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OPINION OF THE

SCIENTIFIC COMMITTEE ON VETERINARY MEASURES RELATING TO PUBLIC HEALTH

ON

REVISION OF MEAT INSPECTION IN VEAL CALVES

(adopted on 14-15 April 2003)

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1. BACKGROUND

The present legislation governing fresh meat and its mandatory inspection is laid down in Council Directive 64/433/EEC as amended by Directive 91/497/EEC.

One of the most important goals of meat inspection, as stated in a previous opinion of the Scientific Committee on Veterinary Measures on Public Health (SCVPH), is to prevent transmission of zoonotic infections and other contamination to the consumer.

The Commission is revising the legislation on meat inspection, as one of the actions foreseen in the White Paper on Food Safety.

The SCVPH has already produced several opinions in relation to meat inspection revision, in particular, one opinion adopted in February 2000 and related to "revision of meat inspection procedures for fattening pigs" (SCVPH, 2000a). In this opinion the Committee stated that: not all lesions are best detected in current meat inspection system…, - there are limitations in terms of consumer health protection in the current procedures…; - there are risks of cross-contamination; - there exists a possibility to tackle meat inspection in a more targeted approach, possibly with a system of "hand-off" inspection, when an integrated system of production is applied".

A second opinion on the control of taeniosis/cysticercosis in man and animals was adopted in September 2000 (SCVPH, 2000b).

A third opinion was issued in June 2001 on "identification of species and categories of meat-producing animals in integrated production systems where meat inspection may be revised" (SCVPH, 2001). This was considered to be a first step approach for the revision of meat inspection procedures.

2. TERMS OF REFERENCE

Considering the above and in view of the future process of redrafting the legislation the Scientific Committee on Veterinary Measures on Public Health (SCVPH) is asked:

- to review the post-mortem inspection procedures for veal calves raised in integrated production systems, at present mandatory, concentrating on the palpation and the incisions.

In particular, for each of the currently required palpations or incisions, to determine:

- which disease or other process is targeted;

- the pathogenic agent and the relevance for human health;

- the risk for Public Health if procedure(s) are to be omitted for the inspection of animals raised in integrated production systems;

- whether alternative methods, including use of laboratory and rapid methods, could ensure a level of health protection at least equivalent to that provided by the current procedure.

3. INTRODUCTION

3.1. Definition

Veal is the meat from a calf or young beef animal and conventionally, veal calves have been reared on all-liquid diets that are digested post-ruminally. Varying terms are used to describe different types of veal calves this include:

- 'bob veal' for calves up to 3-4 weeks or up to a live weight of 70 kg,
- milk-fed veal for those reared on a feed programme using milk-based feeds,
- grain-fed veal for those reared on a feed program using milk based feeds for the first 6 weeks and then given a whole grain-corn and protein supplemented diet, excluding protein of animal origin.
- 'white' veal for calves slaughtered at approximately 16-19 weeks of age.

For the purposes of this report a veal calf is considered as an animal with an upper age limit of 7 months and up to 250 kg liveweight. For veal calves older than over seven months or exceeding the 250 kg equivalence to the conditions of this opinion will have to be shown before the findings of this opinion are applied.

Definitions of calves as laid down within EU legislation are listed in Annex I.

3.2. Veal market and transport

Veal calf production is an important sector of bovine animal production, closely related to dairy production as dairy cows must give birth to continue producing milk. However, male dairy calves are of limited value to dairy farmers who require heifer calves as ultimate replacements for their dairy cow herds. Many surplus calves, and the males in particular, are used in the veal industry while others are raised to maturity and used for breeding or slaughtered as mature beef animals.

Veal is consumed mainly in France, Italy and Germany and The Netherlands that in addition are also important producers of veal calves. A decrease in the number of calves produced, particularly in France and Germany, has been partly compensated by an increase in the carcass weight, especially in The Netherlands and Belgium. For the same reason some countries have turned to sourcing calves from Third Countries. In Italy approximately 60-70% of the veal calves reared and slaughtered come from national dairy cows and the remaining portion are imported from Eastern European countries.

The typical method for veal producers to source calves is through livestock auctions, although in some cases the calves may be moved directly from the dairy farm to the veal unit. Calves from local dairy cow herds are normally collected at the farm of birth during the second week of life, and taken to an

assembly centre from where they are sent to the fattening farm before they are 30 days old. In some cases the calves go directly from the farm of birth to the farm of rearing.

Calves born in EU Member States are individually identified and tagged at the farm of birth during the first week of life. Each of them, therefore, carries two identical ear tags and a passport with the identification code, date of birth, sex, breed, the registration number of the farm, the identification code of the mother, etc. Within Member Sates, movements of the calves are registered in the passport, including movements to assembly centres and fattening farms. Such a procedure allows for a complete traceability of individual animals.

Calves from non-EU countries follow a similar scheme: collected from the farm of origin, assembled in centres where they can be sold and then sent directly to the final fattening units or sent to a second assembly centre before being sold and sent to the fattening farm. Identification of such calves is performed in the fattening farm of destination in an EU country according to European rules. Only calves that have a full proof of origin can enter an integrated system. Assembly of animals, transport and distribution to the final farm of destination requires more time for extra EU calves and for that reason the fattening cycle begin about 10 days later than EU born animals.

The veal industry in Europe is a specialised system carried out by specialised fattening farms normally located not far from the slaughterhouses with travelling time less than 2 hours. However, in some cases, travelling distances can be considerably longer but usually do not exceed 3-4 hours. Normally veal calves do not stay overnight at the lairage of the slaughterhouse and are slaughtered the day of arrival.

In general, calves are transported three times during production:

- from the dairy farms to the auction markets / assembly centres,

- then to the veal calf unit / fattening farm,

- at the end of the production cycle to the abattoir.

In all cases welfare of the calves could be adversely affected, especially in the case of animals imported from outside the EU, due to a more prolonged duration of the journeys. The initial transport to the action market / assembly centres and onwards to the veal calves units have important animal health implications (they expose the calves to the risk of shipping diseases (e.g. pneumonia, diarrhoea) whereas the transport to the slaughterhouse is more important for the risk of cross-contamination by pathogenic micro-organisms.

3.3. Rearing systems, housing and behaviour

Since the 1960's and the development of milk substitutes, veal calf production has developed as a rearing system totally independent from dairy farms. In this system, calves are generally isolated from their mothers, kept

inside, mostly reared in pens on a slatted floor for the whole fattening period and solid feed consumption is minimised.

Calves are reared in varying systems depending on the market demands, technical developments and on the availability and price of dietary milk substitutes. In the past, calves from dairy herds were often slaughtered as so-called 'bobby calves' when a few weeks of age, but this system is generally no longer practised in Europe.

Veal calves from suckler herds are often reared indoors until the age of four to five months. They receive only a milk diet from their mothers or from other cows and may also receive concentrates and some roughage.

In some systems, cows from dairy or suckler breeds are suckled by 2 to 4 calves indoors under controlled conditions twice daily, or freely at pasture while calves are between 4 weeks and 7 months of age.

Over the last two decades there has been increasing public concern for the welfare of veal calves: considering the small space allowance per calf, lack of social contact, the barren environment in which the calves are kept, the denial of roughage and the low haemoglobin levels maintained to produce the white meat. For such reasons, group housing is increasingly being adopted in the EU. Calves are reared in group pens for up to 6 months from entering the fattening farm with the entire cycle from birth to slaughter lasting up to a maximum of 7 months. At the beginning of the cycle the liveweight is approximately 50-60 kg and generally between 230 and 250 kg at slaughter producing a carcase weight approximately 60% that of the liveweight.

Within the EU there are various schemes and accreditation systems for veal calves all with specific rules and requirements. Some further information is provided in chapter 3.5.

Group housing involves less restriction on the behaviour of calves and allows for greater social contact between calves. Although animal behaviour is generally satisfactory in the group pens, there may be a higher incidence of feed competition with resulting physical injury and abnormal behaviours such as cross-sucking and urine-drinking can also occur. The supply of fibre appears to reduce the incidence of such problems. Calves which cannot be kept satisfactorily, due to abnormal behaviours, in group pens are placed in individual pens.

3.4. Diet

The young calf at birth, has a stomach in 4 parts, although the abomasum (fourth part) is the only functional one. Liquid feeds travel directly to the abomasum via a tube formed by the closure of the oesophageal groove.

Calves have low levels of circulating immunoglobulins (IgG) at birth and consumption of adequate amounts of high-quality colostrum by the calf within 24 hours after parturition provides passive immunity and reduces subsequent mortality.

After birth, for several weeks, the calf's gut is principally adapted for the digestion of milk. During the first 4 weeks of life, the only nutrients that can be efficiently utilised when given in liquid diets are milk proteins, vegetable oils , butterfat, or other animal fats, sugars (lactose and glucose), and of course minerals and vitamins. Calves can manage for some months without any solid feed and without rumen development. When solid feed is ingested, the structure and the motility of the intestinal tract change. The feeding of solid feed to veal calves has been encouraged to satisfy their need to ruminate. A minimum daily ration of fibrous food should be provided for each calf over two weeks old, the quantity being raised from 50g to 250g per day for calves from eight to 20 weeks old (Commission Decision 97/182/EC).

Veal calves in fattening units nowdays are fed with milk or a milk substitute which can be digested post-ruminally. Feeds are based on reconstituted milk, a liquid food obtained by dissolving a mixture of defatted milk powder, proteins, fats, vitamins and minerals of various origins. Skimmed milk and other dairy proteins is used in up to 50% of diets but in some cases it may not be used at all. After approximately 1 month from the beginning of the fattening cycle the diet is supplemented with fibre to stimulate the rumen. At slaughter the rumen shows signs of development but the calves do not ruminate normally.

The main production goal with veal calves is to obtain a pale pink meat, a so-called ‘white meat’, and any darkening in meat colour may decrease the value of the meat. The meat colour is directly linked with the myoglobin content and, in order to reduce the synthesis of myoglobin in the muscles, dietary iron intake is restricted. The iron pool of the new-born calf is limited and the iron content of milk and some roughages are low. Iron-deficient calves can develop anaemia and there is a relationship between meat colour and blood haemoglobin concentration of calves. The milk replacer diet contains a minimal iron content to ensure that the blood haemoglobin level does not fall too low and that growth rate and disease resistance remain adequate. The fibre, as with all other nutrients including water, has a controlled iron content to help maintain the typical pale pink colour. The Commission Decision 97/182/EC, amending the Annex of Directive 91/629/EEC, states that the feed of calves shall contain sufficient iron to ensure an average blood haemoglobin level of at least 4.5 mmol/litre.

When additional protein is provided in the diet the source of the protein is from non-animal origin taking note of the requirments to prevent the spread of transmissible spongiform encephalopathy agents via animal feed.

3.5. Certification/Quality Assurance scheme

Veal calf production in the EU is increasingly moving towards specialised integrated production systems frequently working on a franchising based and ‘all-in-all-out’ system of animal production. Integrated production systems are generally certified by independent bodies, in some countries in close co-operation with local authorities (e.g. inspection services of the Ministries of Agriculture and of Public Health). Certification is the latest development of a trend which began in the 1970s and 1980s in reaction to scandals related to

the use of hormones in animals and which saw the producers taking steps to reassure the consumers on the safety of their products. Although initially the focus of the producers was mainly directed at guaranteeing the absence of hormones and antibiotics during fattening, the system now considers a wide range of residues and contaminants, as well as control of feed, housing and animal welfare.

Certification systems are based on specifications agreed between the stakeholders (association of veal producers, franchising consortium, etc.) and the competent authorities. Details of criteria to be met by producers are laid down as well as the required detailed verification and inspection programme to be performed by an accredited organisation. Verification is performed at the fattening farms as well as at the slaughterhouses. Samples are taken by official staff and laboratory examination is made in accredited laboratories. Non-compliance with the rules in place results in the infliction of penalties, the most common penalty inflicted being exclusion from the integrated system.

The main features of such certification systems, in addition to the legislative requirements of legislation are:

1. Complete traceability of the production chain (from birth of the calf to pre-packed fresh meat in the shops).

2.Traceability of the origin of feed used for each batch is precisely determined.

3. Animal performance data: growth rate, feed consumption, mortality.

4. Controls on animal welfare (housing, feeding, etc.), origin and breeding of the animals, correct identification of calves, length of the fattening cycle (e.g. dates of arrival to / departure from the farm, breed, animals used).

5. In addition to the monitoring performed by the authorities as required by local or EU legislation monitoring, at least once for each production cycle testing at the farm and at the slaughterhouse for growth promoters and therapeutic substances.

6. Evidence of external independent verification of the whole system.

3.6. Diseases in calves

Although a range of disease conditions can be seen in veal calves, the most predominant diseases relate to intestinal and respiratory conditions. Possible preventive measures include strict sanitation along with temperature, humidity, and vetilation control, including avoiding draughts. Calf pens should be routinely cleaned, disinfected and bedded with clean straw or shavings (Radostits *et al.*, 1999; Andrews, 1992).

3.6.1. Conditions affecting different systems and organs

3.6.1.1.Skin

Dermatophytosis (ringworm) is a fungal, zoonotic disease seen in veal calves.

3.6.1.2. Alimentary system

Oral and laryngal necrobacillosis (infection with *Fusobacterium necrophorum*) can be observed mostly in calves in young calves (necrotic stomatitis) up to 18 months of age (calf diphteria). Other infections of the oral cavity in bovines (e.g. *actinomycosis, actinobacillosis*) affect older animals.

Gastric disorders in young calves include 'indigestion' associated with 'ruminal drinking' when the milk enters rumen due to insufficient closure of the reticular groove. This can occur primarily in calves milk fed from a bucket, and the calves consequently develop lactic acidosis of the rumen that leads to ruminal parakeratosis and poor growth.

Abomasal tympany in calves can be observed when dietary changes occur and abomasal ulceration is a common finding in veal calves slaughtered at 3-5 months of age (Radostits *et al.*, 1999). The more frequent cause of these ulcers is linked to the ingestion of straw. Most of these ulcers are subclinical and non-haemorrhagic but, occasionally, abomasal ulcers can perforate leading to peritonitis or bleeding.

The most important pathogens associated with diarrhoea in calves are enterotoxigenic *Escherichia coli*, rotavirus, coronavirus, *Salmonella* spp. (especially *S.* Dublin, *S.* Typhimurium), *Cryptosporidium* spp (especially *C. parvum*), *Clostridium perfringens* type C (necrotic enteritis mainly under 10 days of age) and *Eimeria* spp.. Bovine viral diarrhoea virus can also be involved in diarrhoea in veal calves (oral ulceration may be seen). Various other agents can be also implicated: *Giardia*, *Campylobacter* spp. with a mild enteritis, *Yersinia* spp. associated with enterocolitis, *Clostridium* spp. with *C. sordelli* producing mild disease, *C. perfringens* type A a mucoid diarrhoea. In addition parvoviruses, caliciviruses and breda virus have been found, but the exact importance in the field of these viral pathogens for calves is unknown (Radostits *et al.,* 1999; Andrews 1992).

3.6.1.3.Respiratory system

Major respiratory problems in veal calves include a rhinitis with a laryngotracheitis (Infectious bovine rhinotracheitis/IBR), or pneumonia. Pneumonia frequently occurs in calves as a sequel to, or simultaneously with, infectious diarrhoea linked to immunocompetence and thus resistance to some bacteria and viruses.

Major pathogens involved in pneumonia of calves are: bovine respiratory syncytial virus (specific strains different from the same human pneumoviruses), bovine viral diarrhoea virus, parainfluenza virus type 3, *Mannheimia (Pasteurella) haemolytica*, *Haemophilus somnus*. Other

bacteria can occur in combination with other pathogens: *Mycoplasma* spp., *Arcanobacter (Actinomyces) pyogenes*, *Pasteurella multocida, Chlamydia psittaci, Bacteroides melanogenicus, Streptococcus* spp.. Also, aspergillosis (allergic bronchopulmonary aspergillosis) has been shown to occur.

It has been demonstrated that even calves of between 1and 4 months age can develop a severe clinical *M. bovis* tuberculosis, which in some cases may be concurrent with Bovine Viral Diarrhoea (BVD) infection (Monies and Head, 1999) tuberculosis in cattle, including calves, caused primarily by *M. bovis*. It has been shown that calves can become infected with *M. bovis* if in contact with other TB-infected bovines. For example, contact of 6 uninfected calves with 10 infected calves resulted in infection of all in-contact calves, and even mixing of 1 infected calf with 3 in-contact calves resulted in isolation of *M. bovis* from 2 in-contact calves (Cassidy *et al.*, 1999).

3.6.1.4.Umbilicus

Navel infections usually arise as a result of infection with *E. coli*, *Arcanobacter pyogenes* or other bacteria that enter via the torn umbilical stump at the time of birth. The local infection is frequently accompanied by septicaemia. Navel sucking may predispose calves to the development of navel infections or exacerbate existing infection. Omphalitis, omphalophlebitis and/or umbilical abcess are seen ususally in single calves usually 2-6 weeks of age with a large painful swelling of the umbilicus, includes *Arcanobacter pyogenes, E. coli*.

3.6.1.5.Skeleton and muscles

Septic arthritis usually arises as a complication of neonatal septicaemia. Many cases of arthritis are aseptic inflammation arising from chronic pressure and abrasions.

The indoor production system for veal calves prevents exposure of the calves to *Taenia saginata* eggs.

3.6.2. Associations between occurrence of diseases and the age of calves

These associations can be considered in the context of the following typical periods in veal calves production: neonatal period and three periods of the fattening phase (‘start-up’, ‘intermediate’, and ‘end’ periods).

3.6.2.1.Neonates

Many cases of death within the first day of life are a sequel to obstetric complications and congenital disorders. The deaths and diseases which occur subsequently can mostly be attributed to digestive or infectious problems, especially septicaemia. A contributory factor can be inadequate colostral immunity, improper feeding or housing, or adverse environmental conditions. Neonates that survive acute sepsis often develop localised infections, such as pneumonia, uveitis, synovitis, meningitis, hepatitis and enteritis. These conditions may have the consequence of increasing the age at slaughter.

3.6.2.2.Calves under 6 weeks age ('start-up' period)

Diarrhoea

Calves that need to adapt to the new environment, the stress of travel and dietary change, can develop transitional diarrhoea. The incidence varies greatly, from a few percent to 20% (Braggs; personal communication), depending on the size of the batch (range from 200 to 800 calves).

Diarrhoea caused by *Cryptosporidium parvum* can occur, but is generally self-limiting and resolves naturally.

Diarrhoea caused by *Salmonella* spp.,commonly, *S.* Typhimurium and *S.* Dublin, is normally introduced with calves. Clinical signs of *S.* Typhimurium are generally at up to 5 weeks, mainly enteric lesions, and often are bacteraemic (Radostits *et al.*, 1999). In *S.* Dublin infections, which peak in incidence in 6 week old calves, principal signs include dyspnoea, respiratory symptoms, sudden death, with occasional diarrhoea. As a rule, salmonellae are very seldom detected in the faeces of calves older than 6 weeks.

Diarrhoea, caused by Coronavirus and Rotavirus, also can occasionally occur.

Respiratory problems

Lung infections are usually multifactorial, caused by *Mycoplasma* spp., viruses and complicated by *Mannheimia* (*Pasteurella*) spp., and probably represent the most persistent health problem in this age category of calves.

3.6.2.3.Calves 6-18 weeks old ('intermediate' period)

Generally, this age category is characterised by the lowest incidence of health problems but those receiving some roughage can develop tympany.

Lung infections, mentioned in the previous age category (Section 3.6.2.2), continue to represent the most common health problem. The implicated infective agents include viruses, Infectious Bovine Rhinotracheitis (IBR) virus and Bovine Respiratory Syncytial Virus (BRSV), with secondary bacterial complications.

Arthritis caused by *Mycoplasma* spp. can occur, particularly in batches of calves that have been treated with antibiotics for an extended period of time.

3.6.2.4.Calves 19-30 weeks old ('end' period)

During this period, calves are fed at an intensive level, and receive both milk replacer and roughage.

Diarrhoea occurs very rarely, but it is often unclear whether it is caused by infective agents (viruses or bacteria) or by a nutritional disorder.

Sudden death also can occur, with pathological findings including bloody gut contents in which, microscopically, an unusually high number of

Clostridium spp. can be observed. Calves may also sometimes die from a gut torsion, which can be caused by fermentation of the colon content.

3.6.3. Calves at slaughter

3.6.3.1.Postmortem findings in slaughtered calves

At the slaughterhouse the main pathologies observed, in decreasing order of frequency according to available data, would appear to be:

- kidney: hydronephrosis, nephritis, pyelonephritis, petechiae
- lungs: inflammation of the lungs and pleura, mainly in a chronic form;
- liver: fatty degeneration, abscesses;
- abomasum: ulcers;
- heart: calcification of the endocardium;
- bowel: enteritis;
- tongue: injuries;
- carcass: emaciation and/or muscular oedema, icterus, chronic arthritis (non-septic), transport injuries, septicaemia, colour anomalies;

Pathologies other than those regarding the lungs have a frequency <2%. Total condemnation of carcasses is rare and are linked nearly exclusively with severe emaciation, and occasionally, icterus, septicaemia and colour anomalies.

3.6.3.2.Zoonotic agents associated with slaughtered calves

Human health hazards associated with slaughtered veal calves comprise human pathogenic bacterial agents (including from rare cases of septicaemia and multiple abscesses), fungal agents, and parasitic agents.

Calves can be healthy carriers of, or surface contaminated with, other zoonotic pathogenic bacteria, e.g human pathogenic ETEC, *Campylobacter* spp.and *Salmonella* spp. (see Chapters 3.7 and 3.8).

Among these, of particular interest is *M. bovis*, which is, however, much more frequently present in adult cattle than in veal calves. The risk is higher from calves that have suckled for unusually long periods, which may occur in those born outside the EU. Tuberculosis can presently be detected at meat inspection by incision and visual inspection of lymph nodes and some organs, and the lesions are found primarily on lymph nodes draining head and lungs (Wilesmith *et al.,* 1982).

Erysipelothrix rhusiopathiae occurs rarely in calves, but an outbreak of related septicaemia with post mortem lesions of abscesses in liver and lungs

(Rehbun, 1976), as well as cases of related arthritis (Orsini 1990), have been reported.

Other zoonotic bacteria potentially present in some healthy slaughtered calves include *Listeria monocytogenes*, *Leptospira* spp., *Yersinia enterolitica*, *Micobacterium. paratuberculosis* and *Brucella.*

The transmission of zoonotic fungi (ringworm / dermatophytosis) to humans can occur via contact with the skin of affected calves.

With respect to zoonotic parasites, the main concern is with *Cysticercus bovis* and Criptosporidium. However the housing of veal calves and the use of appropriately treated forage prevents exposure of the calves to *Taenia saginata* eggs.

3.7. Farm to slaughter phase: public health risks

Farm-to-abattoir handling of animals can have detrimental effects on meat safety and quality including:

- induction and/or spread of specific animal diseases,
- spread of contamination of animals with pathogenic organisms, including those not causing specific clinical diseases in animals, and
- fatigue and/or mechanical injuries (bruising) reducing the commercial value of meat.

Effects on specific diseases

The issue of the effect of transport of animals (including calves) on the infection with, and spread of, specific animal diseases has been highlighted previously (SCAHAW, 2002). This report identified several actual or potential contributing factors, which are briefly mentioned below.

A variety of stressors are associated with transport and they, by decreasing the efficacy of the immune system, enhance the susceptibility of animals to infection and disease. In cattle, this is particularly relevant for diseases with multifactorial causation, where the immune status is a major factor, such as pneumonia caused by *Mannheimia* spp. and *Pasteurella* spp. (shipping fever) where the pathogens are present in the host before the transport. Other pathogens of special importance in shipping fever in cattle are bovine respiratory syncytial virus, infectious bovine rhinotracheitis, and para-influenza virus 3. It has been shown that pneumonia caused by bovine herpes virus-1 in calves is increased by transport. On the other hand, the effect of stressors on development of some largely monocausal diseases, such as foot and mouth disease where the immune status is less important, is not obvious (SCAHAW, 2002).

Transport can increase the incidence of clinical illness of animals that are incubating a disease or are sub-clinically infected and thus increase the level and/or duration of pathogen shedding. In addition, transport intensifies the

frequency of contacts between animals which significantly influences the rate of pathogen transmission between them.

Carriage of pathogenic organisms

Apparently healthy animals, showing no clinical signs of disease can excrete pathogenic microorganisms in the faeces, and carry them on their coat skin. The transport and lairage of the calves allows for spread of organisms that as a result contribute to carcass contamination during the slaughter process.

Faecal excretion of pathogens is a source of cross-contamination during transport and lairaging (Watson, 1975). It was demonstrated that calves known to be free of *Salmonella* spp. and separated from excretor calves by a double partition became faeces positive for *Salmonella* spp. (Gronstol *et al.*, 1974), probably as a result of faecal splashing and subsequent licking. It has also been demonstrated that faecal excretion of *Salmonella* spp. in calves can increase from 0.6% to 35.6% during 2-5 days at a collection centre (Anderson *et al.*, 1961), and in adult cattle from 18% on-farm to 46% after arrival to abattoir (Barham *et al.*, 2002). Other pathogens, such as *Campylobacter jejuni,* can also be excreted during the farm-to-abattoir phase, and as they have been found in 74% and 54% of rumen and faeces samples respectively from slaughtered calves (Grau, 1988) it is essential that spread to the carcase is avoided by hygienic slaughter.

Contamination of the animal coats with pathogens is recognised to be from various animal-to-animal and/or animal-environment-animal routes during transport-market-lairage but there is limited information regarding pathogens on hides of veal calves. Grau (1988) reported 58% being positive for *C. jejuni* and 71% for *C. hyointestinalis*. However, *Salmonella* was found on hide of 15.4% of slaughtered beef cattle (Bacon *et al.*, 2000), and levels on cattle hair can be as high as $4x10^6$/g (Patterson and Gibbs, 1978). It has been demonstrated that on-farm prevalence of *Salmonella* on hides of beef cattle (6%) increased dramatically to 89% after transport to abattoir (Barham *et al.*, 2002). The prevalence of VTEC O157 on cattle hides can be between 11.7% and 74% (Elder *et al.*, 2000; Midgley and Desmarchelier, 2001; Small *et al.*, 2002; Reid *et al.*, 2002; Avery *et al.*, 2002), and genetic fingerprinting demonstrated that significant cross-contamination of cattle hides occurs in the abattoir lairage (Avery *et al.*, 2002).

Factors contributing to spread of surface contamination of cattle hides during transport and/or markets and/or lairaging include extended duration of transport or holding times in lairages (Samuel *et al.*, 1979), poor hygiene of vehicles and/or pens (Gregory, 1994; McClain *et al.*,1997; Small *et al.*, 2002), and contacts between animals and/or with the environment including lying on contaminated floor (Cockram, 1991; Atkinson, 1992; Small *et al.*, 2002).

Associated health risks

Taking into account the above considerations, there is little doubt that during the farm-to-slaughter handling phase there is an increased risk from induction/spread of specific diseases in calves and also of their contamination with faecal pathogens. Therefore the more complex farm-to-

slaughter system, the higher the overall meat safety risk (as illustrated in Fig. 1).

Inspection during farm-to-slaughter phase

Animals can be inspected before, during and after the farm-to-slaughter phase. The Federation of Veterinarians of Europe's Position Paper on the transport of Live Animals (FVE, 2001) provides information on those conditions that render an animal unfit for travel. This include animals where navel has not completely healed, and calves <14 days old are considered unfit to travel.

The Report of the Scientific Committee on Animal Health and Welfare (SCAHAW, 2002) on the welfare of animals during transport describes inspection before and after transport in more detail. It concludes that the veterinarian is the person ultimately responsible to declare fitness (including absence of diseases) for travel of food animals, including calves, as well as disease conditions on arrival at a slaughterhouse (ante-mortem inspection).

Whilst veterinary inspection can considerably reduce the spread of disease during farm-to-slaughter phase, it cannot prevent it. Despite the animals being checked by a veterinary surgeon before the journey (that may last one or more days) they may develop a disease during the journey and transmit it at the market or abattoir. In addition faecal excretion of pathogens from apparently healthy calves, with spread to other calves and/or surface contamination can occur.

Other potential control measures

Recent studies showed that pre-slaughter fasting, previously advocated, is not an effective measure of controlling faecal pathogens. In fact, there are reports that withdrawal of feed for 48-hours makes calves more susceptible to infection by, and shedding of, VTEC O157:H7 (Cray *et al.*, 1998), although other researchers failed to find a clear association between feed withdrawal and increased faecal shedding of VTEC O157:H7 in calves (Brown *et al.*, 1997).

Routine cleaning and sanitation of transport vehicles (Oosterom *et al.*, 1983) and/or lairages (Swanenburg *et al.*, 2001; Small *et al.*, 2002) to a visually clean standard is necessary, but may not entirely eliminate *Salmonella* spp. or VTEC O157:H7 contamination.

Several EU Member States have used a visual rating system to assess the cleanliness of cattle as a measure to reduce hide-carcase cross-contamination. There are reports that this system can reduce the proportion of excessively dirty cattle presented for slaughter (Ridell and Korkeala, 1993) and the total bacterial load on respective carcasses It may be that such a system is more reliable at lot level rather than at individual animal level (Jordan *et al.*, 1999). Overall, no direct correlation between visual cleanliness and presence/levels of pathogens on cattle hide has been clearly demonstrated.

Earlier attempts to reduce microbial contamination of animal coats by pre-slaughter washing of live animals had little or no success, and efforts more recently have been focused on post-slaughter, pre-skinning, decontamination of hide. It seems that de-hairing of the slaughtered cattle hide using sodium sulphide and hydrogen peroxide can significantly reduce the numbers of VTEC O157:H7 present (Castillo *et al.*, 1998), as can thermal treatment based on steam-condensing at sub-atmospheric pressures (McEvoy *et al.*, 2001). Although the technical difficulties and the economic aspects of such treatments remain to be fully evaluated under commercial conditions, hide decontamination may be considered as a promising potential control point conveniently placed at the end of the farm-to-slaughter phase.

General assessment of public health risks associated with farm to abattoir handling

From a meat safety perspective, along the transport-markets-abattoir chain of events, animals with high health status can become contaminated with pathogens introduced in the environment by animals originating from farms, is of particular concern. If such spread of pathogens occurred to a significant extent, it could largely diminish or negate positive effects achieved in the on-farm control. It is well recognised that any contamination of the animal's coat can result in meat contamination during the skinning and processing of the carcass. Abattoir lairages, in addition to livestock markets, are places where, directly or indirectly, mixing of animals from different farms takes place, with potentially negative consequences from the perspective of transmission of zoonotic agents.

As the animal-to-animal, animal-to-environment and environment-to-animal spread of pathogens occurs in animals during the farm-to-abattoir phase a range of different related scenarios are possible, each with different levels of meat safety risks (see figure 1). However the knowledge regarding the exact, quantitative effects of spread of health hazards in veal calves (as well as in other meat animals) during the farm-to-abattoir phase on carcass meat safety is insufficient.

The main safety concern of veal production concerns microbiological contamination by zoonotic pathogens. Transport and slaughter handling play a major role by creating the conditions both for the spread of contamination among animals and for the contamination of carcasses and fresh meat at the slaughterhouse.

A recent study of Nesbakken *et al.* (2002), for instance, has shown a high relationship between antibody titres and presence of virulent yersiniae in the pigs tonsils. The research has also shown the high contamination risk represented by the incision of tonsils and submaxillary lymph nodes.

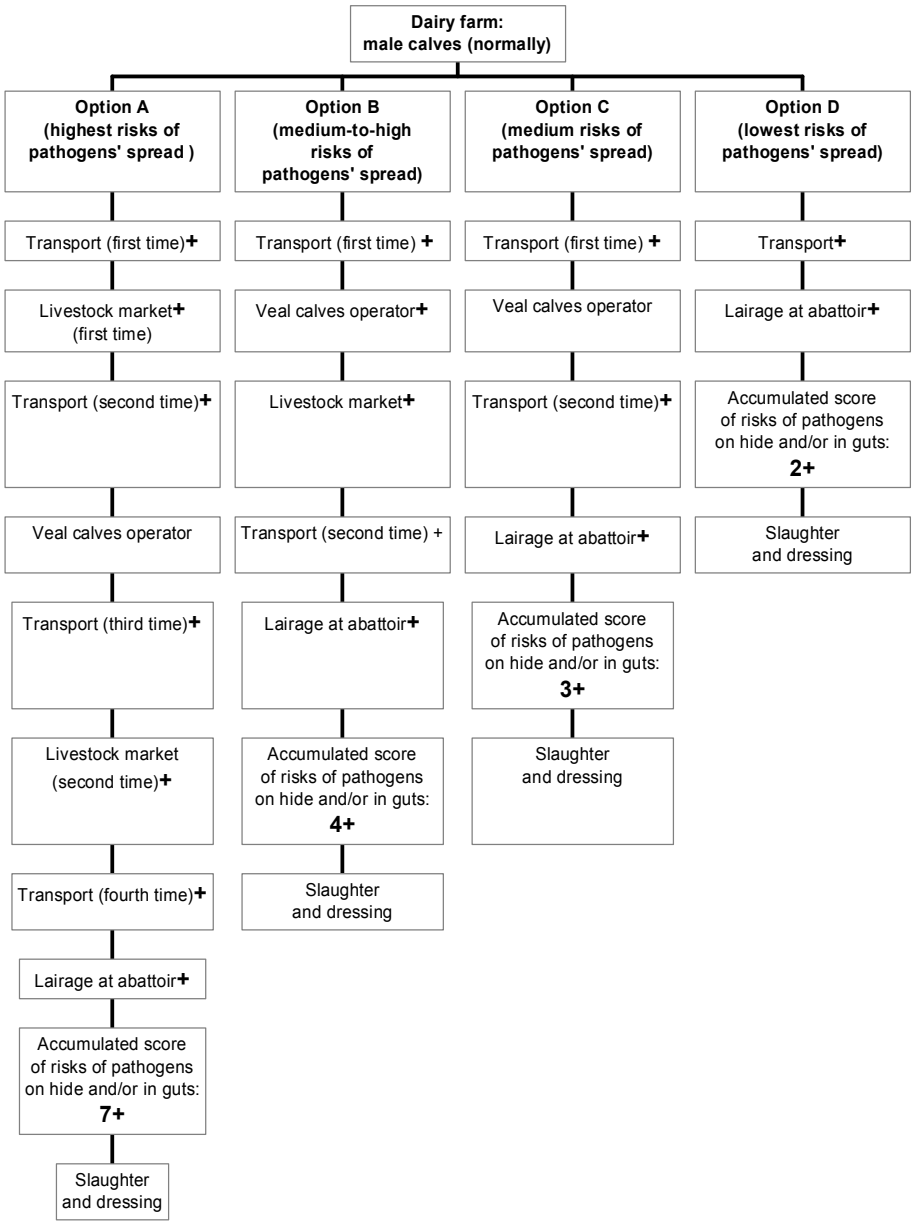

Figure 1: Opportunities for pathogen spread from farm to slaughter*

symbol '+' indicates likely post-farm gate spread of pathogens via animal-animal and / or animal-environment-animal contacts

3.8. Slaughtering and dressing background information

As indicated before, a significant proportion of cattle including veal calves can carry pathogenic microorganisms in their gastrointestinal tract and/or on hide without any signs of disease ante-mortem, or visible lesions post-

mortem. During slaughter and dressing procedures, these pathogens, including VTEC O157, *Salmonella* spp., *Campylobacter* spp. and *Listeria monocytogenes* can be, directly or indirectly, transferred onto the meat but will not be visible to the meat inspection staff during conventional meat inspection of veal calves.

Such meat contamination is primarily a process hygiene issue. Consequently, contamination can be reduced through a more preventative approach based on systematic development and implementation of: a) Good Manufacturing Practice (GMP) dealing with general hygiene requirements as a pre-requisite; and b) Hazard Analysis and Critical Control Points (HACCP) system dealing with identification of the specific processing points where any contamination occurs, as well as with corresponding control measures applied at each identified point (e.g. Critical Control Points (CCPs)).

As slaughter and dressing technologies vary between different abattoirs, HACCP plans have to be specifically tailored for individual abattoirs. Nevertheless, some common CCPs are applicable to all cattle abattoirs including: a) acceptance of animals as being suitable for slaughter; b) hide removal; c) evisceration; and d) meat chilling.

The cleanliness of veal calves presented for slaughter should be assessed under a clean livestock policy that provides for appropriate handling of excessively dirty animals.

At the point of hide removal, any contact between hide and carcass surface ("rolling back") should be prevented, as well as cross-contamination via contaminated hands, knives or other equipment, or aerosols. The hide must be completely removed from slaughtered animals, with the exception of heads of calves up to six weeks age. These may be left non-flayed provided that they do not come in contact with other meat.

At the point of evisceration, the removal of internal organs should be in such a way as to prevent the escape of ingesta, faeces or gut contents and consequent meat contamination. The main control measures consist of sealing the ends of the alimentary tract e.g. 'rodding' of oesophagus and bagging of anus. Carcasses of calves over 6 months of age are currently required to be split lengthways through the spinal column before being presented for meat inspection. However, splitting of veal carcasses may not contribute to increase public health protection. The tonsils should be removed, and the carcass and all parts of the animal must be correlated until meat inspection has been completed. As tonsils represent an important source of possible microbiological contamination, special attention should be paid to the methodology applied for removing this part of the carcase.

At the point of chilling, the carcase temperature must be reduced to below 7^{o}C, and of edible offal to below 3^{o}C.

4. MEAT INSPECTION PROCEDURES FOR VEAL CALVES

4.1. Current mandatory meat inspection procedures for veal calves

The table below summarises the current meat inspection requirements as laid down in Council Directive 64/433 as amended and updated.

Some examples of causes of recorded post-mortem condemnation of veal calves are given in Annex II (two countries have been quoted as examples).

Table 1: Mandatory meat inspection measures in bovine animals under Council Directive 64/433 as amended and updated

Parts to be inspected	Observation	Palpation	Incision	Remarks
Skin and carcass surface	+		(▲)	
Head and throat	+			
Submaxillary lymph nodes	+ (•)		+ (•)	
Retro-pharyngeal lymph nodes	+		+	
Parotid lymph nodes	+		+ (•)	
External and internal masseters	+ (•)		+ (•)	
Mouth and fauces	+			
Tongue	+	+		
Tonsils	+			Tonsils must be removed
Lungs	+	+	+	Lungs must be incised in their posterior third, perpendicular to their main axes. Incisions not needed if lungs are excluded from human consumption
Oesophagus	+	+ (•)		
Bronchial lymph nodes	+		+	
Mediastinal lymph nodes	+		+	
Trachea and main branches of bronchi	+		+	Open lengthwise. Incisions not needed if lungs are excluded from human consumption
Pericardium and heart	+		+	Heart incised lengthwise to open ventricles and cut through interventricular septum
Diaphragm	+			
Liver	+	+	+	Incision of gastric surface of the liver and at base of caudate lobe to examine bile ducts*
Hepatic lymph nodes	+	+	(▲)	
Pancreatic lymph nodes	+	+	(▲)	
Gall bladder	+			
Bile ducts	+		+ (•)	
Gastro-intestinal tract and mesentery	+			
Gastric and mesenteric lymph nodes	+	+	(▲)	
Spleen	+	(▲)		
Kidney	+		(▲)	
Renal lymph nodes	+		(▲)	
Pleura	+			
Peritoneum	+			
Genital organs	+ (•)	(▲)		Palpation of uterus if necessary.
Udder and its lymph nodes	+ (•)	(▲)	(▲)	
Blood	+			
Muscles	+		(▲)	
Connective and fatty tissue	+			
Bones	+			e.g. spine, sternum. Splitting of carcasses when older than 6 months.
Umbilical region (in animals <6 weeks of age)	+	+	(▲)	In event of doubt, umbilical region must be incised
Joints (in animals <6 weeks of age)	+	+	(▲)	In event of doubt, joints must be opened and synovial fluid examined

(▲) on a case by case basis if considered necessary,

(•) not required in animals <6 weeks of age

4.2. Findings at meat inspection findings

The following Tables 2, 3, 4 and 5 collate the diseases that can be diagnosed on post-mortem inspection of veal calves. Not all the diseases mentioned in the Tables are important for meat safety. Indeed, a number of them are not of public health significance but can be important for animal health surveillance or for meat acceptability. The most important pathologies for public health are tuberculosis, multiple abscesses (irrespective of their cause), ringworm and cysticercosis. Each of these will be addressed below, and specifically with regard to related with the risk they might represent for consumer.

The inspection of the head and throat is primarily directed at lymph nodes. The main lymph nodes of the head are the parotid, mandibular (submaxillary) and retropharyngeal. The latter include the medial (suprapharyngeal) and the lateral (atlantal) nodes. The retropharyngeal nodes are particularly important as the medial ones receive most of the lymph emanating from the entrance of both the digestive and the respiratory tracts whereas the lateral ones, besides receiving the lymph from a wide area of the head (tongue, oral cavity, gums, lips, hard palate, salivary glands, muscles of the hyoid) and from the beginning of the neck, collect the lymph of parotid, mandibular and medial retropharyngeal lymph nodes. Both retropharyngeal nodes can be inspected, by observation, palpation and incision, from the back of the head severed from the carcass and for that reason are particularly apt for heads processed without skinning.

Pathological conditions of the lymph nodes (inflammatory, degenerative, hyperplastic) are not always of public health significance but changes in the lymph nodes are useful indicators of the presence of disease. The number of nodes undergoing pathological changes is a reliable indicator of the extent of a disease. It has to be remembered, however, that in rapidly growing young animals lymph nodes are rather prominent and contain more fluid compared with old animals. The finding of a pathological condition in some lymph nodes, therefore, assists in establishing if the process is acute or chronic and if there has been spread to involve the entire carcase. The pathological change seen with generalised lymphadenitis could be related to septicaemia if acute and to tuberculosis for example or toxic pathologies if chronic. Both cases imply a serious risk for public health. A calf-type lymphoma developing in the first 6 months of life has been reported. The suspicion of lymphoma comes from a visible enlargement of all lymph nodes and, therefore, routine incision of lymph nodes is not required and left to a case by case decision. The finding of a generalised lymphoma condition, with metastasis to organs such as the thymus, pericardium, myocardium, lungs, liver, spleen and kidneys, implies the condemnation of the entire carcass. Routine incision of pancreatic, gastric and mesenteric lymph nodes is not advisable due to the risk of spreading bacterial contamination (e.g.: *Salmonella* spp., *Yersinia* spp.).

Tuberculosis is very rare in veal calves as most cattle get infected at an age older than 6 months. In such adult infections the majority of the lesions are in the retropharyngeal, mediastinal and bronchial lymph nodes. The few

cases of tuberculosis observed in calves can be congenital, via the umbilical vessels and the portal lymph nodes are involved. They can also be acquired by inhalation or ingestion, and the lymph nodes of the head are elective sites for diagnosis followed by the bronchial and mediastinal lymph nodes. Such lymph nodes, e.g. portal, retropharyngeal, bronchial and mediastinal, are the only ones which should be incised on a regular basis. Tuberculous lesions of the lymph nodes cannot be diagnosed by observation. The relevance of TB for public health requires that the magnitude of the risk of such a disease from veal calves must be carefully evaluated before the incision of the main lymph nodes mentioned above is totally excluded.

The presence of clinical signs of bovine viral diarrhoea (BVD - mucosal disease), such as ulcers of the mouth, nose, pharynx, lateral surface of the tongue, palate, oesophagus, abomasum, etc., is more related to animal health unless general symptoms (emaciation, dehydration, high fever) are observed in which case total condemnation of the carcass is necessary. Visual inspection is sufficient for routine control. Visual examination might be more difficult in the case of heads kept unskinned but clinical signs of BVD can be seen at the back of the head on the region of the pharynx-larynx where ulcers covered with a grey exudate and possibly necrotic lesions are observable.

Some lesions of the skin, whether of a mycotic (Ringworm) or of a traumatic type, can be relevant to public health. Dermatomycoses are not common in calves but such pathologies are important, as they are transmissible to man. Skin wounds need to be examined to assess the presence/absence of infectious processes and their extent (local, general). Routine visual inspection is required.

Abscesses can be suspected from visual examination and further detailed inspection must be carried out off the slaughter line. Abscesses can be of a primary or secondary nature, the latter being crucial for the final use of the carcass depending on their number and type (small and widely spread) and on the organs affected (lungs, liver, etc.). Abscesses can be found sometimes in the mouth of calves due to wounds deriving from the roughage used for feeding.

Cutaneous papillomas are benign proliferative epithelial neoplasms mostly of viral nature and they are not frequent in calves.

Actinobacillosis is normally confined to the head (tongue, mouth, masseters muscles, lymph nodes) but has to be evaluated for the possible diffusion of abscesses in other areas, namely the lungs with bronchopneumonia. Similar attention has to be given to necrobacillosis, sometimes called “calf diphtheria”. Visual inspection will alert and allow proper palpation and incision if required.

Cysticercus bovis has never been reported in veal calves fed a liquid diet. Theoretically the use of roughage for calves welfare could provide the exposure to *Taenia saginata* cysts. However, if the roughage, is dried and sometimes pelleted, then the risk is considered to be very low. The elective infection sites are the heart, as the prime one, followed by the masseters, the

tongue and other striated muscles. For such reasons it is thought that routine inspection for cysticercus by incision of the tongue and masseters is not necessary for calves, reared in an integrated system and fed with dried roughage, as long as the incision of the heart is used for this purpose as well. The case of the head processed while unskinned would not present a problem for the same reasons. Similarly, incision of the oesophagus and diaphragm is not required on a routine basis as long as the myocardium is examined. It would be advisable, though, to suggest standard processing procedures for roughage to guarantee the inactivation of possible embryonated eggs.

Distomatosis and echinococcosis, like cysticercosis, has not been reported in veal calves fed a liquid diet due to the absence of sources of infestation. As for cysticercosis, standard processing procedures for roughage should be established. Visual examination of the liver and palpation of superficial bile ducts should be sufficient for detecting possible suspect cases.

The lung lesions most frequently observed are the inflammatory ones, normally with no public health implications for the carcass. Other conditions are of interest for the acceptability of lungs for human consumption (e.g., regurgitation, melanosis, emphysema, etc.) but not for public health concern. Routine visual inspection is the only procedure required in all cases, leaving palpation and incision to the inspector on a case by case basis.

Routine incision is required for the heart, with previous opening of the pericardium, to diagnose inflammatory, infectious and parasitic conditions. Findings that suggest septicaemia need to be followed by a detailed general inspection of the carcass (lungs, joints, liver, etc.).

Liver pathological conditions frequently observed in calves are those linked with feeding practices (fatty degeneration, intoxications) and abscesses. Abscesses, most commonly of omphalogenic nature, have to be dealt with as already mentioned above. Incision is not recommended unless in case of doubts and under strict hygienic rules. Visual evaluation is sufficient for the diagnosis of conditions such as discolourations, congenital cysts, hyperplasia, degenerations and intoxications, with palpation helping sometimes. Decision of the outcome of meat inspection (organ(s), partial or total carcass condemnation) depends on distinction between acute and chronic phenomena (infectious and toxic) which can be carried out from clinical signs available by observation/palpation, leaving incision to dubious cases for differentiation purposes. Congenital melanosis has been occasionally reported, with no public health significance. Visual examination is sufficient for condemning the organ on acceptability grounds.

Conditions of the gastro-intestinal tract which are of interest for meat safety (enteritis, peritonitis) can be suspected from visual examination. Incision can be left to the inspector on a case by case basis. Decision on meat destination depends on the inspection of the entire carcass and organs, and in such a case some incisions might be necessary followed, in case of need, by bacterial examination of flesh and main viscera (liver, spleen and kidneys).

Important pathologies of the spleen (e.g. abscesses, lymphomas, splenomegaly) can be suspected, and in some cases diagnosed, by visual examination and require to be evaluated in the framework of the entire carcass.

Kidney pathologies, such as hydronephrosis, cysts, haemorrhages, infarcts, necrosis, nephritis, etc. are detectable by observation, provided that fat covering and kidney capsule are removed. Incision can be useful for the final decision of meat destination for conditions relevant to public health (multiple abscesses from omphalophlebitis, pyelonephritis, metastasis of tumours, tuberculous nodules) or to animal health (petechial haemorrhages from infectious diseases).

Inspection of the umbilical region in calves has to be carried out by visual inspection first and related to possible systemic involvement such as multiple metastasised abscesses, to the liver in particular, peritonitis, septic arthritis. Incision can be performed only on a case by case basis.

Pathologies of the joints are relatively frequent in calves and require, therefore, a routine visual inspection followed by incision, in case of need, to ascertain possible septic conditions to be related with involvement of the carcass. Careful ante mortem examination is advisable due to the possible contamination of slaughter equipment if metacarpal and metatarsal joints are cut before post mortem inspection. Visual examination and palpation of the live animal ante mortem would give clues as to the distinction between rickets and arthritis, whereas a detailed examination of the carcase and offal is needed for a final diagnosis

General systemic pathologies, like emaciation, oedema, colour changes, tumours, haemorrhages, bruises, myositis, etc. can be easily diagnosed by observation. Such conditions can lead to total condemnation of the carcass, not only for public health but also for acceptability reasons, and might require, on a case by case basis, the incision of various parts of the carcass. Such conditions, though, require a thorough examination of the carcass and of the viscera to ascertain/exclude public or animal health related pathologies. Any abnormal muscle colour may indicate physiological conditions such as Dark Firm Dry Meat, Dark Cutting Meat that in addition to welfare implications must be differentiated from fevered meat.

Bacterial contamination of the carcase and offal can be considered the primary reason of public health concern. Any case of contamination of carcass or edible organs by faecal material, ingesta or bile must require the total or partial condemnation of involved parts. Oesophagus and rectum must be tied up or tightly closed in some way to reduce such a risk. In addition heads that have not been skinned must be treated with care as traumas and contamination of the tongue cannot be detected and even with processing of the head in hot water the subsequent manipulation carries significant risk of microbial contamination.

Table 2: Possible findings on meat inspection of veal calves (head and throat)*

Parts to be inspected	Diseases/conditions detectable	Detectable by observation	Detectable by palpation	Detectable by incision
Head and throat	(a) ringworm, (b) papillomas (c) secondary infection of any skin wounds, (d) Bovine Viral Disease, (e) Malignant Catarrhal Fever, (f) inflammation (g) abscesses)	a, b, c, d, e, f		
Submaxillary lymph nodes	(a) TB, (b) abscess, (c) lymphadenitis, (d) generalised leucosis/lymphoma	c, d		a, b, c, d
Retro-pharyngeal lymph nodes	(a) TB, (b) abscess, (c) lymphadenitis, (d) generalised leucosis)lymphoma	c, d		a, b, c, d
Parotid lymph nodes	(a) TB, (b) abscess, (c) lymphadenitis, (d) generalised leucosis/lymphoma	c, d		a, b, c, d
External and internal masseters	(a) parasites (*Cysticercus*)			a
Mouth and fauces	(a) Bovine Viral Diarrhoea, (b) Malignant Catarrhal Fever,	a,b		
Tongue	(a) Actinobacillosis, (b) Necrobacillosis (*Fusobacterium*, with associated pulmonary lesions) (c) parasites (*Cysticercus*)	a, b	a, b	c

*) (Tumours and malformations may occur in any organ)

Table 3: Possible findings on meat inspection of veal calves (thorax)

Parts to be inspected	Diseases/conditions detectable	Detectable by observation	Detectable by palpation	Detectable by incision
Thorax				
Lungs	(a) Inflammation Pneumonia, pleuropneumonia (b) abscesses, (c)infiltration, melanosis, (d) parasitic eosinophilosis (e) complications from necrobacillosis of tongue, (f) emphysema (g) bleeding problems, regurgitation,	a, b, c, d, f	b, f	b, d, e, g,
Oesophagus	(a) *Cysticercus* , (b) Bovine Viral Diarrhoea, (c) Malignant Catarrhal Fever (d) inflammation	a, b,c,d	a	a,
Bronchial lymph nodes	(a) Reaction in case of pulmonary lesion (b) lymphoma, (c) TB	a, b		c
Mediastinal lymph nodes	(a) Reaction in case of pulmonary lesion (b) lymphoma, (c) TB	a, b		c
Trachea and main branches of bronchi	(a) Mucus, oedema and inflammation linked to lungs (b) Blood aspirated at bleeding, regurgitated from stomach, when animal suspended can leak from oesophagus	a		a, b
Pericardium and heart	(a) inflammatory lesions in pericardium, myocardium, endocardium, e.g. Pericarditis associated with pleuropulmonary lesions (b) endocarditis (c) *Cysticercus*	a		a,b, c
Pleura	(a) Pleurisy	a	a	
Diaphragm	(a) *Cysticercus*	a	a	a

Table 4: Possible findings on meat inspection of veal calves (abdomen)

Parts to be inspected	Diseases/conditions detectable	Detectable by observation	Detectable by palpation	Detectable by incision
Abdomen				
Liver	(a) Abscess, (b) cirrhosis, (c) parasites, (d) discoloration (jaundice, congestion, degeneration), (e) changes in consistency of parenchyma (f) omphalophlebitis, (g) portal vein phlebitis, (h) infections and toxico-infections, (i) miliary necrosis (j) lymphoma	a,b,d,h,i, j	a,b,e,	a,b,c,e,f,g,i, j
Hepatic lymph nodes	(a) lymphoma	a		
Pancreatic lymph nodes	(a) lymphoma	a		
Bile ducts	(a) parasites-Liver fluke, (b) distommatosis	a		a
Gastro-intestinal tract and mesentery	(a) Inflammation/ enteritis , congestion, peritonitis (b) perforated abomasal ulcers, (c) toxico-infections, spread of pathogens via the bloodstream (d) hairballs	a,b,c	d	b
Gastric and mesenteric lymph nodes	(a) Hypertrophy, inflammation, congestion, (b) lymphoma, (c) TB	a,b	a,b	a,b,c
Spleen	(a) Splenomegaly, (b) leucosis/lymphoma (c) reaction to infection/septicaemia (d) abscess	a,b,c,d	a,d	a,b,c,d
Kidney	(a) Hydronephrosis, (b) nephritis (may originate from omphalophlebitis), (c) pyelonephritis, (d) cystitis, (e) urolithiasis, (f) congenital cysts, (h) petechiae	a,d,f,g,h	a,g	a,b,c,d,h
Renal lymph nodes	(a) inflammation	a		
Peritoneum	(a) inflammation / peritonitis, (b) septicaemia	a,b		

Table 5: Possible findings on meat inspection of veal calves (Miscellaneous)

Parts to be inspected	Diseases/conditions detectable	Detectable by observation	Detectable by palpation	Detectable by incision
Miscellaneous				
General systemic findings	(a) Emaciation, (b) oedema, (c) fever, (d) septicaemia, (e) contamination, (f) odours, (g) colour changes, (h) injection sites (i) jaundice; (j) haemorrhages, (k) abscesses, (l) tumours, (m) malformations	a,b,cd,d,e,f,g, h,I,j,k,l,m	h,m	b,h,m
Skin and carcass surface	(a) Skin wounds- fresh or chronic (decubital ulcers)	a		
Blood	(a) clotting ability, (b) discolouration	a,b		
Muscles	(a) abscesses, (b) oedema/inflammation	a,b,c,d	a,b	a
Bones	(a) Fractures are frequent, (b) intervertebral abscess (contiguous bone lesions, may be associated with endocarditis)	a,b		
Connective and fatty tissue	(a) oedema inflammation (b) Fat necrosis calcification,	a,b	a,b	a,b
Joints	(a) Arthritis (local, chronic, generalised, septic), (b) joint ill, (c) rickets (will be other general effects), (d) spondylitis in cases of injury	a,b,c,d	a,b	
Umbilical region	(a) Abscesses	a	a	a
Genital organs	Brucellosis	a		a

Consideration of the above tables indicates that in many cases the evidence of lesions and disease is available from visual inspection. The evidence that is only available from palpation and from incision must be considered to

ensure that any omission of palpation and incision will not have an impact on public health.

In addition transparency, traceability, monitoring and surveillance are the basis of such an integrated inspection. The industry is fully responsible for any defects of its products and a number of the actions shown in the table are in fact more relevant to quality matters than animal or public health considerations. The balance between meat inspection, animal health public health and industry. However quality labels, certification and HACCP all contribute to the hygiene of production.

4.2.1. Identification of possible hazards to public health

Potentially pathogenic contaminants and diseases can be transmitted to humans via foodstuffs, but also by direct or indirect contact with living animals, skins and carcasses in the slaughterhouse. Contamination of professionals working in the slaughterhouse or in processing and handling of meat and other products is another possible hazard to public health.

European countries are free of some infectious diseases that pose significant risk in other parts of the world. Greater open market access and possible introduction of exotic diseases highlight the need to maintain surveillance and vigilance to all zoonotic diseases and agents.

Priority of the inspection process should be given to ensuring consumer and public health protection. Calf health and product integrity also deserve consideration: exclusion of sick animals and of some types of lesions or of area of faecal contamination contributes to reducing the risk for the consumer. However, the risk reduction is linked to the frequency of these diseases and lesions. Faecal contamination must be reduced by control of the slaughter process. The risk is also reduced by cooking and by other thermal or other preventive or corrective treatments of veal products. Such treatments do not reduce the risk due to recontamination. Risk reduction cannot be obtained with thermoresistant contaminants, especially bacterial spores and chemical contaminants.

An essential component of any future meat hygiene approach to avoid the introduction of significant levels of microbiological pathogens on to any carcase, and to prevent them from growing, is by the Hazard Analysis and Critical Control Point (HACCP) approach. The European Commission's Decision (2001/471/EC) requires the implementation of HACCP principles in fresh meat and poultry meat slaughterhouses, cutting plants and cold stores and introduces standard procedures for carrying out microbiological checks. Verification is a 'safety net' to establish whether the HACCP plan is right for the actual operation of the abattoir and should show whether or not the monitoring and corrective actions are being properly applied. A good example of verification is the regular testing of carcases for the presence of microbial contamination. Validated HACCP plans that prevent contamination entering the system therefore provide the best assurance for food safety.

4.2.2. To what extent do current inspection procedures provide safeguards?

Discussion on the efficiency of veal calf inspection with or without palpation and incision may include a "what if" element exploring the potential of detection of the main zoonotic diseases (see table 14). Calves contaminated with potentially pathogenic organisms may be slaughtered after varying lengths of time, or with symptoms and lesions of varying degrees, or without any symptoms and lesions. Sick animals should not be presented for normal slaughter. Although some animals can be asymptomatic carriers, and some lesions are too small to be detectable by visual inspection, palpation and incision. The zoonotic character of the lesions may be undiagnosed or misdiagnosed in absence of recognised outbreaks in the farm or of laboratory investigations to complement routine inspection.

Absence of disease and macroscopic lesions does not allow a conclusion on the absence of contamination of skin, mucosa and internal tissues. The contaminated animals without visible symptoms and lesions cannot be detected by organoleptic inspection, but are much more common than diseased animals. As an example, it could be wise to isolate animals from farms known to be contaminated with *Salmonella* spp..

4.2.3. Assessment of the risk to public health if current procedures are omitted

Due to limited availability of relevant data, it was not always possible to quantify and categorise the risk for the consumer if current procedures are omitted. Bovine tuberculosis has become rare in EU Member States and the transmission of *Mycobacterium bovis* to humans by meat is not clearly demonstrated (ACMSF, 2002). Provided the milk fed to the calves has been treated to eliminate *Mycobacterium bovis*, the veal calves were born, reared and slaughtered in a tuberculosis free area, and fed roughage grown in such an area, the likelihood of finding tuberculous lesions at traditional post-mortem inspection is very low. As stated by ACMSF (2002), the removal of incision as part of meat inspection does not appear to reduce the efficacy of the procedure significantly; the sensitivity and specificity of visual inspection and palpation did not differ significantly from the results of visual inspection, palpation and incision. However, bovine tuberculosis is not eradicated, and a surveillance system should be maintained in bovines. The best means for an efficient surveillance need further exploration at both farm and abattoir levels.

Apart from tuberculosis, palpations and incisions remain compulsory in EC regulations to detect cysticercosis. Estimates based on computations from incidence estimates indicate 2 % of human population in Europe are infested with *Taenia saginata*. *T. saginata* is confined to the human intestine and clinical consequences are mild (Murrell, 2000). Breaking the parasitic life cycle of *T. saginata* in the slaughterhouse is limited by the poor efficiency of visual observation after incision system. Provided fed milk and roughage has been treated (by heating or drying) to eliminate the intermediate stage of parasites, the risk of cysticercosis and of transmission to man are negligible

and routine cuts into the mucles of veal calves are not justified on public health grounds.

When palpations and incisions are not compulsory, meat inspection is dependant on the performance of the visual detection. If current procedures of palpations and incisions are omitted, risks from viruses and chemical contaminants will not be altered. But bacterial-cross contamination of tissues will be reduced. Such contamination could be especially frequent and high after the removal of tonsils, the incision of lymph nodes draining the respiratory or gastrointestinal tract and the incision of abscesses not already aseptically removed from the normal tissue.

Basic epidemiological considerations indicate the efficiency of palpations and incisions is very limited when the annual frequency of detected cases in a slaughterhouse has become null or very low (see above). The efficiency is increased by a post mortem inspection related to information on both the origin and the sanitary status of animals. Full recording systems that may provide for the flow of data both to and from the abattoir must be implemented. This is for both public and animal health reasons.

Palpation and incisions are options to carry out inspection and must remain among the procedures of inspection of veal calves: they should be used by inspectors in any suspect or new context.

5. ALTERNATIVE METHODS TO CURRENT MEAT INSPECTION MEASURES

It appears that meat safety systems based only on conventional post-mortem inspection at slaughterhouse would be of relatively low efficacy in terms of public health. Some reports indicate that in animals categorised at the ante-mortem inspection as healthy, the post-mortem inspection on average detect only 20% of all the macroscopic lesions that are actually present in 1% or less of animals (Berends *et al.*, 1993; Harbers 1991). The performance of the post-mortem inspection can be improved, or in some cases replaced, by veterinary herd health actions implemented during pre-harvest phase. (Snijders and van Knapen, 2002).

5.1. Alternative methods for detection of generalised infections

Recently, it has been advocated that it is possible to identify animals with infections during ante-mortem inspection via measuring the levels of so-called acute phase proteins. These proteins are produced in the liver by hepatocytes (and to lesser extent by lymphocytes, monocytes, epithelial cells and fibroblasts) in response to inflammatory mediators, shortly after the onset of an infection, acute inflammation or tissue damage (Kostro *et al.*, 2001). The most important seem to be C-reactive protein (CRP), serum amyloid (SAA) and haptoglobin (Hp). However, significant differences in the acute phase protein response profile exist between animal species, which indicates that each species should be examined individually and that immunoassays for the proteins should be carefully validated before use (Eckersall, 2000).

5.1.1. Acute phase proteins in cattle

The Acute Phase Proteins play a major role in the assesment of the Inflammatory Response. The various Acute Phase Proteins rise in varying levels in response to activation by cytokines, themselves produced by activated macrophages in response to physiological challenge such as Inflammation, Infection, Disease, Trauma or Drug Response. Acute phase proteins can respond in different ways to infections with different pathogens. Generally, the responses to bacterial diseases are greater than to viral diseases, and they are relatively variable with parasitic diseases (Eckersall, personal comm.).

Measurement of serum haptoglobin was used as a marker of inflammation in neonatal farm-raised and bob calves (Gray *et al.*, 1996). In emergency slaughtered dairy cows, muscle traumas were often the most frequent pathological finding in meat inspection, and they included an acute phase response detectable by serum haptoglobin and alpha(1)-acid glycoprotein (Hirvonen *et al.*, 1997). In addition, serum gamma-globulin was increased in these animals, with the levels correlated with the quantity of muscle trauma. However, the results of this study indicated that haptoglobin and alpha(1)-acid glycoprotein did not always quantitatively predict the meat inspection result of the emergency slaughtered cows.

At present, it appears that there is not enough direct evidence demonstrating a link between measurement of acute phase proteins and existing procedures of meat inspection (palpation/incision) in detecting all diseases/conditions relevant for public health in all veal calves. Further research on the relationship between the acute phase proteins and the post-slaughter findings should be encouraged.

5.2. Alternative methods for detection of cysticercosis

The detection and control of cysticercosis has been reviewed in the Opinion of the SCVPH (2000b). Based on abattoir data, the prevalence of bovine cysticercosis in the EU varies between 0.01 and 6.8%, but because the conventional meat inspection methods - incision of the predilection sites followed by visual detection - underestimate the real prevalence by 3-10 factor, reliable data for cattle are lacking (SCVPH, 2000b).

5.2.1. Immunoassays for cysticercosis in cattle

There are no published data on application of immunoassays for detection of cysticercosis infection specifically in veal calves. However, testing of 1164 blood serum samples of cattle at 20 abattoirs using an Ag-Elisa method (detecting circulating cysticercosis parasite antigen) produced 3.09% positive animals, whilst only 0.26% positives were detected by conventional meat inspection. In other words, the Ag-Elisa method yielded around 15 times more positive results (Dorny *et al.*, 2000). On the other hand, it seems that increased levels of blood serum proteins CK and LD also can be associated with cysticercosis infection in both naturally and artificially infected cattle (Oryan *et al.*, 1999).

The sensitivity of the conventional meat inspection in detecting cysticercosis is limited and, in principle, can and should be improved through use of alternative methods based on blood samples (SCVPH, 2000b). Methods based on detection of specific antibodies in cattle cannot differentiate between past and current cysticercosis infection (i.e. whether the cysts are alive or not) and, consequently, can be useful for epidemiological studies rather than for meat inspection. In contrast, methods based on detection of the parasite's antigen in serum of cattle can indicate actual cysticercosis infection i.e. presence of live cysts. However, no larger validation studies specifically with veal calves have been published. Also, before routine use of such antigen-detection-based methods as alternative to conventional meat inspection for veal calves, some other aspects also should have been carefully considered including: a) the younger calves the lower risks of them being infected with the parasite, and b) the simultaneous implementation of other cysticercosis controls within an integrated system would further lower these risks.

5.3. Alternative methods for detection of tuberculosis

5.3.1. Tuberculin skin test

The test is used on-farm and is based on intradermal injection of *M. bovis* tuberculin, a crude protein extract (PPD) from supernatants of cultures of *M. bovis* and measurement of increase of skin thickness after 72 hours. If exclusion of cross-reactivity with *M. avium* is required, a parallel injection of *M. avium* tuberculin is used. Literature data indicate that the sensitivity (% of infected animals correctly identified) of the *M. bovis* tuberculin skin test can vary with an average of around 90%, while the specificity (% of uninfected animals correctly identified) can be as high as >99.9% (Wilesmith *et al.,* 1982; Costello *et al*., 1997; Morrison *et al*., 2000). The meat safety implications of the sensitivity of tuberculin test being less than 100% include that during on-farm testing the TB infection can remain undetected in some animals in multiple-reactors herds, or in herds containing single reactors.

5.3.2. Interferon-γ (IFN-γ) laboratory-based test

The test is based on a whole blood sample being cultured with PPD from *M. bovis,* and IFN-γ production is measured by ELISA after 24 hours (Morrison *et al*., 2000). Some studies showed that relative sensitivity of the IFN-γ test was 84.3%, while relative specificity 99.6%. The sensitivity of a commercially available test kit based on IFN-γ trailed on more than 200,000 cattle in a number of countries (Wood and Jones, 2001) varied between 81.8% and 100% for culture-confirmed bovine TB, and specificity between 94% and 100%. The IFN-γ test kit is applied in New Zealand for detecting tuberculin skin-test negative bovines, and also is officially used in Australia and USA. The IFN-γ test can also be prepared for differential detection of *M. avium*.

5.3.3. Microbiological detection of M. bovis

The main limitation of culture-based methods for detection of *M. bovis* is the fact that several weeks are required to obtain the results. Generally, most

visible lesions yield positive results, and very few positive cultures are obtained from tissues that do not contain visible lesions (Morrison *et al*., 2000).

5.3.4. Detection of M. bovis by molecular methods

Although molecular technology permits detection and identification of *M. bovis* directly in clinical specimens, it is less sensitive than traditional culture method (SCAHAW, 1999).

Presently, no full equivalence between any of the alternative methods and the conventional meat inspection in diagnosing bovine TB in veal calves can be confirmed, because the sensitivities of all of them can vary and none (including conventional meat inspection) has 100% sensitivity. The widely used tuberculin skin-test can fail to detect bovine TB in around 10% infected animals, is relatively slow ($\geq$72 h), requires handling of the animals at least twice, and can affect the results of subsequent testing. Recent information indicates that performance of IFN-γ based methods using blood samples is particularly promising. Therefore, further research aimed at maximising the latter methods' sensitivity and optimising the technical aspects of their use is necessary and should be encouraged.

5.4. Alternative methods based on automated assessment of meat appearance

These methods are primarily based on a range of computerised image analysis/machine vision technical approaches. There are no published data on application of automated methods for post-mortem meat inspection of veal calves or adult bovines. Such automated methods have been used for assessment of some meat quality-related parameters (e.g. fatty tissue, meat colour) in pigs, rather than for inspection purposes. A range of such methods have been used for inspection of slaughtered poultry (Chen *et al.*, 1996; Chen *et al.*, 2000; Chao *et al.*, 2002a, b; Hsieh *et al.*, 2002; Park *et al.*, 1996; Park and Chen, 2000; Van Hoof and Ectors, 2002).

6. CONCLUSIONS

- Meat Inspection has two purposes:
  - (a) assuring public health and
  - (b) monitoring animal health and welfare as well as assisting in herd health management
- For public health traditional meat inspection is less important because, in veal calves held under integrated systems, clinical manifestation of zoonotic diseases are rare.
- However, apparently healthy veal calves may carry and/or excrete zoonotic pathogens. The major concern is the contamination during production, transport and slaughter stages. The application of the HACCP principles to all stages of production and slaughter is therefore useful.

- The cutting during meat inspection of tissues with a potentially high microbial load (e.g. lymph nodes, tonsils and abscesses) will contaminate the inspection utensils. Therefore the application of good hygienic practice and strict cleaning and disinfection procedures is essential.

- Integrated production of veal associated with lower public health risk is possible. The traceability system in association with Quality Control will provide full accessibility of the chain data to the official veterinarian prior to animals going for slaughter.

- With integrated production, and given the age at slaughter, veal calves are not exposed to many infective agents, nor develop the lesions seen at slaughter in older cattle.

- Traditionally, in meat inspection for veal calves, the most important pathologies for public health have been tuberculosis, multiple abscesses, and cysticercosis.

- Tuberculosis is very rare in veal calves. However, the public health risk of tuberculosis must be carefully evaluated before abolishing the incision of the main lymph nodes.

- *Cysticercus bovis* has not been reported in veal calves exclusively fed with milk replacer. If roughage is used this could provide exposure to *Taenia saginata* cysts. However, if the roughage, were dried and/or pelleted, then the risk could be considered to be very low.

- Most systemic pathologies, such as emaciation, oedema, colour changes, tumours, haemorrhages, bruises, myositis, etc. can be easily diagnosed by visual inspection. However, the finding of any abnormality requires further detailed examination of the carcase and offal, including, where appropriate, taking of samples for further investigation. Decision on fitness for human consumption depends on the inspection of the entire carcass and organs.

- There is no evidence, at this time, that currently available alternative methods can fully replace meat inspection procedures. Laboratory measurements, however, can add to surveillance data.

7. RECOMMENDATIONS

(2) Thorough ante mortem examination of veal calves at the farm and at the abattoir is essential. In an integrated system this should be part of a quality control scheme.

(3) Application of good meat hygiene practice and HACCP principles at all stages of slaughter (and processing) is essential to reduce the risk of pathogens carried or excreted by apparently healthy animals.

(4) Full recording systems must be implemented that provide for the flow of data both to and from the abattoir for both animal health and public health reasons

(5) For routine inspection of veal calves reared in an integrated system visual inspection is sufficient subject to the following conditions:

(a) Indications of possible infections must be followed by a detailed inspection of the carcass and offal. Incisions might be necessary followed by, in case of need, laboratory examination.

(b) As long as bovine tuberculosis has not been eradicated, surveillance for tuberculosis should be maintained in bovines at both farm and abattoir levels. Routine incision of the portal, retropharyngeal, bronchial and mediastinal lymph nodes should continue.

(c) Routine inspection for cysticercosis by incision is not necessary for veal calves reared in an integrated housed system. If calves are fed roughage at any stage of their life, this feed must be dried and/or pelleted.

(6) Additional incision(s) should be performed only on a case by case basis.

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10. ANNEX I

10.1. Definitions from Community legislation

A calf is a bovine animal up to six months old (Directive 91/629/EEC). Other definitions indicate calves are of either sex, have not reached puberty (up to about 9 months of age), and have an indicated maximum live weight.

Directive 91/629 laying down minimum standards for the protection of calves: states that for the purposes of that Directive 'calf' shall mean a bovine animal up to six months old.

Directive 93/24 on the statistical surveys to be carried out on bovine animal production divides the category of bovine animals less than 1 year old into

(a) calves for slaughter ; (b) other: male/female

Decision 94/433 laying down detailed rules for the application of Council Directive 93/24 EEC defined:

Calves for slaughter as 'calves less than 12 months old intended for slaughter as calves'

and defined calves as 'domestic animals of the bovine species not exceeding a live weight of 300kg, which do not yet have their second teeth'.

Directive 64/433 on health conditions for the production and marketing of fresh meat has categories of bovine animals under six weeks old and over six weeks old.

11. ANNEX II

Table 12- Data on all types of calves from EU bovine population surveys[1] (source: Eurostat)

Year	1999		2000		2001	
Country	Calves for slaughter[2]	Other calves[3]	Calves for slaughter	Other calves	Calves for slaughter	Other calves
Austria	45,535	585,051	68,049	587,319	68,080	590,850
Belgium	162,473	687,707	179,754	657,565	180,223	618,207
Denmark	6,000	663,000	6,000	599,000	6,000	578,000
Finland	9,200	360,900	9,000	353,000	9,400	345,300
France	692,777	4,579,024	678,921	4,600,394	762,353	4,493,436
Germany	163,243	4,499,450	134,000	4,459,000	104,309	4,273,376
Greece	111,000	91,000	50,000	114,000	67,000	108,000
Ireland	0	1,652,800	0	1,693,600	0	1,884,200
Italy	385,000	1,807,000	401,000	1,948,000	439,000	1,921,500
Luxembourg	2,576	51,592	2,199	50,958	3,294	51,272
Netherlands	800,000	669,000	756,000	635,000	676,000	681,000
Portugal	67,245	324,828	69,900	320,632	78,557	321,757
Spain	1,492,000	725,000	1,483,123	610,757	1,413,837	682,886
Sweden	22,900	504,400	22,300	480,000	25,167	483,211
United Kingdom	39,096	2,990,819	41,207	2,896,595	38,145	2,633,469
EU Total	3,999,045	20,191,570	3,901,453	20,005,820	3,871,365	19,666,460

[1] Produced in line with Council Directive 93/24/EEC on the statistical surveys to be carried out on bovine animal production, as amended by Commission Decision 94/433/EC laying down detailed rules for the application of Council Directive 93/24/EEC.

[2] Commission Decision 94/433/EC defines calves for slaughter as 'cattle less than 12 months old intended for slaughter as calves', and defines calves as 'domestic animals of the bovine species not exceeding a live weight of 300 kg, which do not yet have their second teeth'.

[3] Other bovine animals less than 1 year old

Table 13- Slaughterings of all types of calves[4] from EU bovine slaughtering statistics (Source: Eurostat)

Country	1996	1997	1998	1999	2000	2001
Austria	149,273	148,701	134,888	112,677	104,704	120,374
Belgium	289,546	319,777	311,083	268,419	279,372	296,209
Denmark	56,830	51,400	50,000	49,460	42,740	33,170
Finland	11,173	18,198	13,497	12,012	11,554	9,376
France	1,996,744	2,013,172	1,984,053	1,937500	1,864,609	1,933,430
Germany	526,496	509,422	484,676	456,602	419,052	382,389
Greece	78,918	81,038	82,276	82,342	77,976	91,782
Ireland	2,600	21,500	7,000	23,100	4,100	3,800
Italy	1,229,810	1,131,716	1,099,282	1,078,323	1,108,648	1,104,354
Luxembourg	2,614	2,806	2,992	2,997	2,934	4,353
Netherlands	1,196,225	1,350,661	1,373,170	1,398,893	1,385,883	1,028,626
Portugal	79,826	106,099	118,340	132,598	139,505	147,456
Spain	34,990	119,860	159,564	124,573	113,206	205,522
Sweden	35,047	55,963	52,208	38,417	38,975	34,284
United Kingdom	23,944	20,066	32,017	75,087	153,009	92,192
EU Total	5,714,036	5,950,379	5,905,046	5,793,000	5,746,267	5,487,317

[4] Collected in line with Council Directive 93/24/EEC on the statistical surveys to be carried out on bovine animal production. Slaughtering statistics are drawn up for the following categories: calves, heifers, cows, bulls and bullocks.

Table 14: Causes of total post-mortem condemnation of veal calves (carcass and offal) in numbers per 100,000 from 1993 to 2000 (Annual Report of the Belgian Institute of Veterinary Expertise)

Causes	2000	1999	1998	1997	1996	1995	1994	1993
Death on arrival	14.0	27.2	23.2	22.7	17.3	12.9	11.5	7.1
Insufficient bleeding	4.8	4.5	1.8	5.0	6.5	14.3	12.3	12.6
Tainted (due to late evisceration)	0.8	0.4	3.3	4.4	12.9	6.4	7.8	6.8
Septicaemia	23.9	22.0	30.8	41.0	58.5	57.1	56.6	39.4
Anomalies of colour, smell or consistency	100.2	80.2	90.2	134.0	197.5	104.1	169.4	170.6
Emaciation	38.7	32.5	43.6	54.9	50.3	36.0	55.6	52.0
Hydrops (oedematose)	7.6	4.5	11.0	15.5	12.6	15.2	15.9	13.9
Spoilage	6.8	10.4	7.9	25.5	24.5	23.7	22.2	25.0
Contaminated or tainted	4.4	1.5	0.9	0.9	2.7	0.3	1.8	0.5
Icterus	18.4	19.8	27.4	22.7	32.0	22.0	26.9	33.4
Multiple tumours	1.2	1.5	2.1	3.5	0.3	2.3	1.6	0.3
Necrosis	2.0	0.0	0.0	0.3	0.7	0.6	0.8	0.5
Generalised lymphadenitis	0.8	0.4	1.2	2.2	6.1	0.9	0.8	0.8
Polyarthritis	5.2	5.2	12.2	19.5	8.8	12.0	11.5	11.8
Acute enteritis	0.8	0.4	0.3	0.0	0.0	0.0	0.0	0.0
Omphalophlebitis	0.4	0.0	0.6	1.6	0.0	0.3	0.3	0.0
Emergency slaughtering in combination with enteritis or peritonitis	16.8	8.2	-	-	-	-	-	
Tuberculosis	0.4	0.0	0.3	0.0	0.7	0.0	0.0	0.0
Others (decision of veterinary meat inspector)	6.4	4.1	-	.-	-	-	-	-

Table 15: Body systems cited in partial carcass condemnation of veal calves at post-mortem per 100,000 from 1993 to 2000 (Annual Report from the Belgian Institute of Veterinary Expertise)

Partial condemnation (without identifying the cause)	2000	1999	1998	1997	1996	1995	1994	1993
Heart	289.4	857.8	293.7	615.9	543.8	484.6	453.9	503.1
Liver	915.0	731.3	694.4	1,320.7	2,222.3	1,397.7	1,061.8	1,310.5
Tongue	84.2	82.5	93.5	300.2	234.0	248.0	261.9	230.8
Parts of carcass ?	32.7	98.9	13.4	25.2	29.2	23.1	18.0	27.6
Spleen	88.6	136.6	225.5	332.7	239.3	248.0	269.3	228.0
Kidneys	1,614.8	1,647.0	1,486.3	2,3245	3,037.4	2,820.0	1,763.6	1,208.7
Blood	27.1	86.9	9.7	38.2	19.0	27.5	4.7	5.8
Head	50.3	93.6	98.7	206.2	192.7	218.2	216.8	195.6
Digestive tract	67.5	209.0	207.5	363.3	418.8	342.6	307.4	240.8
Lungs	1,017.5	2,521.3	3,323.0	5,597.3	6,801.4	7,483.2	6,718.7	6,126.0
Others	411.2	239.9	211.2	75.7	75.1	94.0	1.0	0.8

Table 16: Causes of partial condemnation of veal calves at post-mortem per 100,000 from 1993 to 2000 (Annual report of the Belgian Institute of Veterinary Expertise)

Causes of partial condemnation	2000	1999	1998	1997	1996	1995	1994	1993
Abscesses	111.0	57.8	146.2	242.2	414.0	128.5	95.0	87.1
Actinomycosis	1.2	0.0	0.0	0.3	0.0	0.0	1.3	1.8
Ascaridiosis	19.6	41.8	460.1	1,207.2	3,590.8	5.0	1,559.0	554.7
Distomatosis	1.2	16.4	10.1	0.0	1.0	1.8	0.3	3.7
Cysticercosis	1.5	0.8	0.0	0.3	0.7	0.3	1.3	0.5
Tuberculosis	0.4	0.0	0.0	5.7	0.7	0.0	0.0	0.0

Table 17: Slaughtering of veal calves in Belgium

	Number of slaughterings (approved)		Number of slaughterings (condemned)		Number of laboratory examinations			
Year	Commercial (normal)	Emergency slaughter	Commercial (normal)	Emergency slaughter	For Inhibitory substances	No. positive	For Bacteriological examination	No. positive
1998	326,614	553	738	331	903	62	879	106
1999	266,641	756	410	249	805	29	891	54
2000	274,065	794	508	224	911	31	944	43

Table 18: Causes of condemnation of veal calves at post-mortem (1997- GFR). Total number of slaughtered veal calves 509422.

Cause of condemnation	Total number	Cases/100.000
Cysticercosis (low)	65	12.76
Cystercosis (severe)	6	1.18
Salmonellosis	56	11.00
Other transmissible disease	152	29.80
Sarcosporidiosis	2	0.39
Othjer abnormalities (abscesses, emaciation)	1166	228.90
Residues	57	11.19
Natural death (on arrival)	17	3.34
No observation of withdrawal period	14	2.75
No meat inspection within due time	7	1.37
Slaughtering outside the slaughterhouse	4	0.78
Declared unfit for consumption	124	24.34
Abnormal colour, texture, taint	324	63.60
Others	61	11.97
TOTAL	**2055**	**403.41**
Local lesions/deformations	75626	14864.01
Local mycobacterial lesions	7	1.37
Anaerobic Gram + rods	4	0.78
Residues	123	24.15
Evisceration outside slaughterhouse	12	2.36
Unprocessed intestines, bladders, etc	131310	25777.38
Unfit for human consumption (texture, colour, etc)	1422	279.15
Others	474	93.05
Total	**208978**	**41024.34**

Table 19: What is the potential of detection of the main zoonotic diseases and contaminants of calves by inspection ? (not exhaustively listed). (Adapted from Herenda, 1994)

Disease (*Agent*)	Ante mortem (farm + slaughterhouse)	Post mortem	Hazard	Differential diagnostic	Remarks and comments
1. Bacterial infections					
Tuberculosis (*Mycobacterium bovis*)	Information from farm and region of origin. Symptoms mainly in older animals.	Retropharyngeal and mediastinal lymph node examination. Reactors require additional examination of the lymph nodes, joints, bones and meninges.	*Mycobacterium bovis* invade cattle by respiratory (90 – 95 %) and oral routes (5–10 %).	Lung and lymph node abscess, pleurisy, pericarditis, chronic contagious pleuropneumonia, actinobacillosis, mycotic and parasitic lesions, tumours.	Transmission by meat ? Low efficiency of systematic post-mortem examination by incision of lymph nodes in countries with low incidence and without information from farm. Confirmation by laboratory analysis.
Brucellosis (contagious abortion, Bang's disease) (*Brucella* spp)	Information from farm and region of origin.	No gross lesions in calves.	Short life of *Brucella* in the muscles of slaughtered animals. Congenital infection of calves. without symptoms and lesions.	Other causes of abortion in cattle, IBR, vibriosis, leptospirosis, trichomoniasis, mycoplasma infections, mycosis, nutritional and physiological causes.	No visual detection in abattoir. Reactor animals should be carefully handled.
Salmonellosis (*Salmonella* spp)	Septicaemic form occurs most frequently in colostrum deficient animals up to four months of age. Death within 24–48 hours	In acute form, mucoenteritis to diffuse haemorrhagic enteritis with enlarged, oedematous and haemorrhagic lymph nodes.	The young, debilitated and stressed animals are at greater risk.	Acute diarrhoea in calves: diarrhoea caused by infections (such as rotavirus, corona virus, cryptosporidiosis, *E. coli*), septicaemia, dietetic gastroenteritis, coccidiosis, *Clostridium perfringens* type C enterotoxaemia	Necessity of ante mortem exclusion of cases of generalized diseases. Frequent carrier state with no visual detection in abattoir. Usual cross-contamination between animals and white offals. Slaughter hygiene.
Colibacillosis (some serotypes and strains of *Escherichia coli*)	Colibacillosis does not affect calves older than 3 or 4 days of age.	Carrier state of enterohoemorrhagic *E. coli* (EHEC).		See Salmonellosis	No visual detection in abattoir. Slaughter hygiene.

Campylobacteriosis (*Campylobacter*)	Infection only during the first two weeks of life. Usually asymptomatic.	Enteritis. Healthy carriers	Transmission by faeces and water. Bacteria die rapidly when surface of carcasses dries.	See Salmonellosis	No visual detection in abattoir. Slaughter hygiene. *C. fetus* subsp. venerealis not considered signifiant as a zoonotic agent.
Yersiniosis (*Yersinia enterocolitica*)	Diarrhea with gradual or fulminant onset	Enteritis. Healthy carriers.	Role of stressfull circunstances. Bacteria can growth at near-freezing conditions. Easier detection with Yersinia selective media.	See Salmonellosis	No visual detection in abattoir. Slaughter hygiene. Emerging foodborne disease, mainly related to pork.
Q fever (*Coxiella burnetii*)	No clinical signs of this disease in calves.	No gross lesions are reported in calves (and in adult cattle).	Shedding of the organism in urine, faeces (in milk, placenta and foetal fluids in adult animals). Relative resistance to heat and drying.	See Brucellosis	Contaminated meat (and water) and inhalation of contaminated dust or droplets are among means of transmission.
Listeriosis (*Listeria monocytogenes*)		Intestinal carrier state.	Resistance of *Listeria* in the environment.	Otitis	No silage as feed to veal calves. Possible transmission by skin
Antibiotic resistant microbes	Increased suspicion if group pathology	Increased suspicion if traces of injections			No visual detection in abattoir. Slaughter hygiene.
2. TOXINS of bacterial origins					
Botulism (*Clostridium botulinum*)	Sporadic outbreaks of botulism are reported in most countries. Incubation period 12 – 24 hours but can be longer). From restlessness to progressive muscular paralysis from hindquarters to forequarters.	*Cl.. botulinum* is often found in anaerobic conditions of deep wounds. Foreign material in fore-stomachs or stomachs may be suggestive of botulism	Various strains of *Clostridium* produces neuroparalytic exotoxins (botulinal neurotoxin BoNT is more usual) which cause symptoms of the disease. Decomposed flesh and bones are the source of infection for animals. *Cl. botulinum* is found in the digestive tract of herbivores. Soil and water contamination occurs from faeces and	Paralytic rabies, miscellaneous poisoning.	Usually death in the farm. Possible aggressive contamination? Ante mortem exclusion of systemic diseases. Total condemnation of carcass because of human hazards. Botulinals toxins are heat labile.

			decomposing carcasses.		
Anthrax (*Bacillus anthracis*)	The peracute and acute forms are without clinical signs. Death may follow in the peracute form after 1 – 2 hours of illness. The acute form lasts about 48 hours. Dark-tarry blood discharge from body orifices. Absence of rigor mortis. Usually death in the farm.	The suspect carcass must not be opened : an open carcass facilitates exposure of *B. anthracis* to air and consequently, spores are formed within a few hours: Haemorrhage of the mucous and serous membranes, lymph nodes and subcutaneous tissue. Enlarged spleen with tar-like tissue. Severe haemorrhagic enteritis. Degeneration of the liver and kidneys. Bloating and rapid decomposition of carcass	Highly contagious. Transmission by animal products containing spores. Anthrax spores are resistant to heat and disinfectants and may survive in a suitable environment for years. Humans may contract anthrax by inhalation, ingestion and through a wound in the skin.	Peracute blackquarter and septicaemic form of other diseases. In splenic enlargement as seen in babesiosis, anaplasmosis and leucosis, spleen consistency is firm. In anthrax, the spleen is soft and upon incision the pulp exudes like thick blackish-red blood.	Ante mortem exclusion of systemic diseases. Possible aggressive contamination ? If an animal has died suddenly from an unknown cause in an abattoir's pen or in the stockyard, a blood smear from the tip of the ear should be examined to eliminate anthrax as a cause of death
3. Virus et Prions					
Rabies	Furious or paralytic form.	Possible inflammation of gastrointestinal mucosa	Usually transmitted through the saliva by a bite from a rabid animal.	Indigestion, milk fever or acetonemia when first seen, foreign body in the mouth, early infectious disease, poisoning, listeriosis, BSE.	Regions of origin. Infection does not occur by consumption of meat from a rabid animal. Prevention of occupational hazards through surface contact with infected tissue.
Bovine spongiform encephalopathy (BSE, “Mad cow disease”)	BSE affects only adult animals and the incidence within-herd is low.	Neurological signs.	Asymptomatic infection of calves ?	Rabies, listeriosis, bovine pseudorabies (mad itch), other brain infections in cattle, the nervous type of acetonemia, hypocalcemia, hypophosphatemia and hypomagnesemic tetany.	Transmissibility before symptoms ? Diagnosis by serology and confirmed on the post mortem histological examination of brain tissue.

4. Parasites					
Cysticercosis (*Taenia saginata*)	Muscle stiffness if heavy infection	The sites of predilection are the masseter muscles, tongue, heart and diaphragm. 1. Small white lesions (cysticerci 2 – 3 weeks after infection) in muscle tissue 2. Clear transparent bladders 5 x 10 mm (infective cysticerci, 12 – 15 weeks after infection) 3. Opaque and pearl like (over 15 weeks of infection)	*Cysticercus bovis* in cattle, *Taenia saginata* in humans. Cattle become infected by ingestion of feedstuff containing ova passed from infested humans including farm workers. Intrauterine infection of a bovine fetus was also recorded.	Hypoderma species (migration to heart), nerve sheath tumour, eosinophilic myositis, abscess and granuloma caused by injections	Better probability of detection if heavy infestation. Low gravity and efficient treatment in man. Major role of infested humans in the transmission cycle. Need of indirect tests (e.g. serology) on farm to orientated inspection ?
Hydatid disease (Hydatidosis, Echinococcosis) (*Echinococcus granulosus*)	No symptoms of significance	Cysts detectable only in older calves. Hydatid cysts are found in : 1. Liver, heart, lungs, spleen, kidneys 2. Muscle and brain 3. Any tissue including bone	Ingested eggs develop into hydatid cysts at the end of about five months. These cysts measure commonly 5 – 10 cm and contain fluid.	Retention cysts in kidneys, cysts in liver, granulomatous lesions, *Cysticercus tenuicolis*, and tuberculosis	Mainly in sheep. Role of infested carnivores. In humans hydatid cysts can cause serious disease. Utility of indirect tests (e.g. serology) on farm to orientated inspection ?
Giardiasis (*Giardia intestinalis = G. lamblia*)	Infestation between 4 and 10 weeks of age followed by a lifelong carrier state. Few animals develop pale and yellow diarrhoea.	Microscopic cysts (5 to 15 micrometers)	Transmission by faeces and water. Resistance of cysts in water and to disinfectants (e.g. chlorine). No effect of antibiotics.	Other causes of diarrhea	Infestation compromises immunity (possible secondary infections). No visual detection in abattoir. Slaughter hygiene.
Sarcocystosis (Sarcosporidiosis)	Frequent infestation of calves. Few animals	The cysts are microscopic (3 to 7 micrometers) and	Humans acquire the infection when they eat bovine tissues	Cysticercosis, toxoplasmosis, neurofibromatosis, eosinophilic	Usually no post mortem visual detection in abattoir. Judgement

(*Sazrcocystis bovi-hominis*)	develop pale and yellow diarrhea. Infestation further compromises immunity (possible secondary infections) 1. Incubation period 5 - 11 weeks 2. Fever 3. Loss of appetite 4. Excessive salivation 5. Anaemia	therefore are not detected on routine post-mortem inspection. They cause little tissue reaction. Rare macroscopic presence of cysts.	containing the viable Sarcocystis cysts. Transmission by faeces and water. Resistance of oocysts in water and to disinfectants (e.g. chlorine). No effect of antibiotics.	myositis	should be made on macroscopic presence of cysts. Microscopic examination of muscle may show as much as 70 % infestation in animals world-wide. Slaughter hygiene.
Cryptosporidiosis (*Cryptosporidium parvum*)	Neonatal diarrhoea. Carrier state.	Intestinal inflammation.	Faecal shedding and manure spreading linked with wide-spread and persistent waterborne contaminant.	Other causes of diarrhoea	Some genotypes transmitted between animals and humans.
5. Chemical hazards					
Chemical residues and contaminants	Chemical contaminants usually linked with region of origin or feed.	Chemical residues usually linked with lesions (e.g. in lungs, intestines, joints, navel).	Natural or voluntary origins		Usually no visual detection in abattoir but abattoir is one of the possible sites of control or of sampling for surveillance
Hormones	Suspicion based on morphometric (e.g. ponderal) criteria	Lesions due to injections	Voluntary origins		Usually no visual detection in abattoir but abattoir is one of the possible sites of control.