The abattoir's view of the material received from the producer.

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Introduction

The role of the abattoir industry in the meat chain has changed dramatically over the last number of years due to the privatisation of the industry. Where before abattoirs have acted mainly as an agent to slaughter livestock, the bulk of slaughter is now taking place by the owner of that livestock or at least of livestock that was bought for own account. In this respect abattoirs are taking responsibility for the product once it is slaughtered with regard to quality and safety, and at the same time have to incur losses attributed to the poor quality of purchased livestock.

The development of the meat industry is also such that abattoir owners are often more involved in the processing side of the product and this has placed an even more direct burden on the abattoir owner when livestock of an inferior quality is received.

Quality and safety issues with regard to meat are more often referred back to the abattoir owner due to the increased awareness among consumers on health related matters. Todays customers demand that the product is wholesome and free of residues and will stop buying a product, or search for an alternative supplier, if it does not prove to be the case. BSE, dioxin and the major outbreak of *E coli* food poisoning in Japan are only three major international food scares that had a direct influence on the market and especially the first two, rely heavily on producer assurances!!?? Can they be provided.....?

I would like to review some of the aspects with regard to livestock received by the abattoir which directly affects the safety and the quality of the product as well as the measures to confirm or rectify possible shortcomings.

Slaughter and abattoir statistics

Livestock are currently being slaughtered at 461 abattoirs in South Africa producing approximately 1.750 million cattle, 4.500 million lamb and sheep and 1,870 million pig carcasses. It is estimated that 80% of this production is slaughtered at 20% of these abattoirs.

Legislation pertaining to the meat industry

Of the approximately twenty acts and directives influencing the abattoir industry, a umber has direct reference to and shared responsibility by the producer.

The following is of more importance in this regard:

ABATTOIR HYGIENE ACT	**NO 121 OF 1992**
FERTILIZERS, FARM FEEDS, AGRICULTURAL REMEDIES AND STOCK REMEDIES ACT	**NO 36 OF 1947**
AN**ANIMALS PROTECTION ACT**	**NO 71 OF 1962**
LIVESTOCK BRANDS ACT	**NO 87 OF 1962**
ANIMAL DISEASES ACT	**N0 35 OF 1984**
MEDICINES AND RELATED SUBSTANCES ACT	**NO 101 OF 1965**
STOCK THEFT ACT	**N0 57 OF 1959**
DRAFT ANIMAL IDENTIFICATION BILL	**NOTICE 13 OF 1999**
SOUTH AFRICAN MEDICINES AND MEDICAL DEVICES REGULATORY AUTHORITY ACT (To replace act 36 and101)	**NO 132 OF 1998**

These acts mainly involve the producer in the following way:

Provision of an animal of which the ownership is proven and the necessary documentation is available to confirm this.

Transport of livestock in accordance with acceptable norms and standards to ensure the welfare of the animal and the quality of the product.

Presentation of a clinically healthy animal and the presentation of the necessary documentation and/or evidence if this may not be the case.

An assurance that the animals were not subjected to products which might lead to residue concentrations higher than what is safe for human consumption.

RISK ASSESSMENT

Risk assessments are the basis of the application of hygiene management systems such as HACCP which is now firmly established as the foremost means of assuring food safety throughout the food chain. Although the genuine application of HACCP principles can be difficult in the design of HACCP plans for raw food commodities, especially in the case with fresh meat, it is generally accepted that the status of the animal slaughtered, significantly influence the safety and quality of the product.

The following areas are examples of control areas(not always critical control points) at the abattoir to eliminate or reduce these risks:

Assessment of the transport used for animals to the abattoir
Ante-mortem inspection of livestock
Compulsory resting periods for slaughter stock
Measures to ensure the cleanliness of slaughter stock
Meat inspection
Slaughter processes and control measures to reduce the possible contamination of meat with the external skin/hide surfaces.
Routine and specific laboratory diagnostics to confirm disease conditions or residues.
Chilling

There are hundreds of food safety hazards and prioritising them according to the type of

product, process and end use, an effective, practical and economical safety management system can be developed. When analysing the hazards the risks can be assessed by determining: severity, incidence and onset.

Bacteria gain access to a carcass in the following ways:

Deep infection - the invasion of the musculature, via blood and lymph circulation. Such bacteria arise from either the intestinal tract which can infect the liver via the portal system or by the throat cut to cause the animal to bleed to death, allowing bacteria to enter the circulation system.

Contact or surface bacteriological contamination - the bacteriological load applied to the exposed surfaces of the carcass during the process of dressing and subsequent handling.

In general the micro flora on the meat will be that of the external surfaces of the animal, contaminating the meat by direct contact through air, water, soil, manure and the hands and tools of the worker.

Three critical factors which influence the microbiological status of meat are:

the microbiological status of the animal at slaughter
the extent of transfer of micro-organisms to the meat during slaughtering and
the temperature, time and other conditions of storage and ditribution.

The main sources of contamination are:

the slaughter man=s knife after the opening lines
the hands and fore arms of the slaughter man.
contact between freshly exposed surfaces of the carcass and dirty hide, fleece or slaughtering surfaces.

The following *control measures* have been shown to considerably reduce the *Salmonella* carrier rate in pigs, poultry and calves and thereby the related incidence of cases of food poisoning:

the use on the farm of feeding stuffs free from *Salmonella*
hygienic standards of animal husbandry, including proper control of slurry disposal and water supply and full protection from insects and rodents
hygienic conditions of transport and lairaging, with the avoidance of stress at all stages from farm to slaughter
proper design of slaughter lines and the adoption of efficient, hygienic methods of slaughter and carcass dressing which minimize cross-contamination
suitable sewage treatment
bacteriological monitoring, which should include a presence/absence@test for *Salmonella*
efficient refrigeration and hygienic methods of processing
1. avoidance of consumption of raw meats, unhygienic handling in the home and the use of storage systems which contribute to the proliferation of bacteria of all types
2. complete thawing of frozen meats and adequate cooking to ensure destruction of potential pathogens and spoilage organisms

The slaughtering process is described from the point of holding live animals to chilling of the carcasses. The skinning and evisceration steps are major sites of contamination and if these procedures are conducted in a correct manner, the degree of contamination can be reduced. The risk associated with the process is also to a large degree dependend on the status(cleanliness) of the livestock received.

Dehiding and Evisceration

Slaughter stock themselves are a major source of carcass contamination. Potentially pathogenic and spoilage bacteria reside mainly on the hide or the intestinal tract of animals slaughtered. Currently available dressing procedures cannot be relied upon to prevent or remove all of the bacterial contamination on the carcass surface. Evisceration can be carried out with minimal contamination of the carcass provided the intestinal tract is not ruptured or punctured. Experiences suggest that this is often not the case. The washing of the carcass does not substantially alter the bacterial load of the carcass and is mainly done to satisfy trade and consumer demand for a clean carcass.

Meat inspection

Meat inspection should be seen as an integral part of the slaughter and production process and is not regarded as an end product inspection. It consists of the following aspects:

Ante-mortem inspection
Primary (on the line) inspection
Secondary meat inspection of detained carcasses or organs
Laboratory analysis including screening procedures

A final decision about a carcass or part of one must be based on all the information obtained from these ante-mortem inspections, visual inspections, palpations, incisions, smells and laboratory analysis forth coming from these procedures.

The following areas of concern are addressed during this process:

An ante-mortem inspection is the first opportunity to:

recognize and have removed those animals that cannot be converted to a wholesome product or may act as a possible source of contamination
identify and slaughter separately animals suspected of being affected by a disease that might render the carcass or part of it unfit for human consumption
gather information of importance for the evaluation of the carcass during meat inspection. Examples are Rabies,Tetanus, diarrhoea and abscesses

A routine meat inspection remain the most important way to identify and remove pathology and abnormalities, including contamination that pose a threat to both the safety and quality of the product. The judgement of carcasses and organs are based on the :

severity of the lesions
the causes thereof

and the duration of the lesions.

Laboratory diagnostics and analyses are often used to confirm the presence, severity and/or extent of abnormalities. The use of veterinary drugs for the treatment , mitigation prophylaxis and diagnosis of disease as well as for the improvement of production in food producing animals also raises concern. Drug residues in food produced by animals may result in either systemic toxicity, reproductive toxicity, genotoxicity, carcinogenicity, immunitoxicity, antimicrobial- or pharmacological -effects following consumption in man. These effects may be acute or chronic in nature. An effective residue monitoring programme is essential to for the control of residues in meat. Laboratory analyses are also used to provide information on both individual cases and screening tests to detect the presence of residues.

Provided care is taken in the interpretation of results, microbiological examination of meat is of value in the assessment of wholesomeness, of hygienic methods adopted during slaughter, dressing and processing and of the efficiency of methods of preservation. It can also indicate the potential shelf-life and identify potential health hazards.

While it is useful to have a presence of absence of bacteria approach the possibility of false positives due to environmental contamination makes this difficult unless special precautions are taken, eg: use of laminar airflow cabinets.

The bacterial status of meat is determined in superficial and deep samples. *Superficial* samples may be taken by removing thin slices, by rinses, swabs or adhesive tape, or by the agar sausage and impression plate techniques. *Deep* samples of meat must be taken with care in order to avoid superficial contamination. They can be obtained using sterile scalpels and forceps or, in the case of frozen meat, a cork borer or an electrical drill fitted with a bore-extracting bit.

Although microbial counts have been made the basis of food microbiological analysis, they are defective indicators for the following reasons:

bacteria in food are not stable line heavy metals; their populations range constantly
food usually contains a variety of microorganisms, some or all of which may enhance or inhibit each other
time of sampling, usually at plant or retail shops, gives no indication of the final microbial count in the consumer=s home, long after sale
the number of organisms or amount of toxin or allergen which affects man is not known
environmental conditions, eg: temperature, pH and type of sampling, markedly influence bacterial growth
counting microbes is a cumbersome procedure

It is suggested that instead of trying to define food quality in terms of microbial numbers, attention is paid to those factors to which *human beings* respond, eg: changes in colour or texture, pH, concentrations of volatile sulphides, fatty acids, toxins and allergens.

Although much debate currently exist about the future of this traditional post mortem inspection procedures, and the failure to allocate inspection resources according to their maximum ability to reduce food borne diseases, it is suggested that this remain a critical control area under most South African abattoir conditions.The more abattoirs can rely on the quality of the livestock

received, the less important meat inspection procedures will become. It should also be used in conjunction with the generally accepted guidelines of an integrated and preventive approach such as HACCP.

Chilling

In general, low temperature preservation adds nothing to the quality of the final product. Its aim is only to slow down or arrest the micro -biological, biochemical and other effects that lead to spoilage. The quality and safety of the final product are determined by the initial quality of the muscle, hygiene standards during dressing and processing, temperatures throughout processing operations and finally the duration of and environmental conditions during the chilling and storage phase.

It is with regard to the chilling stages that conflicting factors with regard to safety and quality often exists. Current regulatory stipulations for both local and export requirements stipulate a deep bone temperature of 7^{o}C. Spoilage due to bone taint is unlikely to occur at this temperature. Low temperatures with high air velocities to obtain this temperature does however greatly increase the possibilities of cold shortening, resulting in tough meat.

Chilling procedures do not prevent the activity of spoilage organisms, which can grow at about 7^{o}C however, temperatures below 2^{o}C will delay the onset of slime formation.

Control of the relative humidity in chill rooms, eg: reducing the amount of A_w (water activity), can reduce bacterial spoilage, but results in a loss of carcass weight and liability to spoilage by psychrotropic bacteria and some moulds.

Residue monitoring

Agricultural chemicals and animal remedies are used extensively in SA to control pests and parasites in crops and to prevent and control diseases in livestock. These compounds may be taken up in the food chain and may therefore be in concentrations higher than the permitted maximum residue levels (MRL) safe for human consumption. Results have shown that in out of 5820 random samples tested during last year with the following results:

Antibiotics:

NATIONAL AGRICULTURAL MONITORING SCHEME

Results for the period 1997 - 1998

Species	No tested	% positive
Bovine	2842	14
Mutton	231	12

Poultry	371	56
Ostrich	366	18
Pork	360	55

Organochlorines:

22 tests out of 963 were above the maximum residue limits

Heavy metals:

3 tests exceeded the maximum residual levels.

National residue programmes conducted by Veterinary Public Health Authorities are currently used to verify the prevalence of residues and to provide health assurances to the local and international market. The responsibilities in this regard should rest with or at least be shared by the producer.

Some specific disease and conditions pertaining to livestock

The following conditions identified at the abattoir are not only related to the handling of the livestock or the product at the abattoir but are the result of a combination of factors which originated on the farm or on its way to the abattoir:

DFD in cattle *(Dark cutting meat)*

Introduction

The muscle cells in the carcass of a slaughtered animal continue living for a while by using stored glycogen for energy. This glycogen is converted to lactic acid which causes the acidity in the muscles to increase and thus the ph to fall. Normal lamb and beef carcases reach an ultimate ph after 24 - 36 hours (10 hours for pork).
Without glycogen reserves to break down after slaughter, the following changes will occur:

muscles become stiff almost immediately after slaughter
these muscles look black
are very firm
and retain water

This is referred to as **DARK CUTTING MEAT.**

Dark Cutting Meat is usually identified only during the processing stage and for this reason the incidence of the problem is not always certain. International literature does however suggests that the **cost to the beef industry may be as high as R20 - R30 for every feedlot animal slaughtered**.

Causes of DCM

The two main factors responsible for DCM are **EXERCISE and STRESS.** During exercise and/or exposure to stressful conditions, animals use up their muscle glycogen. This cause the ultimate ph to become progressively higher.

The following are examples of factors that might induce DCM:

disease
fever
strenuous exercise
mounting behaviour
fighting for social dominance of unfamiliar animals
being put in an unfamiliar situation
injury
change in weather conditions
nervous excitement

The stressors have their effect over a prolonged time before slaughter, usually more than four hours. DCM is not an all-or-nothing phenomenon and can occur in various degrees. At the same time it is often a combination of factors leading to the occurrence of DCM. Not all animals respond equally to these stressors.

Problems caused by DCM

Appearance:

DCM appears unattractive. This dark appearance is often associated with old animals or with meat that has deteriorated.

Sensory problems:

DCM has a changed flavour profile and is sticky

Tenderness:

The development of tenderness during aging is markedly slower in meat with an ultimate ph between 5.8 and 6.2. Meat in this ph range will be tougher.

Spoilage:

At higher ph values meat tenderization becomes very rapid, but this meat has a poor texture, poor cooking qualities and undergo rapid spoilage.

Determination of DCM

Extreme dark cutters can be identified by the **appearance** and feel of the cut meat surface.

Ph measurement 16 - 20 hours after slaughter accurately identify high ultimate ph responsible for DCM. Electrical stimulation immediately after slaughter can result in the meat reaching ph levels of 5.8 in about 2 hours.

Prevention of DCM

The following factors are important to reduce the incidence of DCM:

Strange animals should not be mixed shortly before slaughter.

Animals should be well rested before being presented for slaughter.
Stunning should be effective: Similarly the handling prior and during stunning should be in a calm manner.
Cattle should be transported in vehicles specifically designed to prevent unnecessary stress and injuries.
Water should always be available to cattle during the waiting period at abattoirs prior to slaughter.

Bruising

The incidence of bruising of cattle and the consequent losses to the industry, remains a serious concern to the meat industry as a whole. The really bad news is that bruises have probably stayed at the same level on a national basis during the last two decades and will remain that way unless measures exist to stop the current lack of accountability. Although the producer is currently not compensated for this trimmings, unless cattle are bought on the hoof, it is also not reflected in the payment as being condemned for this specific purpose. Surveys conducted has indicated that trimmings for this reason may be as much as .6 kg per carcass resulting in a loss of R 6 million rand per annum taking into account that part of this trimmings may be utilised for by-products if this facility is available. Unfortunately this is not always the case with decentralised slaughter facilities.

Wet carcass syndrome in sheep

Ovine wet carcass syndrome is a condition characterised by a wet shiny appearance of a carcass due to the accumulation of a watery fluid in the subcutaneous and other connective tissues of the carcass. Affected carcasses have poor keeping qualities and are also aesthetically unacceptable to the customer. Losses due to this condition as a result of condemnation or trimmings has a seasonal incidence of enormous proportions in the sheep industry.

Although this condition was researched and investigated during the last 15 years, it can be concluded that a number of factors influencing the food and water intake of sheep over an extended period prior to slaughter, may induce this condition.

They are:

Chronic ketosis during the week or days prior to slaughter.
Source of energy and feeding patterns during the feeding period.
Water deprivation patterns prior to slaughter.
Rest periods before slaughter.
Undue stress as a result of transport and handling prior to slaughter.

The interstitial fluid of wet or oedematous carcasses show the following significant changes compared to normal ovine interstitial fluid:

Total protein content (g/l)	(14 vs 52)
Albumin to globulin ratio	(3,2.vs1,5)
Osmotic pressure (mm Hg)	(3 vs 9)

Ovine wet carcasses can be prevented or at least controlled taking the following into consideration :

1) Slaughter sheep should only be restricted from water during transport periods

2) Slaughter sheep will be rested overnight or (at least) for 8 hours prior to slaughter
3) In the case of sheep subjected to poor feeding, this rest period may be lengthened with access to roughage 2 to 4 days prior to this period
4) Chilling period of suspect cases should be lengthened with an additional 8 - 12 hours under optimum condition e.g. air speed.

Although the development of ovine wet carcasses is of a multi-factorial nature with an underlying nutritional basis, the resolvement remain with both producer and abattoir industry to limit the condition to an acceptable level.

Value chain of red meat production

The relative contributions to value adding of stages in the meat marketing chain, using indicative estimates of costs associated with various stages of the transformation, allocate a minor contribution to the abattoir industry. Substantial guarantees are however expected from this sector to provide a safe and wholesome product to the consumer. The abattoir industry accepts this challenge, but rely on the added and sustained value to the product in the rest of the marketing chain to the benefit of the industry.

Conclusion

The South African Meat Industry is facing fairly difficult times as a result of issues ranging from higher feed costs, climatic conditions, decline in consumption and general economic factors. There is no single magic answer. It is the responsibility of every sector to make sure that the product they pass on to the next, is safe and provide quality assurances to the consumer.

It is only with an integrated approach of this kind that we can safely say.

CONSUME RED MEAT, IT IS GOOD FOR YOU!!

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