Alternatively, the coagulated mass can be placed in a simple solar dryer for drying.

Wet Rendering of blood

In plants that have steam-rendering tanks, the fresh blood can be mixed with selected non-carcass components and wet-rendered. In this instance, the blood should substitute for water in the tank. An advantage here is that the protein content of the offal meal will be raised quantitatively with the addition of blood, although some amino acids may be damaged by the strong action of the heat while others may leach into the cooking water.

Commercial Drying of blood

A more productive approach is to process the blood under relatively reduced temperature conditions using a commercial blood drier. In principle, the blood-drier is a dry-rendering tank disposed horizontally and invested with a steam-jacket. Special devices are provided within the tank to prevent blood from coating on the interior walls and reducing drying efficiency. Blood is introduced into the tank as a coagulated mass, previously obtained by steam action. As much liquid as possible should be squeezed from the coagulum. Heating is initiated at 82 °C and progressively raised to 940°C for about three hours, and finally elevated to 100 °C for 7 hours. Drying is complete when the final moisture level in the dried product is about 12%. During drying, moisture is removed rapidly and constantly from the tank by means of condensers to which the tank is connected. Complete moisture removal is not desirable otherwise the final product would darken or char, while above the 12% level the residual moisture can cause deterioration and loss of nutrients. The protein content of the finished product is about 80%.

6. Manure, paunch and viscera contents

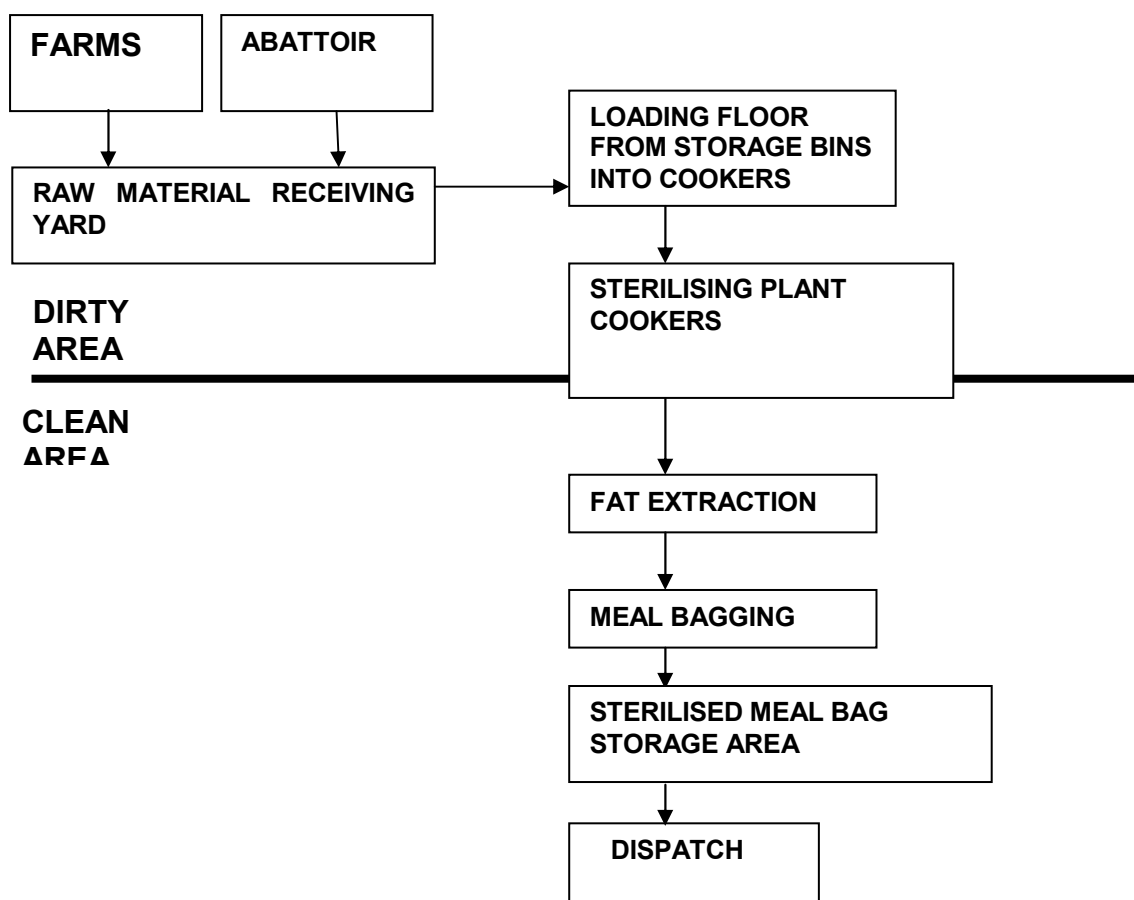
These must be disposed of in a manner which will not create a sanitary problem on the premises of the registered slaughter establishment. Storage of such wastes in the vicinity of the registered establishment is unacceptable.

Manure, Compost and Biogas

Digestive and excretory wastes of ruminants, collectively referred to as manure are a mixture of dung and urine and occur in two forms:

- (1) as sweepings from lairages which are built into heaps outside the slaughter building and occasionally collected in small quantities by small-scale farmers to enrich soil fertility.
- (2) And secondly as kraal manure which may remain permanent on the holding ground. Kraal manure is less preferred because it is often sodden with water (from rains) or mixed with earth from treading by the animals as well as straw from bedding, thus creating problems in collection and spreading on farms.

8. FLOW DIAGRAM OF STERILISATION PLANT



9. DISPOSAL OF ABATTOIR EFFLUENT

The volume of waste water from abattoirs is 80 – 85% of the water intake. This waste water typically contains the following contaminated waste material: blood, bits of meat, fat, paunch contents, urine and dung. Each of these waste materials contributes to a high organic load as well as a considerable amount of suspended material in the waste water.

The management and treatment of waste water is a specialised subject and professional advice from consulting engineers is essential.

Most abattoirs including large ones make use of municipal sewerage systems. Where these facilities are not available alternative arrangements must be made in consultation with officers of the Department of Water Affairs. Care must in all cases be taken to avoid contamination of natural streams and water sources.

Removal of as much of the solid waste in the effluent is essential in making further processing of effluent more manageable. Excessive amounts of solids in effluent may lead to exorbitant levies by municipalities or the overloading of systems on the abattoir premises.

In a system where solids are removed effectively, the remaining fluid may be disposed of in a percolation system (French drain) or used to irrigate lands.

It is important that sewerage from toilets are not mixed with abattoir effluent but is channelled to a septic tank system associated with a French Drain.

1. Septic tank systems

Based on a CSIR technical guide K86 of the Institute for Water Research

A septic tank system usually consists of two main components:

the septic tank
the final disposal system, that is usually an underground seepage furrow.

Each of these components has specific functions and should be designed accordingly

1.1 The functions of the components

Raw sewerage will clog the soil, causing ineffective absorption by the sub-soil. The septic tank, however, will condition the incoming sewerage, separating the solids from the liquid phase by either setting to the bottom or collecting at the surface (float). This results in the formation of three distinct layers :

Layer of sludge on the bottom,
A floating layer of scum on top and
A relatively clear liquid layer in the middle.

Bacterial digestion of organic material will cause liquefaction of the solids with associated gas formation – thus reducing the solids volume.

The only function of a soil disposal system is to get rid of the effluent from the septic tank in a safe and inoffensive manner.

1.2 Designing requirements

(a) Septic tank

The tank must function both as a sedimentation tank as well as a digester.
The capacity of the tank should be large enough to provide ample retention time for in-flowing sewerage.
Possible clogging of the in- and outlet and internal pipes must be limited to a minimum.
Provision should be made for ventilation for gasses to escape.
The possibility of passage of sludge and scum to the soil percolation system must be avoided as far as possible.

(b) Sub-soil percolation system

- (a) The nature of the soil to a large extent determines the shape and size of the system.
- (b) Locations should be such that it does not create a danger for public health or pollute either ground- or surface water.
- (c) The clogging effect of the effluent on the surface soil must be avoided
- (d) Facilitate full use of the available infiltration area.

1.3 Public Health aspects of septic tank systems

In built up areas, this system should be seen as a temporary measure. There is practically no difference between the effluent from a septic tank and raw sewerage as far as potential danger for public health is concerned. Organisms causing disease can be present in the effluent of the septic tanks. In communities where drinking water is derived from boreholes, it is usually unwise to make use of a septic tanks system.

1.4 Combined and separate disposal systems

Two types of disposal systems are in use:

1. A separate system for the ablution facilities (cloakrooms, toilets and kitchens) utilising a septic tank and a separate or common soil percolation system

2. A second system for the abattoir effluent incorporating the necessary solids/fat traps and sedimentation tanks to remove solids (pieces of meat and fat). Effluent from this system can be discharged in a separate of the same common soil percolation system

a. Designing criteria

Holding pens	10%
Slaughter and dress	20%
Offal area	25%
Warm water	25%
Steam	5%
Chilling	8%
Ablution	7%

b. Volume sewerage water

Abattoirs require a water supply of at least 900 litre per slaughter unit. The water must be available at an effective pressure and be protected against pollution

Average water consumption at a high throughput abattoir can be subdivided into:

The volume of effluent in approximately 80 – 85% of water required.

Typical abattoir effluent contains blood, pieces of meat, fat and gut. Constant urine and dung in suspension. Each of these contributes to a very high organic load.

2. Septic tanks

(a) Location:

Local authorities usually have by-laws determining the minimum distances for the placing of septic tanks from buildings and boundaries. It is recommended that the tank be located near to a driveway to facilitate cleansing by means of a vacuum tanker. From a health point of view it is sufficient to have a soil cover of 150 to 200 mm over the system.

(b) Capacity:

Calculation of capacity is based on usage per person per day with a retention period of 24 hours in the septic tank to provide for separation of scum and sludge thus providing for a relatively clear effluent.

Shape proportions and structure:

The shape of a given capacity and depth of tanks, is relatively unimportant. The liquid depth should be between 1 and 2 meters. Single compartment tanks usually give acceptable performance but if a tank is divided vertically into two compartments with the first compartment half to two thirds of the total volume, the amount of suspended solids removed from the effluent is greater

Inlet, outlet and inter-compartment arrangements:

The illustration indicates the positioning of the above in terms of the water level. To accommodate the scum accumulation, the distance between the waterline and the roof of the tank should at least 20 percent of the water depth.

Access and ventilation:

The different compartments/components should be accessible for inspection and maintenance. The location of man holes should be as such that admission is easily obtained to pipes that could block. Ventilation is usually through the inlet sewer to the vent pipe against the wall of the building.

(e) Inlet, outlet and arrangements between compartments:

Figure 1 shows the above in terms of the water level. The distance between the water level and the roof of the tank must be at least 20% of the water depth to accommodate the scum.

Materials:

Septic tanks should be constructed of materials such as concrete, bricks, coated steel or any other materials which are not subject to excessive corrosion.

3. Design and construction of soil percolation system

Location :

Percolation trenches should be located where dangerous pollution of ground water is least likely to occur.

Suitability of the soil :

There is no simple test to accurately determine if soil is suitable to absorb the effluent. The standard SABS-test gives an indication and can be used as a guide-line.

The relative proportion of sand, silt and clay determine the texture of the soil and influences the absorbing ability. The larger and more uniform the particles, the faster the percolation rate. Yellow and reddish-brown soils usually have good absorption quality, whereas a dull-grey (high clay content) has not.

Trench design:

The bulk of the effluent enters the soil through the side walls of the trench. Deep narrow trenches are therefore preferable to wide shallow trenches. A permeable layer, covered with impervious strata will require a deep trench, while the permeable topsoil, with permeable sub-soil will call for shallow trenches.

Trench construction:

Trenches should be constructed along the contours. Where two more trenches are adjacent to each other the distance in between should be twice the depth. After excavation the sides of the trenches should be roughened to restore the natural surface. Filling material should be clean and free of dust or silt. The size of the filling material is not critical and can be from 6 mm to 75 mm or more. It is advisable to have a layer of fine gravel or coarse sand against the infiltration surfaces. The trench should be filled with gravel to about 100 to 150 mm from the top. Prior to back-filling, a layer of finer gravel should be placed on top to prevent soil from entering the trench.

If the length of the trench is in excess of 6 m it will become necessary to provide an open jointed distribution pipe.

The trench should be approximately 4 m in length for every 1000 litres given average absorption of the soil.

(e) Maintenance

Septic tanks require effective maintenance. When scum and sludge gets discharged into the percolation trenches, the septic tank should be emptied and the silt and foam should be removed. If this is not done, the seepage system can be damaged permanently. When a ground seepage system starts clogging, there is little to be done, but proper usage of the septic tank can extend the life time of the furrows considerably

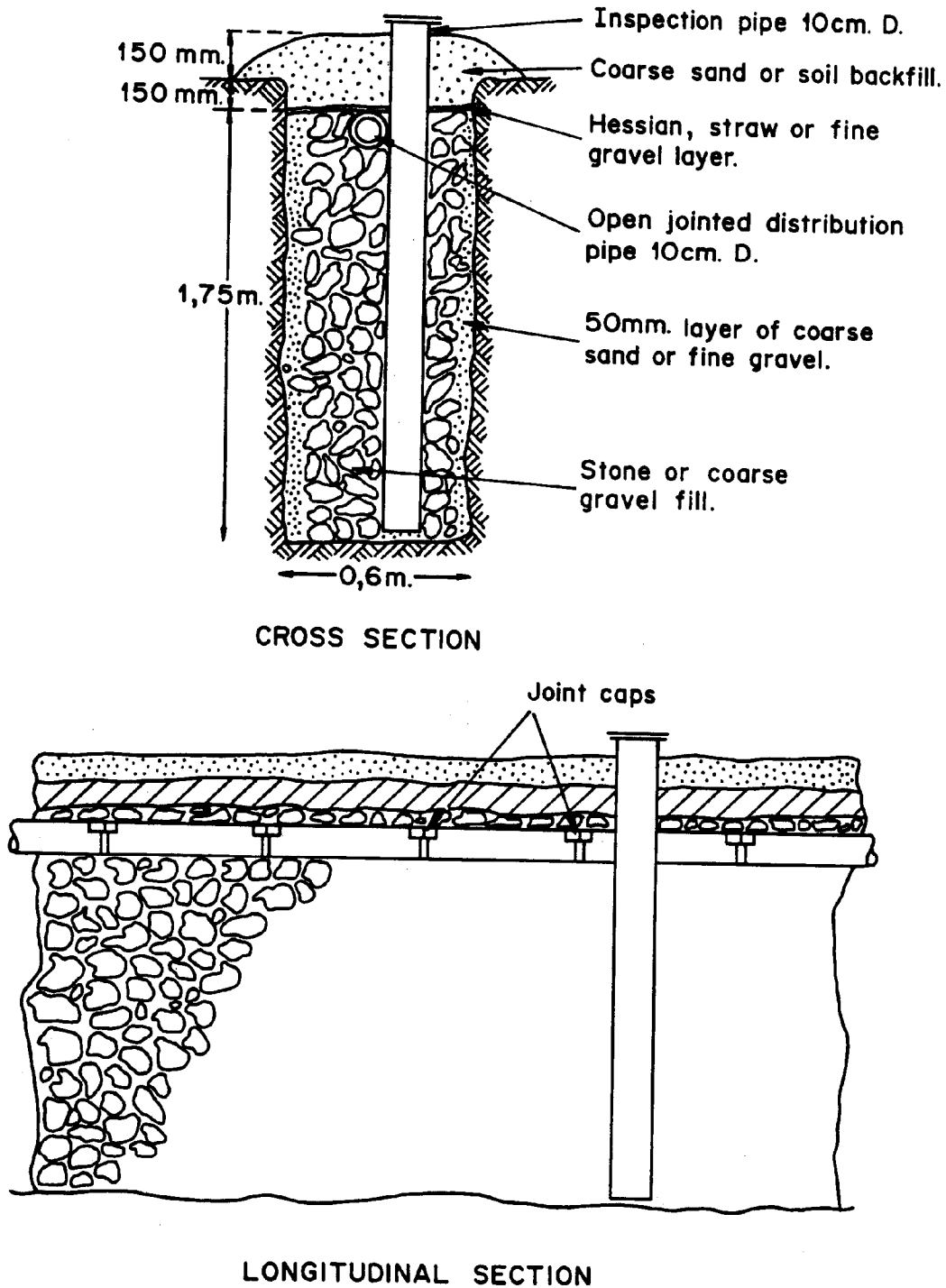


Fig. 8 Details of trench construction.

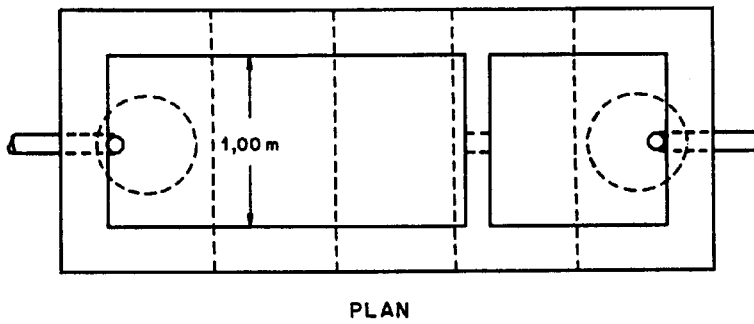
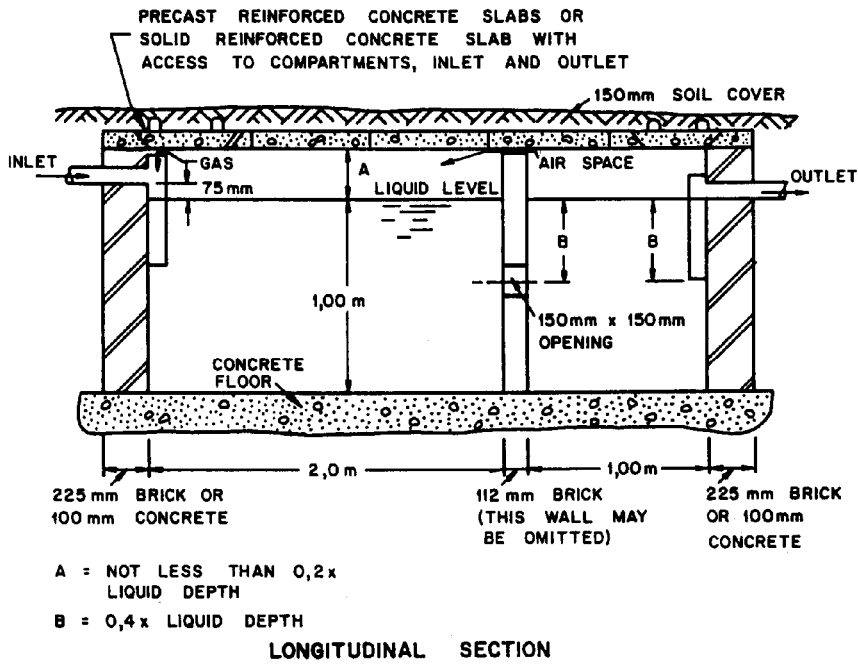


Fig. 5. Typical septic tank of 3 000 ℓ capacity.

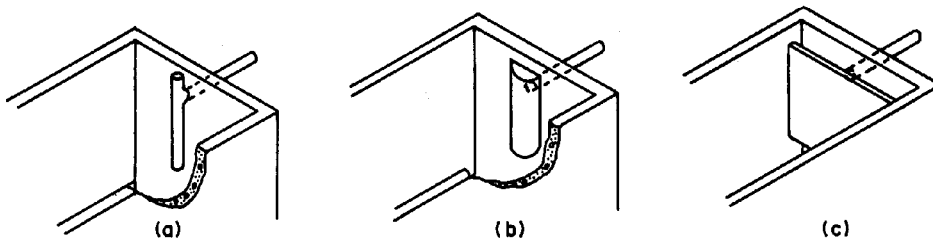


Fig. 6. Inlet and outlet arrangements.

MEAT INSPECTORS MANUAL

PART I ABATTOIR HYGIENE

MODULE 5

PEST CONTROL

INDEX

Pest Control

1. INTRODUCTION
 - a) Preventing of pests through design
 - b) Preventing pest entry to the food facility
 - c) Preventing pests through good sanitation
 - d) Preventing pests through good housekeeping
 - e) Storage practice
 - f) Thresholds
 - g) Self assessment or auditing programs
2. HOUSEHOLD PETS AND DOMESTIC ANIMALS
3. BIRDS
 - a. Bird management procedures
4. RODENTS
 - a. Recognizing rat and mouse signs
 - b. Rodent management procedures
5. INSECT AND RELATED ARTHOPODS
 - a. Cockroaches
 - b. Stored product pests
 - c. Domestic flies
 - d. Occasional pests
6. SUMMARY

1. INTRODUCTION TO AN INTEGRATED PEST MANAGEMENT (IPM) PROGRAM

In an IPM program the causes of pest infestation in and around the facility are removed cost effectively and control is exercised if infestation occurs. These pests mainly include rodents, flying and crawling insects and birds.

An IPM program will include measures to:

- Eliminate breeding places and natural habitats
- Restrict access to the processing areas
- Deny pests access to food, water and harborage
- Monitor all areas of the plant regularly
- Identify the pest accurately
- Assess the best options to control the pest including procedures to eliminate those pests which eventually find their way into restricted locations.

Lasting success can be accomplished only when the reasons for the infestation are controlled

a. Prevention of pests through design

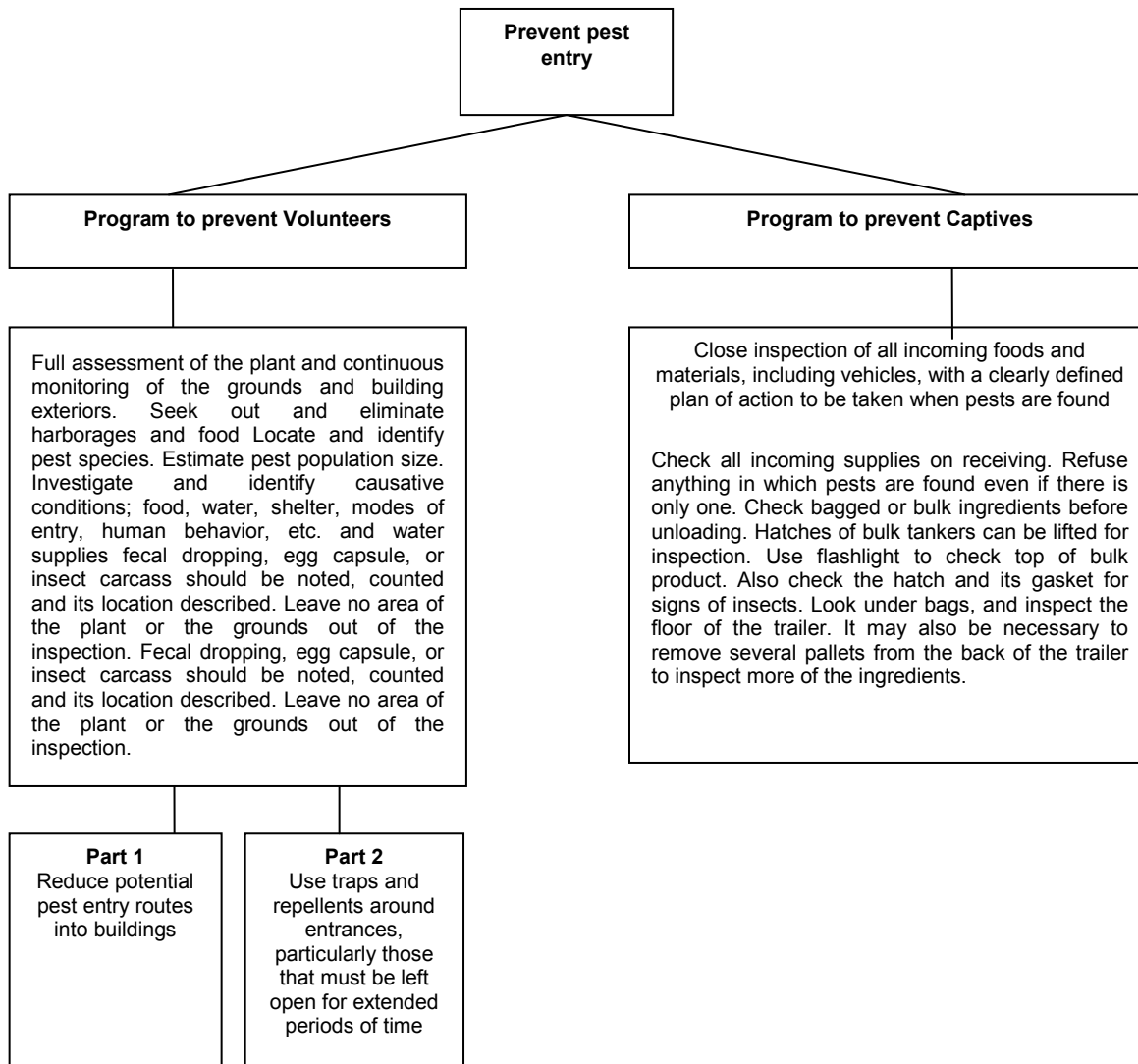
1. Short grass, neatly trimmed shrubs, paved access ways and proper drainage outside.
2. Urinals, water fountains, lockers etc. must be wall suspended and together with electrical and plumbing equipment installed against the wall in such a way that the wall is easily cleanable allowing a sanitation line. Use good quality pipe insulation.
3. All other equipment either raised or sealed to the floor with pliable material and away from the wall.
4. Smooth non- absorbent undamaged walls with no ledges.
5. Wet areas must be resistant to erosion with small joints well grouted, floors well sloped with check valves on floor drains.
6. Roofs must be smooth especially around ventilation gutters.
7. Closed glass-block windows or tough Lexan sheeting at windows prevents pest entering.
8. Doors should be of metal and have tight fitting seams and with auto closing devices.
9. Good lighting with dust tight fixtures. High intensity sodium lights are best. Keep night lights away from doors.

b. Preventing pest entry to the food facility

Full assessment and continuous modifying and maintaining of grounds and structures are essential. This is to prevent volunteer pest entry as well as to eliminate harborages, of which fecal droppings, carcasses and eggs are an indication.

To avoid pest entering as captives inspect all incoming foods, materials and vehicles inside and out. If one insect, eggs, droppings or carcasses are found-

NO ENTRY OF THE PRODUCT !!!



c. Prevent pests through good sanitation

Sanitation of equipment must be complete, even motor compartments of machines. Dough the size of a golf ball can support 30 cockroaches for weeks.

e. Prevent pests through good housekeeping

The housekeeping program must include both the inside and the outside of the plant. All trash must be removed immediately, the garbage area kept clean, containers kept closed with tight fitting lids and frequent pick-ups of trash out of garbage areas is essential.

e. Storage practices

There are three basic rules for the storage of products:

1. Off the floor.
2. Away from the wall. To create a sanitation line. The floor can be painted white to aid in detecting signs of harborage.
3. First in first out (FIFO). Applying a receiving date sticker is helpful.

f. Thresholds

In most cultures when an insect is found in food, the consumer is not interested in whether the insect is a primary consumer or a "beneficial" parasite or predator. The pest evidence is seen only as a contaminant and as an indicator of further unseen contamination. Therefore, the cultural threshold the food industry strives for is complete elimination of all food industry pests.

g. Self assessment or auditing programs

The larger corporations may have a well-staffed inspection department. Smaller organizations may be limited to multi-role staffs that have inspection responsibilities in combination with others. Some corporations may hire the services of an outside professional inspection service or a qualified consultant. To be effective, the in-house inspection program needs the following essential features:

1. Management Commitment. Full commitment and involvement by all levels of management is essential. The inspection group must report to top management who ultimately bears the responsibility for compliance with regulations. An effective reporting and follow up system is important as well as corrective actions.

2. Qualified and Motivated Personnel. Inspection personnel need to be academically qualified in environmental health, entomology, microbiology, food science, or those with equivalent experience and specialized training. Other attributes - alert, observant, good analytical judgment, honest, good communication skills.

Dedication to the IPM program must be consistently renewed with positive motivational reminders that the plant must:

- a. protect the consumer
- b. operate in compliance with GMP'S
- c. avoid enforcement actions
- d. maintain a respected trade name

Other motivational tools could be competitions, sanitation workshops, training sessions and the demonstration of visible top management interest.

3. Inspection Tools and Guidelines. Personnel must have knowledge of the quality standards from a regulatory, as well as a corporate point of view in order to determine if the plant is in compliance. Normal tools include, but are not limited to: flashlight, black light (rodent urine) camera, pyrethrum aerosol, spatula, scrapers, pliers and a magnifying glass. Additional tools include paper and pencil for notes, a backpack vacuum cleaner and perhaps a caulking gun to seal cracks and crevices as they are found.

2. HOUSEHOLD PETS AND DOMESTIC ANIMALS

may under no circumstances enter the grounds or facility. Urine, feces and shedding cause a major health risk in food facilities. Appropriate fences, gates and personnel training should be in place.

3. BIRDS

Birds near or in facilities is a contamination risk because:

1. Their dry, dusty droppings may contain fungus spores which can cause the human disease Histoplasmosis. Treating with any good acaricide following label directions is necessary and should be handled with care to avoid contamination.
2. Ectoparasites such as mites, made homeless when pigeons are removed, may migrate into areas where humans are.
3. Bad odor and filth in nesting and feeding areas.

a. Bird management procedures

Remove sources of food like grain spills, weeds and garbage as well as sources of water.

Exclusion: Prevent birds from roosting or nesting inside or near the plant by screening out openings with galvanized mesh, rustproof wire or plastic bird netting.

Repellents: Sticky bird repellents can be used in possible roosting areas. Should be replaced regularly and not subjected to very hot or cold temperatures.

Electric roosting repellents provide a weatherproof system. Ask the advice of pest control operators experienced in installing these devices.

Other repellents that have been used such as revolving lights, noise makers, high frequency sound vibrations or tape recorded noise generally have only temporary effect and, at best, only move birds into another area.

Suppression or population reduction methods must be performed in conjunction with sanitation and exclusion. Methods of suppression include:

Nest removal with appropriate cleaning up.

Trapping: Several different types of traps can be used. Pre-baiting and the use of decoy birds increases trap effectiveness. Trapped birds must be removed daily.

Shooting: Shooting with a .22 caliber or #1 2 bird shot by responsible individuals and with permission from local ordinances.

Chemical management: Chemical management with avicides or other pesticides in certain situations may be the only means of effective management. Pesticides may not be used in a manner inconsistent with the label. Decisions as to the need, type of toxicant used and manner in which it is used should be made by professionals.

4. RODENTS

Domestic rodents constitute a major pest problem to the food industry. They eat any foodstuff and contaminate much more than they eat, resulting in products that must be destroyed.

There are three major domestic rodents;

	Brown rat	Black rat	House mouse
Droppings	Large in size 55 / day av.	Smaller, slightly curved 59 / day av.	Small pointed ends 50 or more / day

a. Recognizing rat and mouse signs

Rats and mice are habitually nocturnal and secretive and their signs are found in secluded places like rubbish piles or under boxes or vegetation. From the rodent signs, one can tell the species present and whether a rodent infestation is current or old, heavy or light.

Droppings: Fresh droppings of feces are usually moist, soft, shiny, and dark, but in a few days they become dry and hard. Old droppings are dull and grayish and crumble when pressed with a stick.

Runways: Rodents like concealment, best routes of escape and shortest distances to resources. Rats habitually use the same runways between food, water, and harborage. Rats prefer continual body contact with at least one vertical surface, such as a fence or wall which becomes greasy. Rats also follow "odor trails." Outdoors, their runways are narrow pathways of beaten earth swept clear of debris. Undisturbed cobwebs and dust in a runway indicate that it is not in use.

Rub marks: Dark greasy rub marks form along runways. Rub marks are soft when fresh and flakey when older. The rub marks of the Norway rat are mostly found near ground or floor level, while those of the roof rat mostly overhead as swing marks beneath beams or rafters at the point where they connect to the walls. Mice do not leave detectable rub marks except when the infestation is heavy.

Burrows: The Norway rat prefers burrows for nesting and harborage; the roof rat burrows only occasionally. Burrows are found in earth banks, along walls, under rubbish or concrete slabs, and in similar places. If a burrow is in use, the entrance will be free of cobwebs and dust. Fresh rub marks on hard packed soil, food fragments and droppings and freshly dug earth at the opening indicate a well established and presently used burrow.

Gnawing: Rodents gnaw almost anything to gain entrance or obtain food. Small chips of wood or other materials indicate recent gnawing. With age, wood gnawings become dark and smooth from weathering and from frequent contact with the rodent's body.

Tracks: Fresh tracks are sharp and distinct, whereas old tracks are covered with dust and are therefore less distinct. To see tracks in the dust, the inspector should hold a flashlight at an angle that causes the tracks to cast distinct shadows. Tail marks are also often visible in dust or tracking patches.

Urine stains: Rodent urine will naturally fluoresce under ultraviolet illumination (black light). But other substances like optical bleach will also fluoresce under a black light. For positive identification use Urease-Brom Thymol-Blue test paper. Moisten with water, cover with a cover

glass. If a bluish spot appears after three to five minutes it is rodent urine. An older stain will be yellow to white.

b. Rodent management procedures

Removing or reducing available food and harborage with good housekeeping, storage and maintenance practices are essential in rodent management. Failure to combine the necessary elements of a sanitation program will result in the failure of the rodent management program, in spite of baiting and trapping activities.

Non-chemical management: trapping

Traps are non-toxic and can be disposed of immediately but can be labor intensive.

There are a variety of traps to choose from and can be used according to the label.

Here are some final tips for using rodent traps:

- Eliminate sources of food as much as possible before trapping
- Maintain traps by cleaning and keeping well oiled
- Store traps in plastic bags to keep them from absorbing repellent odors such as pesticide odors
- Do not pet cats or dogs before handling traps, simply wash your hands if you think any odors persist
- Snap traps that are warped should be replaced as they will scare rodents when they rock

Chemical management: rodenticide use

After taking every practical measure to build rodents out and to eliminate their food and harborages, we can supplement these preventive controls with the use of rodenticides. Their toxic effects are not limited to rodents, they can harm people or other animals as well. The professional pest manager must know and understand the use of rodenticides and strictly follow label directions. Tamper proof (resistant) bait stations with spilling trays should be selected and placed out of the reach of animals, children or uninformed persons. Rodenticide label requirements must also be followed precisely.

There are two major types of rodenticides set apart by their toxic action on the rodent: Anticoagulants which cause capillary damage and non-anticoagulants which vary in their mode of action. Both have strengths and weaknesses that must be considered. Always follow label instructions carefully.

Tracking powders

Tracking powders' use is not recommended due to risk of food contamination.

Fumigating rodent burrows

Fumigants are poisonous gases that are very acutely toxic to people, pets, rodents and most insects. Fumigants can be applied to outdoor rodent burrows only. Fumigation will kill both the rodents and their ectoparasites in the burrow.

5. INSECTS AND RELATED ARTHOPODS

Only a small portion of insects are relevant in the hygiene management of food plants. A few of the most important are discussed here.

a. Cockroaches

Cockroaches contaminate our food with their droppings, their bodies, and with bacteria they carry. Cockroaches vary somewhat in their appearance and habits. All have chewing mouth parts, are flat, brownish or dark colored. The eggs of cockroaches are enclosed in a capsule which contains several eggs (highly reproductive). The young resemble the adults, but are smaller and do not have wings.

They are omnivorous, which means simply that they can eat anything such as their own cast skins, live or dead plant material, leather, glue, hair, wallpaper, fabrics and starch in book bindings and almost any human food. They have very secretive habits and move fast which protects them from detection and destruction.

Cockroach pest management

Most cockroaches seek out warm, moist, dark harborages that are narrow or tight e.g. sewers, floor drains, garbage disposals, inside wet equipment, motor housings and bathrooms. They travel mainly along intersections, such as along the back edge of a shelf or the juncture of the floor or ceiling and walls as well as inside plumbing connections.

Sanitation is extremely important for effective long term cockroach management. Food, moisture and harborage must be eliminated.

Non-insecticide options are heat (120 F) or freezing temperatures, traps and biological controls (predators and parasites).

Insecticide applications should be selected in coordination with the other management procedures and according to label instructions. Place Insecticides directly into harborages and along travel routes. Non-residual insecticides must be used in wet or steamy areas.

b. Stored product pests

There are several important pests of stored food. They eat large quantities and contaminate the food with feces and silk with which food is webbed. Excessive populations may lead to microorganism problems.

Stored product insect pest management

Stored product insects are detected by sifting.

Sanitation should be complete because they are very adaptable and flourish in small amounts of flour, rice, nuts, pasta, dry dog food, spices etc.

Product rotation, first in-first out, is also a critical management procedure. The food facility should be "pest proofed" to deny flying pests' entrance to the facility.

Non-chemical alternatives: High or freezing temperatures, modified atmospheres (CO₂), sticky traps and electrocutors.

Insecticide application should be selected and prescribed in coordination with the other management procedures, and label instructions followed completely.

c. Domestic flies

Some flies suck blood and directly inject disease organisms into the blood stream. The house fly feeds on liquid food and contaminates food by regurgitating. Flies have been known to carry the organisms of tapeworm, hookworm, whipworm, roundworm, pinworm, diarrhea, typhoid and cholera. Flies experience complete metamorphosis with egg, larval, pupal and adult stages.

Domestic fly management

Eggs are laid in wet decaying organic material such as garbage and animal excrement.

Sanitation: the washing and drying out of the garbage area and bins and twice weekly pick-ups of garbage. Good drainage in trash area with no puddles.

Screening of windows, roof vents etc. Doors should be self-closing. Freight doors may be protected with air curtains.

Various fly traps can be placed strategically.

Poison fly baits can be used as part of the outside management program. Keep outside the reach of children and pets and consider label directions.

Contact adulticide sprays to be used with great care. It gives no lasting residual killing action.

d. Occasional pests

- Ants
- Bristle Tails (Silverfish-Firebrats)
- Crickets
- Spiders
- Mites
- Centipedes

SUMMARY

An IPM program should be dedicated to removing causes rather than treating symptoms. It requires that the pest manager become a structural ecologist, who recognizes the characteristic habitats of pests and works systematically to correct the causes of continued infestations.

MEAT INSPECTORS MANUAL

PART I ABATTOIR HYGIENE

MODULE 6

SANITATION

INDEX**Sanitation**

1. INTRODUCTION
2. DEFINITIONS
3. REQUIREMENTS FOR CLEANING AND DISINFECTING THE ABATTOIR AND EQUIPMENT
4. PRE-OPERATIONAL CHECKS AND BACTERIAL MONITORING
5. SOURCES OF CONTAMINATION
6. THE PRACTICE OF CLEANING AND DISINFECTION
7. LEGAL ASPECTS REGARDING CLEANING AND DISINFECTION

SANITATION IN THE ABATTOIR

1. INTRODUCTION

During the slaughtering process meat, which is practically sterile, is exposed to contamination with bacteria from the outside surface and intestines of the animal, from equipment such as knives, saws, hooks and so on, and from the air and the hands of the workers. When equipment is not regularly cleaned therefore, there is a building up of bacteria which shortens the shelf-life of the meat and could also cause food poisoning in consumers. Proper sanitation will reduce the amount of bacteria in all work areas and on the equipment, and therefore has a direct effect on the quality of the meat provided to the consumer.

2. DEFINITIONS

The concepts of sanitation, hygiene, cleaning and disinfection are very broad and to a considerable extent overlap with each other, so for the purpose of this chapter we will assume that:

- a. **Sanitation** refers to all the processes and principles which are applied to ensure that the micro-organism count is kept at a safe low level in accordance with (official health) regulations.
- b. **Hygienic** refers to a condition that includes the concepts of “clean” and “safe” (in other words the absence of harmful organisms or substances).
- c. **Cleaning** refers to the ongoing process of cleaning which takes place throughout the day and reaches its peak after the slaughtering process has ended. This process includes the mechanical and chemical methods by which macroscopic, visible dirt is removed. When an object appears to be clean, it is not necessarily free of harmful micro-organisms.
- d. **Disinfection** refers to the process of sterilisation by which micro-organisms and their spores are killed or inactivated so that they cannot spread to other objects and contaminate them.

The desired condition can be achieved by the application of heat and/or chemicals.

3. REQUIREMENTS FOR CLEANING AND DISINFECTING THE ABATTOIR AND EQUIPMENT

The aim of food hygiene is to ensure clean, safe and wholesome food.

It is extremely important for the management of an abattoir to be fully informed of their duties in respect of hygiene, which the Act imposes on them. If they are not, a tendency could arise to favour production above hygiene, or even attempt to economise on cleaning and disinfecting materials.

1. All equipment, implements, tables, containers, disposal chutes and so on must be made of a material that can be easily cleaned and sterilised.
2. All parts of an abattoir as well as fixed articles, equipment, tables and implements must be kept clean and in good condition to the satisfaction of the meat inspector.
3. All parts of the abattoir, as well as all partitions, equipment and utensils used in the abattoir and which come into contact with the carcass, meat or animal product, must be thoroughly cleaned and disinfected at the end of the working day, or more frequently should it be required.
4. All machinery and equipment used in an abattoir must be so designed and situated as to be easily accessible for cleaning.

5. All equipment used in an abattoir must always be kept in a clean, protected state when not in use.
6. Equipment such as fillers, boilers, autoclaves, digesters and mixer tanks must, when not in use, be kept at a temperature that inhibits the growth of heat resistant micro-organisms.
7. All equipment that has been in contact with bile, faecal or disease-infected material must be cleaned and sterilized immediately before re-use.
8. Metal brushes or steel wool may not be used, because they damage the surface of the equipment; this makes proper cleaning and disinfection difficult.
9. Cloths may not be used for drying, as this only spreads contamination.
10. No polish or other substance that contains any poison may be used for the cleaning or polishing of equipment. All such substances must be SABS approved.
11. After cleaning all utensils and surfaces of equipment, the abattoir must be thoroughly disinfected, including the floors and walls.
12. The disinfection of an abattoir and its equipment, which is infected by a contagious human or animal disease, must be done in a way and with a disinfectant approved by the National Executive Officer.
13. The holding area must also be thoroughly cleaned and when necessary disinfected.
14. A water supply of at least 900 liters per slaughter unit in the case of red meat abattoirs and 15 liters in the case of a chicken abattoir must be available to protect against contamination, and the quality of this water must meet certain requirements.
15. A satisfactory supply of hot water at a minimum temperature of 40 - 50°C must be available at all times during working hours where necessary for cleaning.
16. It is the responsibility of the abattoir owner to ensure that the premises are kept as free as possible from rodents, birds, cats, dogs, flies and other insects at all times, and that no breeding place or circumstances are permitted on the premises which could encourage the breeding of vermin.

4. PRE-OPERATIONAL CHECKS AND BACTERIAL MONITORING

4.1 Pre-operational check:

In order to check up on the effectiveness of the cleaning and disinfection processes, it is very important to inspect the slaughter floors and equipment first thing in the morning. If there are any problems, there is still time to re-clean properly before slaughtering begins. A pre-slaughter inspection of the abattoir is essential.

A visual inspection of the abattoir and equipment will reveal immediately any traces of meat, fat, blood and other contaminants that have not been removed. These remnants are highly undesirable, as they attract insects and rodents while also serving as an excellent growth medium for bacteria.

During inspection the senses of smell, sight and touch are employed and samples are taken for bacteriological analysis. Odours in an abattoir can give a good indication of whether the cleaning and disinfection processes have been carried out properly.

While bad odours such as rotting meat immediately indicates ineffective cleaning procedures, an excessive smell of chemicals is also undesirable, as it can easily mask bad odours, and meat is also well known for its ability to absorb odours.

Important information can also be obtained from touching surfaces, especially those that are not easy to see. Greasy surfaces, dust, splits and cracks can be traced in this way.

4.2 Bacteriological Monitoring:

Samples for bacteriological culturing must be taken regularly from surfaces which come into contact with meat and edible offal, equipment, protective clothing and so on to give a good indication of how effective the cleaning and disinfection functions in the abattoir are.

If the required level of hygiene is to be maintained in an abattoir, cleaning and disinfection must logically take place on a continuous basis throughout the slaughtering process, because contamination also takes place all the time. If this is not done, the entire slaughtering floor will soon be covered with blood, intestinal contents and trampled bits of fat and meat, and microorganisms will be transferred from "dirty" to "clean" areas. The floor and equipment directly under carcasses should therefore not be sprayed, as water that splashes up can only contaminate the carcasses - squeegees must be used for this purpose.

Effective supervision and regular inspections throughout the day are absolutely essential to ensure the success of the cleaning and disinfection processes.

5. SOURCES OF CONTAMINATION

In order to apply effective sanitation in an abattoir, it is necessary to take all sources of contamination into account and to eliminate them as far as possible or to restrict them to the minimum. Effective cleaning and disinfection of the abattoir and equipment can be nullified by conditions that bring about recontamination of the abattoir and equipment.

Slaughtering facilities and equipment

It is of the utmost importance to keep the micro-organism count in abattoirs as low as possible and to keep contamination of meat and other edible products to the minimum during the slaughtering process. This is why wood and cloths are not allowed in abattoirs. Rusty equipment and grease from the rails are also sources of contamination.

Animals slaughtered

It is obvious that the animals that are slaughtered in an abattoir can be the most important source of contamination if strict precautionary measures are not taken to prevent this. Animals infected with one or more kinds of micro-organisms, in other words sick animals, can spread their contamination to the meat and other edible animals products, as well as to the abattoir workers. This is why ante-mortem inspection is so important.

Slaughtering And Processing Procedures

Poor slaughtering techniques include:

- Poor stunning
- Poor bleeding out
- Damaging intestines when eviscerating

Apart from poor slaughtering techniques, the following factors also contribute to contamination during the slaughter and processing of meat:

- Untrained and careless workers. Satisfactory training and encouragement can largely eliminate this problem.
- Production line and slaughtering speeds that are too fast mean that the hands and equipment cannot be washed and disinfected regularly.

- Not enough working spaces and cramped working conditions. (See Abattoir Layout.)
- Contamination which is washed off instead of being trimmed off.
- Recovering on the slaughter floor itself. This practice can only spread the contamination, and should rather be done in the detention area.
- Overloading the refrigeration facilities, causing carcasses to touch each other and consequently ineffective chilling.

Abattoir personnel

Workers can also be a source of contamination of meat. The abattoir supervisor must inspect all the workers every day before they start work to establish whether they have any abnormalities such as skin diseases, visible open wounds or septic sores on the head, neck, arms or hands or unnatural discharges from the eyes, nose ears or skin. If such an abnormality is identified, the worker must be examined by a nursing sister or a doctor to establish whether he/she is fit for work that day or not.

The Abattoir And Its Environment

The situation of the abattoir can also be a source of contamination. Large amounts of pollution from smoke, dust or unpleasant smells can make it extremely difficult to maintain a high standard of hygiene.

Water Quality

Water is used as the universal cleaning medium. However, pure water does not exist in nature and the quality of water (chemical and microbiological) varies considerably depending on area and time of year. Since, especially the chemical quality of water has a dramatic effect on the performance of detergents it is important to establish water quality and its influence on a sanitation program.

For example: For a chlorinated alkaline cleanser an extra amount (over the recommended concentration) of 1 gram is needed for every 50 ppm hardness over 150 ppm; water hardness in the South African context is often over 150 ppm and even up to 500 ppm.

Water used in food plant sanitation must be of potable quality and should conform to the following specifications:

Total bacterial count:	< 100 viable organisms/ml (30 °C/ 48 hours)
Coliform count	: < 0/ 100 ml
Faecal coli	: < 0/ 100 ml

The water supply should be monitored regularly for the presence of psychrotrophic (cold loving) bacterial contamination.

Protective Clothing

Protective clothing must be provided every day before work and sometimes during working hours if desired hats, aprons and boots must be cleaned regularly before and during the slaughtering process and replaced when necessary.

Containers For General Refuse

Rubbish containers must be made of durable, rust-resistant, non-absorbent materials and must be provided with tight fitting lids to protect the contents against flies and cockroaches and to limit unpleasant smells to the minimum. The containers must also be emptied regularly and then cleaned and disinfected. The use of disposable plastic rubbish bags does not mean that the containers need not be cleaned and disinfected.

6. THE PRACTICE OF CLEANING AND DISINFECTION

6.1 The 7 basic steps of cleaning and disinfection

1. **Removal** of loose bits of rubbish such as meat, fat, skin and bone from equipment walls and floors to facilitate cleaning.
2. **Loosening** pieces of rubbish, blood faecal and other contaminants by means of dry sweeping, and removing them by picking them up. Bits of meat and fat and skin, in particular, must not be washed into the drainage system.
3. **Pre-washing** all equipment, floors and walls with clean hot water (40 - 50°C) to soften and loosen the remaining particles.
4. **Washing and scrubbing** with detergents and hot water under pressure.
5. **Rinsing** with clean hot water (45 °C) under pressure in order to remove the loosened particles and detergents properly.
6. **Disinfecting** with a suitable disinfectant at the proper concentration.
7. **Microbiological survey** of the equipment and walls to establish the effectiveness of the cleaning and disinfecting.

Two other important factors to remember is that condemned material and trimmings must be put into containers and not thrown on the floor, and racks and reels must be provided for brooms and hoses.

According to SABS 049 – 1989, acceptable standards are:

QUANTITY OF ORGANISMS	JUDGEMENT
0 – 15 organisms / 10 cm ²	satisfactory
16 - 75 organisms / 10 cm ²	fairly satisfactory
75 + organisms / 10 cm ²	unsatisfactory

6.2 Guidelines For The Compilation Of A Cleaning And Disinfection Programme

A hygiene specialist in co-operation with the production management, abattoir engineer, and the manufacturers of cleaning and disinfecting agents must lay down procedures for cleaning and disinfection. Standard Operational Procedures (SOP's) must be compiled for cleaning and disinfection of the abattoir equipment and vehicles but also for the equipment which is used for cleaning and disinfection such as brooms, brushes, containers etc. The complete procedure must then be written down in schedule form and made available to both workers and management for regular consultation and reconsideration. Strict supervision on the part of management must ensure that the established procedures are being followed in order to make a success of the cleaning and disinfection programme.

How to draw up a cleaning and disinfecting programme

- a. Make a list of all the surfaces which have to be cleaned, the material they are made of, and the standard of sanitation required for each.
- b. Decide on the method of cleaning and sanitation in each case and the sequence in which each surface must be cleaned. Make sure that when a surface is cleaned, surfaces, which are already clean, do not get soiled again. Disinfecting should preferably take place at the end of the cleaning programme, in the same sequence as the cleaning.
- c. Decide in co-operation with the hygiene department what kind of cleaning and disinfecting agents should be used and at what concentrations.

- d. Standard operating procedures (SOP's) which set out the instructions based on the above points in which the method of cleaning and disinfecting, the kind and concentration of chemicals and the sequence of cleaning and disinfection are clearly stated should be available to every member of the cleaning team.
- e. The cleaning team must be well trained, and strict supervision must then ensure that the above instructions are carried out meticulously.
- f. Make use of the **WHO, WHAT, WHERE, WHEN** and **HOW** PRINCIPLES. Each member of the team must know exactly **WHO** must do the work, **WHAT** must be done, **WHERE** it must be done, **WHEN** it must be done and **HOW** it must be done.
- g. Arrange for microbiological surveys. Unacceptable results will reveal weaknesses in the cleaning and disinfecting programme as well as problem areas.

6.3 Detergents

The purpose of detergents is to render water insoluble dirt soluble or dispersible in water. Because of the variety of pollutants occurring in the meat industry and their different solubility characteristics, there is **NO SINGLE MIRACLE DETERGENT** which will remove all the dirt at all times.

6.3.1 *The Following 4 Anionic Detergents Are Most Frequently In Use*

a. Acid Detergents

These are used to dissolve mineral deposits on the surface of equipment. The pH of the solution is usually 2,5 or lower.

b. Alkaline detergents

Alkalis are the main ingredients of the majority of detergents. They react with fats and proteins to make soluble compounds that can easily be dissolved in water

c. Chlorinated detergents

Chlorine reacts strongly with proteins, and is therefore added to alkaline detergents. It also reduces mineral deposits resulting from the detergent. At the high pH at which they are used, however, chlorinated detergents cannot be used as disinfectants. The high pH also reduces the corrosion problems experienced with ordinary chlorine.

d. Foam detergents with enzymes

Recently, a new type of cleaner has appeared which is designed primarily for poultry and meat plants. This cleaner, or, actually, cleaning system, consists of two components. The first contains a mixture of surfactants and a mixture of enzymes, and the second is an alkaline solution supplemented with water softeners and conditioners. The two components are mixed with **warm water** (maximum 45° C) just before use and usually applied as foam. These enzyme-based detergents have many advantages. The concentrated foam clings to all surfaces including vertical surfaces, which gives the chemicals enough time to emulsify the dirt. If they are used in chillers the relatively low temperature save energy as well as refrigeration costs

6.3.2 *Detergent Product Selection Guide*

- a. The product should be economical, the factor to measure this by is price of the solution used, not price per litre or kg of product.
- b. It should contain corrosion inhibitors to prevent attacks on soft metals such as aluminum and galvanising.
- c. It should display good soil (dirt) penetration through wetting action.

- d. It should be able to sequester water hardness of 150 mg/kg or more to prevent deposition of mineral salts.
- e. It should have good soil suspending properties to prevent re-deposition of emulsified soils.
- f. It should be free-rinsing.
- g. It should be readily water soluble.
- h. It should be of low toxicity and acceptable effluents (biodegradable).
- i. Its foaming characteristics need to be matched to its application.
- j. It should adjust the pH of the cleaning solution to the required value (alkaline for the removal of fats, proteins and heavy soils, acid for the removal of alkaline scales and mineral deposits).

6.3.3 Factors Affecting The Effectiveness Of Detergents

Even the best detergent available is only as good as the way in which it is used. There are 4 deciding factors that determine the effectiveness of a detergent:

a. Concentration (Chemical action)

Every product has its optimum concentration. A weaker concentration lowers its effectiveness, and a higher concentration does not give better results; it only increases costs.

b. Mechanical action

This includes such actions as scrubbing, brushing, rinsing and high-pressure spraying which are essential if the detergent is to function properly.

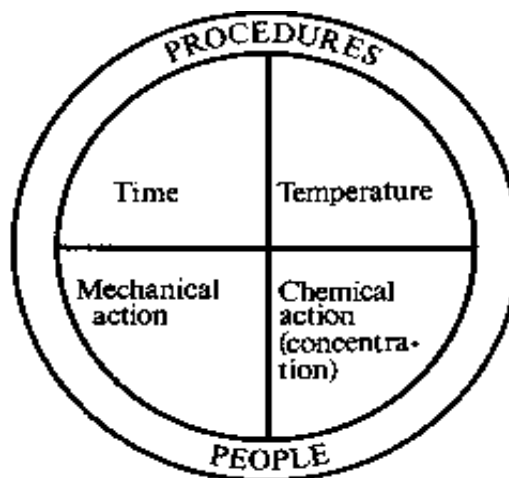
c. Temperature

This is a deciding factor for the effectiveness of any detergent. In general it can be said that the higher the temperature (up to 80°C) of the solution, the more effective the operation, especially in respect of greasy dirt.

d. Contact time

The contact time between the detergent solution and the dirt must be long enough, as most detergents rely on chemical processes and reaction to remove dirt.

The effectiveness of cleaning method depends in every aspect on the interaction of these 4 factors. Generally speaking the reduction of one factor requires the increase of one or more of the others. If cleaning is not thorough, disinfecting will also be ineffective.



6.3.4 Five Fundamental Steps In Cleaning

- a. Bringing the detergent solution into intimate contact with the soil by wetting and penetrating.
- b. Displacing the soil from the surface by saponifying fat, peptising proteins and dissolving minerals.
- c. Dispersing the soil in a solvent by dispersing, de-flocculation and emulsification.
- d. Preventing re-deposition of the soil onto the clean surface.
- e. Rinsing the soil from the cleaned surface.

GOOD SANITATION IS 90% CLEANING AND 10% DISINFECTION!

6.4 Disinfectants/ Sanitizers

Even the most thorough cleaning will not remove all the micro-organisms from a surface. Disinfection is therefore essential to bring the microbe population of a surface down to levels that will be safe for public health. This can be obtained by using a SABS approved disinfectant.

6.4.1 For effective disinfection the following requirements must be met:

- The surfaces must be thoroughly cleaned.
- The contact time between disinfectant and surfaces must be at least 30 minutes, and preferably overnight.
- The concentration of the disinfectant solution must be strictly in accordance with the manufacturer's instructions. Too little disinfectant can result in ineffective disinfection, and too much increases the danger of contaminating meat with the chemicals.

6.4.2 The Following 3 Kinds Of Disinfectants Are Most Often Used In The Meat Industry:

a. Chlorine-based disinfectants.

They have good disinfectant properties against a wide range of bacteria. In properly mixed solutions they are relatively non-toxic, colourless, non-staining and easy to prepare and to use. Chlorine disinfectants are however inactivated to a considerable extent by organic material, and can also cause soft metals to corrode.

b. Iodine-based (iodophor) disinfectants

They have a rapid disinfectant action against a wide variety of gram-positive and gram-negative micro-organisms. At working concentration they are relatively non-toxic, non-irritant and stable. The temperature of the working solution must not exceed 45°C. No rinsing is necessary with solutions less than 25 ppm of iodine.

c. Quaternary ammonium compounds (QAC)

These are effective against many gram-positive and some gram-negative bacteria. In working solutions they are colourless, odourless and non-toxic. They are stable when heated, but are also inactivated by organic material. No rinsing is necessary for solution of less than 200 ppm of active ingredients.

d. Comparison test between a disinfectant and water at 82 °C

Disinfection by heat at 82°C is not usually as effective as chemical disinfection, except in the case of equipment small enough to be immersed into a steriliser and kept under water at, 82°C for relatively long periods. In a test at an abattoir the disinfection efficiency of heat at 82°C was compared with that of a chemical disinfectant. Microbiological surveys conducted throughout the test gave the following results (measured in numbers of **colony-forming units/cm²**):

This pattern has also been observed at other abattoirs where similar tests were performed.

These results show clearly that:

- The application of water at 82°C for 2 minutes did not result in sterilisation. After sterilisation there should not be any living organisms present.
- Chemical agents did not always result in sterilisation even after 30 minutes application. They are therefore not real disinfectants, but rather sanitation agents, because they simply lower the micro-organisms population to a safe, low level.

6.4.3 Disinfectant Product Properties Selection Guide

- Rapid kill in short time (seconds).
- Broad kill and rapid kill time.
- Safe and non-irritating to employees.
- Safe for consumers and acceptable to or approved by regulatory agencies.
- Freely rinsable.
- No adverse effect on food being processed.
- Economical (consider use-dilution).
- Easily tested for use-solution concentration.
- Stable in concentrate and use-solution form.
- Non-corrosive.
- Readily water soluble.
- Compatible with other chemicals and equipment.

6.5 Acceptable Standards In Respect Of Cleaning And Disinfecting

Cleaning and disinfection can be regarded as effective when:

- a. no more visible dirt occurs;
- b. no chemical residues from the cleaners and/or disinfectants occur on working surfaces;
- c. there are no mineral deposits from the water;
- d. no unacceptable smells or odours occur;
- e. there are no stains;
- f. no physical damage such as cracks or splintering is present;
- g. acceptable bacteriological counts are obtained.

6.6 Sanitation Chemicals

Detergents and disinfectants should be purchased only from reputable suppliers according to the guidelines supplied in this manual. Close attention should be paid to using disinfectants at the specific concentrations for no-rinse approval.

6.7 Do's And Don'ts With Sanitation Programmes

DO!

- a. Remove gross soils such as scraps, fat, meat juices and other organic matter before applying the detergent foam or solution.
- b. Always rinse with warm water (40-50 °C).
- c. Foam or scrub with detergent solution (60-70° C).
- d. Allow a contact time of 10 minutes for foam.
- e. Use disinfectants at the recommended concentration only.
- f. Drain equipment and store dry where possible.

DON'T!

- a. Misuse chemicals - both overuse and under-use is wasteful.
- b. Use cold water - it increases your chemical requirements.
- c. Mix different chemicals without the manufacturer's instructions they may react dangerously or may neutralise each other.
- d. Add chemicals to foodstuffs.
- e. Rinse after sanitising - allow to air dry.
- f. Use pieces of cloth (rags) anywhere - it facilitates contamination of surfaces and products.

A sanitation program for each work area is important. Cleaning and disinfection is just as important for the production of a safe product of high quality as any other part of the program.

7. LEGAL ASPECTS REGARDING CLEANING AND DISINFECTION**Abattoir design and facilities**

1. The design of an abattoir and the equipment used must be such as to facilitate easy cleaning and sterilisation.
2. The following water supply must be available for sanitation purposes during production and sanitation:
 - (1) Water used for sanitation must be potable;
 - (2) Hot water at 82°C in sterilisers for disinfecting hand equipment;
 - (3) Water at 40°C at hand wash basins for washing of hands;
 - (4) Water at 40°C for general cleaning purposes.
3. The abattoir owner must supply all the necessary equipment needed in the sanitation process.

Sanitation programs

4. A detailed post slaughter sanitation program must be in place detailing the following information:
 - (1) A list of all areas and rooms to be cleaned;
 - (2) The frequency of cleaning;
 - (3) Step by step cleaning procedures for each area, room or equipment, including ablution facilities, meat transport vehicles and lairages;
 - (4) Technical sheets of the chemicals used must be available with reference to accredited approval for use in meat plants, active ingredients, dilution rates and applications;
 - (5) Target results, including microbiological monitoring, to be obtained as the objective of the sanitation program;
 - (6) Job descriptions and training program for all cleaners.
5. Programs must be in place for continuous cleaning during:
 - (1) Production;
 - (2) Breaks;
 - (3) Shift changes.
6. An effective pre-production monitoring program must be in place to ensure cleanliness of all facilities before production commences.
7. All these above programs must be approved.
8. Slaughter must not commence before all areas, rooms and equipment have been cleaned and disinfected.

9. No sanitation must commence in any area before all edible meat products have been removed to prevent contamination.

Chillers and Freezers

10. Chillers must be sanitised before a fresh load of carcasses or products are loaded.
11. Chillers may not be sanitised if it contains meat.
12. Freezers must be defrosted and thoroughly sanitised at least once a year or more often if required by the authorised person.

MEAT INSPECTORS MANUAL

PART I ABATTOIR HYGIENE

MODULE 7

QUALITY & SAFETY CONTROL SYSTEMS

INDEX**QUALITY & SAFETY CONTROL SYSTEMS**

1. INTRODUCTION
2. DEFINITIONS
3. THE NEED FOR QUALITY SYSTEMS
4. HACCP AS A FOOD SAFETY MANAGEMENT SYSTEM
5. QUALITY SYSTEMS AS PRE-REQUISITES FOR HACCP
6. HACCP IMPLEMENTATION
7. HYGIENE MANAGEMENT SYSTEMS (HMS)
8. KEEPING OF RECORDS
9. HAS

QUALITY & SAFETY CONTROL SYSTEMS

1. INTRODUCTION

Quality control is becoming an increasingly more important factor in the food industry. The new Meat Safety Act legalises Hygiene Management Systems. The main objective of HACCP is to make provision for a safe product while ISO 9000 is a quality system. The HAS is a system used to monitor the different safety and quality systems. HACCP, HMS and HAS will be discussed shortly.

2. DEFINITIONS

2.1 Quality

Quality means to comply with standards set by the customer/consumer, management or legislation.

2.2 Quality Assurance (QA)

The system used to interpret and formulate the firm's policy with respect to quality and the setting of parameters against which standards can be measured.

2.3 Good Manufacturing Practice (GMP)/ Good Hygiene Practise (GHP)

GMP means manufacturing procedures and methods that, while taking into account the principles of hygiene, are applied in such a way that food is not spoilt during the manufacturing process.

2.4 Hazard Analysis and Critical Control Point (HACCP)

HACCP is a system that identifies, evaluates and controls hazards that are significant for food safety.

2.5 Critical Control Point (CCP)

It is a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

3. THE NEED FOR QUALITY SYSTEMS

This is not a course on HACCP but only an introductory text to some of the basic facts about quality control systems and HACCP. Considerably more training in these systems than the following text will be required for their successful implementation.

A quality management system allows for planning to prevent things from going wrong during processing; it does not wait for things to have gone wrong before acting. The risk must be managed and must be as small as possible. It is generally accepted that a quality system should be:

- Established – What is the right way/ right procedure/ right standard?
- Documented – The right way must be written down
- Maintained – You must do what you have written down
- Audited – Checked that you are actually doing what you say you are doing

Various quality systems are available. These include the ISO 9000 series, and in the food industry at present, mostly GMP and HACCP. Having a HACCP system in place is an absolute requirement for exportation of meat to the European Union (EU) and the United States of America (US). While GMP mostly refers to quality systems including hygiene, HACCP deals only with food safety. The standard texts at present are the publications of the international Codex Alimentarius Commission's guidelines for both HACCP and hygiene.

4. HACCP AS A FOOD SAFETY MANAGEMENT SYSTEM

The Hazard Analysis and Critical Control Point (HACCP) is a system to manage food safety. It is a proactive system because food safety hazards are controlled throughout processing instead of only after production by end-product testing. It gained prominence because the incidence of food borne human illness is increasing thus causing world-wide concern over food safety issues. In recent times food borne disease has been on the increase all over the world and even first world countries experience a worrying increase in outbreaks of food borne disease. In fact, food borne disease has been described by the World Health Organisation as one of the most widespread public health problems of the contemporary world. The international community is now are pinning their hopes on pathogen management systems to help solve the problem.

The HACCP system is science based and systematically identifies specific hazards as well as measures for their control in order to ensure the safety of foods. It includes control of microbiological, chemical and physical hazards.

The HACCP concept is simple:

It is a proactive approach to prevent food safety hazards by focussing resources at those points in food production where food safety hazards can be controlled, instead of placing emphasis on (reactive) end product testing.

5. QUALITY SYSTEMS AS PRE-REQUISITES FOR HACCP

The main prerequisite for implementation of quality systems and HACCP is management commitment. Management must be willing to render visible as well as financial support to the HACCP and prerequisite quality programmes. Do not attempt introducing HACCP without it!

The production of safe food products requires that the HACCP system be built upon a solid foundation of pre-existing programmes. These prerequisite programmes provide the basic environmental and operational conditions that are necessary to produce safe, wholesome food. Common prerequisite programmes may include but not be limited to:

Procedures for:

- Sanitation
- Pest Control
- Maintenance of equipment and facility
 - Slaughtering and dressing
 - Chilling
 - Dispatch
 - Offal processing
- Water supply controls
 - Plant water supply
 - Chlorination

Personnel

- All personnel should receive documented training in:
 - Personal hygiene
 - Good Manufacturing Practices
 - Cleaning and sanitation procedures
 - Personal safety
 - Their specific role in GMP and HACCP programmes
- Training should be updated where necessary. With required updating and new appointments, training almost becomes a continuous task.
- It is most important that all employees (including management) as well as other persons entering the plant, must observe all rules of personal hygiene and behaviour. GMP must become a way of life at the plant.

- Recall procedures for faulty products
- Supplier quality assurance
- Etc.

Pre requisite programs are often confusing in that they can be called different names in the different spheres or organizations where food safety programmes are implemented. To simplify it for the sake of this module in broad terms the following names will in essence describe pre requisite programmes:-

Hygiene management programs
 Good Manufacturing programs
 Good hygiene programs
 Quality management systems
 etc.

One or more of the above are often required for an effective pre requisite program for HACCP.

6. HACCP IMPLEMENTATION

Although the HACCP concept is simple and at first glance obvious, its implementation is difficult. It is based on science and scientific fact and not simply on perceptions. HACCP implementation includes control of microbiological, chemical and physical hazards. Successful implementation requires input from a variety of fields such as processing, engineering, maintenance, microbiology and hygiene, food technology etc. It is unlikely that one person can be an expert in all these fields and especially in the smaller plant where multitasking is practised, outside assistance with the HACCP plan may be required.

The 7 principles of HACCP are:

- Principle 1: Conduct a hazard analysis
- Principle 2: Determine the critical control points (CCP's)
- Principle 3: Establish critical limit(s)
- Principle 4: Establish a system to monitor control of a CCP
- Principle 5: Establish a corrective action to be taken when monitoring indicates that a particular CCP is not under control.
- Principle 6: Establish procedures for verification that the HACCP system is working effectively.
- Principle 7: Establish documentation concerning all procedures and records appropriate to these principles and their application.

The 12 stages in HACCP implementation are:

1. *Assemble a HACCP team*
2. *Describe product*
3. *Identify intended use*
4. *Construct a flow diagram*
5. *On-site confirmation of flow diagram*
6. *List all potential hazards associated with each step, conduct a hazard analysis and consider any measures to control identified hazards (see Principle 1)*
7. *Determine Critical control points (see Principle 2)*

8. *Establish critical limits for each CCP (see Principle 3)*
9. *Establish a monitoring system for each CCP (see Principle 4)*
10. *Establish corrective actions (see Principle 5)*
11. *Establish verification procedures (see Principle 6)*
12. *Establish Documentation and record keeping (see Principle 7)*

Since HACCP is a tool to establish control systems that focus on the “prevention rather than cure” approach, the concept can be applied to other aspects of food quality and successfully used to ensure production of a quality product every time.

7. HYGIENE MANAGEMENT SYSTEMS (HMS)

The Meat Safety Act, 2000 (Act 40 of 2000) provides for the implementation of hygiene management systems. The following extract was taken from the regulations in terms of this act.

The owner of an abattoir must –

- (a) provide the provincial executive officer with a documented Hygiene Management System containing detailed information on control measures or programmes required to monitor identified control points, including the methods of monitoring or checking these control points, for approval;
- (b) provide relevant records of observations, checks, measurements or results;
- (c) provide sampling programmes for laboratory analyses, as well as names of laboratories to do the required analyses;
- (d) provide written accounts of decisions relating to corrective actions when taken; and
- (e) assess the hygiene status of the abattoir by means of the Hygiene Assessment System (HAS) and provide results to the provincial executive officer for verification as frequently as he or she may require.

1. Document management system

A document management system must provide for –

- (a) the retrieval of documents relating to an identified slaughter batch;
- (b) the recording of each slaughter batch containing information regarding date of slaughter, species slaughtered, mass, quantities, identification and destination for carcasses as well as cut meat; and
- (c) a documented product recall procedure approved by the provincial executive officer.

2. Schematic plan of abattoir

The owner must prepare an updated schematic plan of the abattoir to include details of –

- (a) all the different areas on each level;
- (b) all the different rooms in each area identified, indicating the process or operation including the capacities or rates of operation that take place in such rooms;
- (c) the flow of the product;
- (d) ancillary structures on the premises;

- (e) the required temperature as well as the capacity of each room where temperature is controlled;
- (f) the different ablution facilities for workers in clean and dirty areas as well as the personnel entrances to the different areas;
- (g) all entrances to rooms, areas and building; and
- (h) boundaries, indicating entrances and exits to and from premises.

3. Flow diagram of slaughter process

The owner must prepare a flow diagram of the slaughter process which must include –

- (a) all steps involved in the process, including delays during or between steps, from receiving of the animals to placing of the end product on the market; and
- (b) details and technical data including equipment layout and characteristics, sequence of all steps, technical parameters of operations, flow of products, segregation of clean and dirty areas, hygienic environment of the abattoir, personnel routes and hygienic practices, product storage and distribution procedures.

4. Potential hazards

The owner must prepare a list of all potential biological, chemical or physical hazards that may occur at each step of the process, including –

- (a) unacceptable contamination or recontamination of a biological, chemical or physical nature;
- (b) unacceptable survival or multiplication of pathogenic micro-organisms; and
- (c) unacceptable production or persistence of toxins or other undesirable products of microbial metabolism.

5. Prevention of hazards

The owner must prepare written hygiene management programmes (HMP) for approval by the provincial executive officer, to prevent, eliminate or reduce hazards mentioned in regulation 53 to acceptable levels and must –

- (a) ensure that management programmes for each hazard is implemented;
- (b) establish critical limits for control points;
- (c) establish a monitoring or checking system for each control point; and
- (d) prepare written corrective actions that must be taken without hesitation when a deviation is observed and such corrective action must specify –
 - (i) the persons responsible to implement the corrective action;
 - (ii) the means and action required for each hazard;
 - (iii) the action to be taken with regard to the meat having been processed during the period when the process was out of control; and
 - (iv) that a written record of measures taken must be kept.

6. The owner of an abattoir must –

- (a) a HMP for ante-mortem inspection, including control measures to –
 - (i) ensure that all animals/birds which for some reason or other cannot be processed into safe meat are identified and handled in accordance with Part VIII;
 - (ii) identify animals/birds with diseases and conditions of which symptoms may not be visible during post-mortem meat inspections;
 - (iii) identify animals/birds with zoonotic diseases;
 - (iv) identify animals/birds with highly contagious diseases or diseases controlled under the Animal Health Act, 2002 (Act No. 7 of 2002); and
 - (v) identify animals/birds that pose a high contamination risk, such as those with septic conditions or animals that are excessively soiled; and
 - (vi) ensure that injured animals/birds in obvious pain are presented for emergency slaughter or preferential slaughter without undue delay;
- (b) a HMP for slaughter and dressing, including –
 - (i) control measures (CM) to ensure that no contamination of meat and edible products occur from –
 - (aa) the external surface of the animal slaughtered;
 - (bb) wind and dust;
 - (cc) the contents of hollow organs;
 - (dd) persons working with edible products; or
 - (ee) contact with unclean objects;
 - (ii) slaughter and dressing procedures which must limit any contamination to the absolute minimum;
 - (iii) training of all workers in correct slaughter techniques including principles of hygiene practices which must be monitored;
 - (iv) a programme for the daily checking of carcasses for soiling to provide for regular checking of a representative sample of carcasses throughout the day on a random basis and to determine the levels of contamination of carcasses;
- (c) a HMP for meat inspection, in terms of which the supervisory registered meat inspector (SMI) assisted by the registered veterinarian must monitor meat inspection by means of implementation of written control measures to ensure –
 - (i) that meat inspection is done according to Part VI;
 - (ii) the competency of the meat inspectors and meat examiners;
 - (iii) the personal hygiene of the meat inspectors and meat examiners;
 - (iv) that heads, red and rough offal are correlated to the carcasses of origin;

- (v) the security of detained carcasses and organs;
- (vi) the security of provisionally passed carcasses and organs;
- (vii) the security of the stamp of approval;
- (viii) the security of condemned material;
- (ix) the implementation of standard operational procedures (SOP's) for –
 - (aa) emergency slaughter;
 - (bb) preferential slaughter;
 - (cc) provisional slaughter;
 - (dd) slaughter of cattle which have reacted positively to Brucellosis and Tuberculosis tests done on the farm and branded with the “C” and “T” brand marks;
 - (ee) dirty animals; and
 - (ff) dropped meat;
- (d) a HMP for personal hygiene of workers in terms of which –
 - (i) a general code of conduct , approved by a registered inspector, for personnel and in particular for workers who come into direct contact with meat and edible products, must be available;
 - (ii) a training programme, as well as registers of attendance, for all personnel to apply the principles of the code of conduct referred to in subparagraph (i) must be available; and
 - (iii) records of surveillance and supervision including records of disciplinary action in cases of repetitive misconduct or non-compliance must be available;
- (e) a HMP for medical fitness of workers in terms of which –
 - (i) records of initial medical certification that workers are fit to work with meat and edible products, prior to employment, must be available; and
 - (ii) records of daily fitness checks, including corrective actions applied in cases of illness and injury, must be available;
- (f) a HMP for the temperature of water in sterilizers and maintenance of sterilizers in terms of which control measures to ensure the continuous availability and accessibility of sterilizers in good working order at water temperatures of 82 °C, including registers for daily checks indicating frequency of checks as well as corrective action procedures in cases of non-compliance, must be available;
- (g) a HMP for the availability of liquid soap and soap dispensers, toilet paper, and disposable towels, in terms of which control measures to ensure the continuous availability and accessibility of liquid soap and soap dispensers for hand-washing purposes, toilet paper and disposable towels at pre-identified points must be available;
- (h) a HMP for sanitation and continuous cleaning including a cleaning schedule providing –
 - (i) a list of all the areas to be cleaned;

- (ii) a list of all the rooms that have to be cleaned within every area;
 - (iii) the name of the person responsible for the cleaning of each area, section or room;
 - (iv) for each room within a particular area, a detailed description of the cleaning of each structure, including –
 - (aa) the frequency of cleaning;
 - (bb) step by step methods of cleaning;
 - (cc) data of the chemicals which are used, such as registration data, safeness, dilutions, application prescriptions;
 - (dd) the correct application of the detergents such as dilution, temperatures and contact times;
 - (ee) the rinsing off of applied chemicals; and
 - (ff) the results to be obtained as an objective of the cleaning programme;
 - (v) an addendum for each room in which the cleaning of each structure must be described in detail including aspects such as method, frequency and target results;
 - (vi) for the training of cleaning teams in the execution of these programmes;
 - (vii) for control over the storage of detergents to prevent contamination of edible products;
 - (viii) a detailed description for continuous cleaning on the processing line during processing, which must include –
 - (aa) a list of all the actions in this programme including the cleaning of moving equipment and crates; and
 - (bb) a step by step description of each action;
 - (ix) for these programmes to be approved by a registered inspector; and
 - (x) for laboratory checks as control of effectiveness of the cleaning programmes to be instituted and documented;
- (i) a HMP for availability and quality of water in terms of which –
- (i) the owner of the abattoir must account for the source of water supply and the status of such water;
 - (ii) the owner must be able to demonstrate the water distribution system within the abattoir and provide an updated schematic plan of the water distribution on the premises;
 - (iii) a sampling programme must be followed to ensure that all outlets, including water hoses are checked on a repeated consistent basis within an allotted period of time, and the sampling procedure must be described; and

- (iv) the owner is responsible to ensure that water used in the abattoir is potable and that records of microbiological and chemical water test results are available;
- (j) a HMP for vermin control in terms of which the owner of the abattoir must provide a written control programme for each vermin type for approval by the provincial executive officer, and such programme must include –
- (i) schematic drawings indicating the position of bait stations;
 - (ii) a poison register, including specifications for the use of different poisons; and
 - (iii) training programmes for persons working with poisons;
- (k) a HMP for waste disposal, including condemned material, in terms of which –
- (i) the owner of the abattoir must provide a written control programme for the removal of each different category of waste material including general refuse removal for approval by the provincial executive officer; and
 - (ii) security arrangements to prevent condemned material from entering the food chain must be described;
- (l) a HMP for in contact wrapping and packing materials in terms of which –
- (i) the owner of the abattoir must provide a written control programme addressing the suitability as well as the storage and handling of all in contact wrapping and packing material;
 - (ii) control measures to prevent contamination in store rooms must be provided; and
 - (iii) control measures to prevent contamination of wrapping materials must be provided;
- (m) a HMP for maintenance, providing for the owner of the abattoir to provide a document addressing the routine maintenance of all equipment and structures; and
- (n) a HMP for thermo control in terms of which –
- (i) a plan must be provided that indicates the layout of all the chillers, freezers and processing rooms where temperature control of the rooms is required including –
 - (aa) each temperature controlled room or area;
 - (bb) the number of the room or area;
 - (cc) the temperature requirement of each room; and
 - (dd) the throughput of each room;
 - (ii) each room must be equipped with a recording thermograph, or equivalent means of monitoring and recording must be used, that indicates the temperature measurements in the room on a continuous basis;
 - (iii) the graphs or data must provide the actual time and temperature as well as the correct date;
 - (iv) annual calibration and certification to this effect must be available;

- (v) records in respect of regular testing of digital thermographs and meters against a certified fluid in glass thermometer, done by the owner, must be available;
- (vi) placing of the thermo-sensors within a room must be representative of the temperature in that room;
- (vii) if a centralized computer system is used for this purpose all the relevant temperatures must be recorded on an ongoing basis at least every 30 minutes;
- (viii) the temperature status of every room must be checked at least every 12 hours by the owner to ensure maintenance of temperatures and all deviations must be accounted for;
- (ix) checks by the owner must be recorded on the temperature control records;
- (x) any deviations from the required temperature must receive immediate corrective attention;
- (xi) the hygiene manager must be notified immediately in every case where a temperature breakdown has occurred;
- (xii) records must be available for inspection by the national executive officer or provincial executive officer; and
- (xiii) the hygiene manager must indicate daily control checks by way of signature on the records.

8. KEEPING OF RECORDS

Record keeping is the collection, notation, and filing of relevant information in an organised manner. The purpose of record keeping is as follows:

1. The information collected has statistical value.
2. The information collected shows tendencies.
3. The information can be demanded by importing countries.
4. The information can be used for reference as needed, i.e. motivation for a Directive.

Examples of forms that can be used for record keeping are attached. These forms can be modified to comply with specific needs. If necessary, the local Veterinary Public Health officer can be contacted.

1. Vehicle inspections (Transport of livestock/Dispatch of carcasses).
2. Secondary inspections (Measle control/detentions/bruising trimming).
3. Temperature control (Carcasses/chillers/freezers/dispatch/deboning).
4. Lairage inspections (Blood smears/removal of dead animals/shoot and destroy).
5. Changing room and toilet facilities (availability of soap/neatness).

The following examples of forms are commonly used in abattoirs. As a result of personal preference and specific management systems, different forms are used in different abattoirs. The "Schedule 8" forms are prescribed by the Abattoir Hygiene Act and serves to report all condemnations to the Directorate Food Safety and Veterinary Public Health.

9. HAS (HYGIENE ASSESSMENT SYSTEM)

The Hygiene Assessment System is a nationally standardised evaluation system that quantifies the standard of hygiene management at abattoirs. Different roleplayers need it for different reasons. The most important is the abattoir owner and more specifically the person in control of hygiene management at the abattoir (Hygiene Manager - HM/ Quality Controller-QC). This is usually the most

senior meat inspector. This person has the responsibility to frequently monitor the standard of hygiene. The HAS is 'a pre-determined standard to which he/she can measure the hygiene standard at the abattoir, against essential national standards. Progressive improvement or deterioration can easily be monitored and corrective actions can be documented according to the marks scored. The periodic auditing by provincial and national inspectors is essential in order to maintain set standards. HM's and QC's must be trained to interpret the guidelines as objectively as possible. Copies of these evaluations must be kept on record at the abattoirs for the different role players.

- Provincial and national inspectors.
- Co-ordinators of inspectors who are in the service of agencies delivering meat inspection services.
- Co-ordinators of meat classification services.
- The abattoir owner may make the results available to clients as part of a marketing strategy.

The next is an example of page 3 of the HAS form that is used at high throughput red meat abattoirs. The complete form has approximately 20 pages. This example illustrates the different aspects covered by the HAS. Only the page used to indicate the marks is included.

ABATTOIR: _____ ABATTOIR NO: _____ GRADE : _____ DATE: _____

DAILY THROUGHPUT: C _____ P _____ S _____ Other _____

INSPECTION COMPONENT				
RANK	NAME	DESIGNATED		EMPLOYER
		YES	NO	
VETERINARIAN:				
MEAT INSPECTORS:				
MEAT EXAMINERS:				
MEAT CLASSIFIER				

OWNER / MANAGER

NAME	CAPACITY	ADDRESS / PHONE / FAX

HYGIENE MANAGER

NAME	CAPACITY	ADDRESS / PHONE / FAX

HAS - SCORE SHEET

CATEGORY	CATEGORY SCORE	WEIGHT	WEIGHTED SCORE	VERIFICATION BY PROVINCIAL INSPECTOR Date:..... Signature:..... Comments:.....
A. ANTE MORTEM		.10		
B. SLAUGHTERING AND DRESSING		.20		
C. MEAT INSPECTION / MARKING		.15		
D. CHILLING / DISPATCH		.20		
E. OFFAL PROCESSING		.05		
F. SANITATION / PEST CONTROL		.10		
G. PERSONNEL		.10		
H. GENERAL CONDITIONS		.05		
I. RECORDS		.05		
FINAL SCORE				

100																				EXCELLENT	
95																					
90																					
85																					
80																					GOOD
75																					
70																					
65																					
60																					
55																					
50																					
45																					
40																					
35																					
30																					
25																					
20																					
15																					
10																					
5																					
	A	B	C	D	E	F	G	H	I	FINAL											
	10	20	15	20	5	10	10	5	5	SCORE											