Opinion of the Scientific Panel on Biological Hazards on the request from the Commission on Meat Inspection Procedures for Lambs and Goats. [1]

(Question N° EFSA-Q-2003-027)

Adopted on 22nd April 2004

SUMMARY

Food animals can be infected with zoonotic microorganisms causing clinical signs *ante-mortem* and/or lesions detectable *post-mortem*. However, reports indicate that the *post-mortem* inspection of pre-slaughter of apparently healthy animals detects only 20% of all the macroscopic lesions that are actually present in 1% or less of animals. On the other hand, food animals also carry pathogenic microorganisms in their gastrointestinal tract and/or on coat without any signs of disease *ante-mortem*, or visible lesions *post-mortem*. During slaughter and dressing procedures, these pathogens, including *E. coli* O157 and other VTEC, *Salmonella* spp., *Campylobacter jejuni* and *Listeria monocytogenes,* can be directly or indirectly transferred onto the meat surface, but will not be visible to the meat inspection staff during conventional meat inspection of sheep/goats. In addition, it is recognised that physical meat inspection involving palpation and incision (as required under 64/433/EEC) increases the risk of cross-contamination of the meat with these organisms. Therefore some modified approaches are needed so as to reduce meat inspection-mediated cross-contamination of meat, whilst improving or at least maintaining the efficacy of the conventional *post-mortem* inspection of lambs and goat kids.

Such an approach aims at: a) identifying non-suspect lambs and goat kids, based on their background information including veterinary herd health actions implemented during pre-harvest phase to reduce/prevent public health hazards and actions to reduce/prevent spread of public health hazards *ante-mortem* during transport-market-lairage phase, in which *post-mortem* inspection can be simplified; and b) use of alternative methods for detection of public health hazards *post-mortem*. This approach is only possible where the lambs and goat kids originate from, and are reared and finished in an integrated production system. The production systems in EU member states are complex, involve different production stages conducted at different farms and may require lambs to move from one farm to another for different stages of production. Nevertheless, the opinion takes note of the previous

[1] For citation purposes: Opinion of the Scientific Panel on Biological Hazards on a request from the Commission related on Revision of Meat Inspection Procedures for Lambs and Goats, *The EFSA Journal* (2004) 54, 1-49

opinions in the series[2] and considers that an integrated production system, incorporating integrated quality assurance implemented along the entire production chain, for lambs and goat kids is possible. Furthermore, it can result in a higher proportion of animals of a lower public health risk being presented for slaughter.

Today, conditions that are most often detected at the traditional meat inspection of lambs and goat kids are animal health-related, and much less frequently public health-related. This is because the clinical manifestation of zoonotic diseases in lambs and goat kids held under integrated systems, as defined in the "Opinion on Species and Categories of Animals that might be suitable for Alternative system of meat inspection", is rare. In other words, within an integrated production system, and given the age at slaughter, lambs and goat kids are less exposed to infective agents, are not or less likely to develop the lesions more frequently seen at slaughter in older animals. The main conditions seen *post-mortem* in lambs and goat kids include emaciation, oedema, colour changes, tumours, haemorrhages, bruises, arthritis, septicaemia, etc., which can be diagnosed by visual inspection only.

This implies that, within an integrated system, *post-mortem* palpation and incision may not be necessary in visually inspected, non-suspect animals. This alternative, simplified inspection system is possible only under the following conditions: a) it includes other hygiene and inspection activities including use of laboratory (e.g. microbiological) tests; b) thorough *ante-mortem* examination of lambs and goat kids which is ensured with full recording systems implemented that provide for the flow of data both to and from the abattoir for both animal health and public health reasons; c) suitable conditions and facilities for an efficient visual inspection are provided; and d) all indications of any abnormality is followed by further detailed examination of the carcass and offal, including, where appropriate, taking of samples for further investigation.

The indications of possible abnormal conditions, to be followed by a detailed inspection of the carcass and offal, may arise from the data from the farm of origin and/or the results of meat inspection of previously slaughtered batches indicating possible problems either of animal or public health significance e.g. Salmonellosis, liver fluke, hydatid, *Toxoplasma gondii* or *Cysticercus ovis* or *tenuicollis* cysts. In such cases, palpations/incisions may be necessary and the Official Veterinarian has an important role in the decision to incise or to take samples that might be necessary for laboratory examination. Nevertheless, additional benefits from adoption of this alternative system include a more rational direction of some of the resources e.g. better disposition of hygiene/inspection staff and better exploitation of food chain information.

On the other hand, as stressed previously, apparently healthy lambs and goat kids may carry and/or excrete zoonotic pathogens. The major concern is the spread of

[2] Opinion on revision meat inspection in veal calves. SCVPH adopted in April 2003; opinion on identification of species/categories of meat-producing animals in integrated production systems where meat inspection may be revised. SCVPH adopted in June 2001; opinion on revision of meat inspection procedures. SCVPH adopted in February 2000.

contamination during production, transport, slaughter and dressing stages. The application of the Good Hygiene Practices (GHP) and Hazard Analysis and Critical Control Points (HACCP) principles to all stages of production and slaughter is useful to reduce this risk.

The essence of this opinion is that, in the case of non-suspect lambs and goat kids from integrated systems, as based on the chain information and the results of both the *ante-mortem* inspection and the *post-mortem* visual inspection, the risks of cross-contamination of public health concern resulting from palpation/incision would exceed the risks from not detecting hazards by visual inspection only. Generation of, and the use of, information from both the farm and the abattoir is an important aspect of chain information in an integrated system. Overall, it is considered that the public health benefits from the simplified inspection would significantly outweigh the potential public health risks from the latter procedure. At the same time, however, the awareness about the important role of *post-mortem* inspection as a source of information on animal health aspects needs to be maintained.

TABLE OF CONTENTS

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[3].
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) providing scientific advice to the European Commission, is to prevent transmission of zoonotic infections and other contamination to the consumer.

The European 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 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". This was considered to be a first step approach for the revision of meat inspection procedures.

A third opinion was issued in May 2003 on "Revision of meat inspection in veal calves" as a second step in revising the inspection procedures for the identified species/categories of animals in the opinion issued in June 2001.

TERMS OF REFERENCE

Considering the above and in view of the future process of redrafting the legislation the Scientific Panel on Biological Hazards (BIOHAZ) is asked:

- to review the currently mandatory *post-mortem* inspection procedures for lambs and goats raised in integrated production systems, 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;

[3] Council Directive 91/497/EEC of 29 July 1991 amending and consolidating Directive 64/433/EEC on health problems affecting intra-Community trade in fresh meat to extend it to the production and marketing of fresh meat *Official Journal L 268 , 24/09/1991 P. 0069 - 0104*

- 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.

ASSESSMENT

1. INTRODUCTION

1.1. Definition

Definition of lambs and goat kids could not be found except for the definition of lambs – male or female sheep up to approximately 12 months old (2003/597/EC), which was drafted for a particular purpose: statistical survey on sheep and goat population and production in Member States.

The term lamb is given to a class of sheep according to age or weight and varies between, and sometimes within Member States of the EU. The historical definition is that a sheep is called a lamb until weaning. Within this classification there are also:

- Light lambs – up to 7 kg carcass weight
- Heavier lambs from 10-15 kg and also up to 22-25 kg carcass weight, the mean weight is 17 kg for lambs from integrated systems. These lambs can be either weaned or not, but they are fed concentrate *ad libitum* until the slaughter or they are animals that stay with their dam in the pasture and are finished in fattening units using concentrates at 4-6 month of age.

It is recognised that there are differing production systems within and between different Member States. In addition, with the exception of flocks used for milk production or with specific breeds, the lambs are exclusively fed with ewe's milk until slaughter which takes place about 25-45 days of age with carcasses up to 7 kg weight (usually 5.5-6 kg).

In some systems there is reference to lambs until much older but during the year of birth e.g. "tup lambs". Therefore while recognising both the difficulty in ageing sheep and current TSE rules, the maximum age of any lamb in this report will be twelve months of age.

Goat kids are usually slaughtered at the suckling stage (1 month of age; and up to 5-5.5 kg carcass weight)

1.2. Market and movement

Lambs are used in the following text for illustration purposes. However, the same may also apply to goat kids produced in comparable systems.
Lamb meat production comes from milk farms or from farms of meat breeds. In the Mediterranean countries, the lambs from milk farms are slaughtered at approximately one month of age (suckling lambs) and they may represent 11-65% of the total national sheep meat production. In some of these countries the lambs from meat breeds are slaughtered at 70-100 days of age and may represent up to the 75% of total national

lamb meat production. In the northern countries the rearing systems usually produce heavier lambs which may be slaughtered at 6 or more months of age.
Although the production and the consumption of lambs have decreased in recent years, lamb meat continues to be a traditional product consumed in some countries of the EU such as the United Kingdom, Ireland and the Mediterranean countries (Spain, France, Greece and Italy). These countries have the largest populations of sheep inside the European Union. In general, the southern countries produce lighter carcasses (about 10 kg) than the northern ones (18-20 kg).

Lambs from meat or milking breeds may be reared and fattened on the farm of birth or in major fattening units where lambs originate from several farms. In the meat breeds, when the lambs are fattened in units from several origins, they are collected from the farm of birth at 40-60 days of age and directly sent to the fattening farm. In the fattening farm the lambs stay 2-6 weeks after which they are sent to the abattoir. The fattening for units may be part of a cooperative which assembles lambs from its associated farmers or of an independent operator who buys lambs from different flocks. In the first case the fattening units are near to the birth farm of the lamb (no more than 50-100 km). In the case of the independent operators or when the lambs come from long distances there may have been an intermediate assembly centre where the lambs were assembled prior to be sent to the the fattening farm.

In other countries, lambs born from "meat ewes" are reared on the dam and are usually reared on only one farm, (e.g. "sheepfold lambs" in France) and they often have a quality label. The lambs born from milking ewes are sold for rearing and fattening in rearing farms and represent "integrated system lambs". They could come from several farms and are distributed in several fattening farms.

At the farm of birth the lambs are commonly identified with an ear tag with the farm official registration number. In the fattening units, an additional tag is put in the other ear with the official registration number of the fattening unit or in the case of cooperatives it is usual to put on only an auricular tag at the farm of birth, with both registration numbers, that of farm of birth and that of the fattening units. The animal with quality marks are identified by an individual number in the ear tag.

In some countries during the movements of the lambs, i.e. from farm to farm or farm to abattoir, the animals travel accompanied by a specific document of transport. If the animals are moved inside a region to an abattoir and the farm is integrated inside a Sanitary Defence Grouping, as in some regions, there is a declaration signed by the lamb owner giving details of the number of animals, the origin and destination, along with details on the medicines used and a statement that "the animals have no visual abnormalities". When the animals are moved between different regions, between farms or when the farm is not inside a Sanitary Defence Grouping, an official document is signed by an official veterinarian with a similar declaration.

In some countries, a document is needed to move animals from farm to farm. This document is signed by the owner and indicates the farm of origin stating its farm official registration number, the number of animals which move and the status of the farm (e.g. free of brucellosis).

The slaughtered lambs usually come from farms or fattening units that are near to abattoirs (50-100 km) but may come from farms 300-800 km away. Normally the travelling time is less than 2 hours, although in some cases this travelling time may be

considerably longer. In this respect the current EU legislation on journey times will apply and the journey may therefore be interrupted.

In general, the possible movements of lambs and goat kids are:

- Farm of birth – abattoir
- Farm of birth – assembly or regulatory centre – abattoir
- Farm of birth – assembly centre - fattening farm (cooperative or independent operator) – abattoir
- Farm of birth – fattening farm (cooperative or independent operator) – abattoir
- Farm of birth – fattening farm – assembly or regulatory centre - abattoir

The batch of lambs sent to the slaughterhouse is made up of lambs originating either in one fattening farm or in several fattening farms. Batches of lambs can be gathered together a few days just before going to slaughter.

To satisfy the integrated system we are of the opinion that there should be no more than two farm premises involved in the formation of a batch before animals go for slaughter with full identification and traceability. This recognises the practice of using a regulated collection centre between the farm of origin and the fattening unit and also before transport to slaughter.

1.3. Rearing systems

1.3.1. Species

Sheep - Sheep farming takes place over areas of Europe because sheep are able to live in a wide range of environments, even those hostile for other animals. There are different ways to raise sheep according to the environment, the breed and the people. There are essentially three kinds of farming: sheep raised exclusively for meat and wool (typical for Australia, New Zealand, South America, some areas of Europe), fat-tailed non–Merino breeds bred only for meat (Africa) and dairy sheep farming (Mediterranean basin). The meat production in Europe reflects the diverse farming systems. For instance, in Italy the ovine meat production comes from milk-lambs (*agnelli da latte*) (65%), light and heavy lambs (*agnelli leggeri* e *pesanti*), *agnelloni* (5-6 months old lambs) (25%) and older animals (10%). In France lambs born from milking ewes are sold for rearing and fattening in rearing farms and represent integrated system lambs. They come from several farms and are sent to several fattening farms where they are reared until they are sent to the slaughterhouse. The batch of lambs sent to the slaughterhouse is made up of lambs originating either in only one fattening farm or may be from several fattening farms. Lambs born from "meat ewes" are reared on the dam and often have a quality label. On the other hand, as in Spain, lambs may come from either milk or meat flocks. At present, in the most frequent rearing systems of the ewes they are grazed on pastures near the farm. The ewes may graze during the day and are stabled at night when they are given supplementary feed.

Goats - Goats are generally reared in extensive systems and traditionally live in poor areas, mountains or arid regions and traditionally have been reared with sheep. At

present, in extensive production systems, flocks of goats only, without sheep present are rare. Milk goats are reared in similar systems to sheep milk flocks with grazing near the farm or kept housed. The kids are generally reared like the suckling lambs and are slaughtered at approximately one month.

1.3.2. Production and Rearing systems

Extensive systems of rearing are used for 90% of sheep production in the EU with intensive husbandry systems more common in milk flocks. In general the types of husbandry systems are:

- Semi-extensive systems with grazing near the farm. The sheep graze during the day and are stabled at night when they are supplemented.
- Extensive system with grazing in different pastures of the same geographical area. In poor grazing areas sheep are housed in winter.
- Extensive systems in which sheep graze in different geographical areas in different months of the year. In spring and summer the flocks go for grazing to mountain areas or in winter go to the southern lands.

The "sheep year" can be considered to start with preparation for breeding that includes selection of the ewes, preparation of the males, checking of teeth, udder and feet for fitness for production and rearing of lambs. The preparation includes parasite control, *Clostridium* and *Pasteurella* vaccines and possibly foot rot vaccine. This varies between and within Member States.

There is normally one crop of lambs born each year, from Christmas through to Easter time, but it is possible for certain types of sheep to have two crops of lambs. In addition there is a need for the ewe to produce a lamb before joining the milking flock.

The lambing period is a time when the farm is working under pressure and when attention to detail is essential if problems with both dam and lamb are to be avoided. The actual time of lambing may depend on the region, topography of the farm and severity of winter weather and can be as early as December/January through to April/May.

The prolificacy of the ewe will depend on the nutrition provided up to and during the mating time and thus is very important. Following mating nutrition continues to be of importance through to lambing, with metabolic problems being of major concern if the nutrition is faulty. As pregnancy continues there is a risk of abortion with *Chlamydophila abortus* and *Toxoplasma gondii* as the most likely causes, however, *Salmonella* spp. and *Campylobacter fetus* may also be causal agents of abortion. Normal biosecurity rules will reduce the risk, especially by preventing the introduction of the disease agent into the flock with replacement stock. Vaccines also exist for enzootic (*Chlamydophila abortus*) and *Toxoplasma gondii* abortion.

A summary of the common problems and diseases and involving lambs are given in Table 1.

Table 1: Summary of common diseases and problems involving lambs or goat kids relating to different stages of production

PERIOD	DISORDERS
Partum	Dystocia
	Maternal influence -metabolic disorders; mastitis
	Primary septicaemias in the neonate
Postpartum	Congenital disease – e.g. swayback, border disease, nutritional myopathy
	Hypothermia
	Watery mouth – *E. coli*
	Lamb dysentery – *Clostridium* spp.
	Enteritis – *E. coli, Rotavirus, Cryptosporidium* spp., *Salmonella* spp., coccidia
	Umbilical infection – spinal abscess/liver abscess as sequel
	Orf (Contagious Ecthyma)
Rearing	Major problems most often associated with the thorax with pneumonias– multifactorial in origin but mainly *Pasteurella* spp., both in the acute and chronic forms, along with Mycoplasmas and viruses.
	Parasitic bronchitis and gastroenteritis if grazing
	Clostridial diseases
	Polyarthritis – *Erysipelothrix rhusiopathiae*
Fattening	Pneumonia and parasitic gastroenteritis possible with a seasonal increase in risk
	Trace element deficiencies – cobalt, copper
	Myiasis

1.4. Husbandry through to dispatch for slaughter

Many sheep are brought indoors just for the period of lambing with the ewe and lamb(s) turned out to grass soon after. For flocks lambing early in the year this is only really possible in some regions if housed both during and after the lambing period.

Lambs from meat breeds stay generally with their mothers until they are weaned at the age of 40-45 days when they are isolated in the fattening unit where they are fed with roughage and concentrates. During this period ewes may be housed or grazed on pasture. In some cases while the ewes graze, the lambs continue to be reared indoor, and fed, separated from the mother, with roughage and some concentrate in addition to suckling the dam.

Lambs of milk breeds are weaned at the time of birth and fed with milk substitutes. In the fattening units lambs are classified by weight and age, and maintained in more or less group pens with roughage (or straw) *ad libitum* and fed with concentrates. In general, the animals rest for 2 to 14 hours in the lairage pens of the abattoir before being slaughtered. Initially the feed is milk followed by access to grass, either as grass, or grass conserved as hay or silage. There may also be supplementary feed provided it has been compounded from a variety of ingredients.

There are four phases involved in raising lambs: newborn care and colostrum period, suckling, weaning and fattening. A similar system is followed for goat kids. This may include periods of housing and grazing. A summary of the different systems is given in Annex [6].

1.5. Health Certification/Quality Assurance schemes

The main features of such certification systems, in addition to the legislative requirements should be:

1. Complete traceability of the production chain (from birth of the lamb 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 lambs, length of the fattening cycle (e.g. dates of arrival to / departure from the farm, breed and animals used).

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

6. Compliance to the EU recommendations and legislation for the eradication and control of small ruminant TSEs.

7. Evidence of an external independent verification of the whole system.

In the different European areas there is a variety of integrated production systems and different specifications. For instance, lamb meat production in Spain is increasingly moving towards specialised integrated production systems. Many farmers are organised in cooperatives and these have a system of quality control with verification and certification by independent organizations. Farmers send their lambs to the cooperatives fattening units. In other cases, cooperatives only have regulation centres to where the farmers send their lambs before the slaughter. In these centres the lambs stay only one or two weeks for regulating the slaughtering and selling.

A summary of examples of certification and assurance systems are shown in Annex [6].

1.6. Diseases in lambs and goats

Although a range of disease conditions can be seen in lambs and goats, the predominant diseases relate to intestinal and respiratory conditions. Where scheduled diseases are encountered, in all cases the relevant regulatory authority should be notified.

1.6.1. Conditions affecting different systems and organs

1.6.1.1. Skin

The most common skin condition of lambs and goats is orf (contagious echthyma), but ringworm and mange has also been recognised along with psoroptic mange, headfly and blowfly, staphylococcal dermatitis and ectoparasites, including *Ixodidae* (hard ticks).

1.6.1.2. Alimentary system

The most important pathogens associated with diarrhoea in lambs and goats are enterotoxigenic *Escherichia coli*, rotavirus, coronavirus, *Salmonella* spp., *Clostridium* spp., *Cryptosporidium* spp. (especially *C. parvum*), and *Eimeria* spp. Various other agents can also be implicated with a mild enteritis e.g. *Giardia* and *Campylobacter* spp.

Clostridial diseases inflict heavy losses among livestock. They are responsible for the following diseases:

Enterotoxemias: *C. perfringens* type B (diarrhoea of lambs under two weeks of age), type C (necrotic enteritis mainly under 10 days of age) and type D (pulpy kidney disease). *Clostridium chauvoei* B (blackquarter), *Clostridium chauvoei* A (bradsot), *Clostridium novyi* B (black disease), *Clostridium haemolyticum* (red water disease), *Clostridium* spp. (big head), *C. sordelli* producing mild disease and *C. perfringens* type A producing the hemolytical disease

Dicrocoelium dendriticum and *Fasciola hepatica* which cause haemorrhagic tracks in the liver or cholangiohepatitis and *Cysticercus tenuicollis* which forms fibrous and haemorrhagic tracks and cysts in the abdomen.

1.6.1.3. Respiratory system

Major respiratory problems in sheep lead to pneumonia and pleurisy. Pneumonia frequently occurs as a sequel to, or simultaneously with infectious diarrhoea linked to immunocompetence and thus resistance to some bacteria and viruses.

The major pathogen involved in pneumonia is *Mannheimia* (*Pasteurella*) *haemolytica*. Other agents can occur in combination with other pathogens: *Mycoplasma* spp., *Arcanobacter* (*Actinomyces*) *pyogenes*, *Pasteurella multocida*, *Chlamydophila abortus*, *Streptococcus* spp. Parasitic bronchitis are caused by *Dictyocaulus filaria*. In fattening units pneumonias by *Mycoplasma* spp. (atypical pneumonia) are particularly important.

Sheep pulmonary adenomatosis (SPA) is a naturally occurring contagious lung tumor of sheep which has been associated etiologically with a type D- and B-related retrovirus (Jaagsiekte retrovirus; JSRV). Although rare, it can also affect 5-6 month old lambs.

Tuberculosis in sheep and goats is caused by *Mycobacterium bovis*.

1.6.1.4. 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. Omphalitis, omphalophlebitis and/or umbilical abscess are seen usually in single animals.

Chlamydophila, *Staphylococcus* etc may be involved in such lesions.

Septic arthritis usually arises as a complication of neonatal septicaemia. Many cases of arthritis are associated with aseptic inflammation arising from chronic pressure and abrasions. This may commonly involve *Erysipelothrix rhusiopathiae* and *Streptococcus* spp. with other pathogens found occasionally.

1.6.2. Associations between occurrence of diseases and the age of sheep and goats

The associations between disease and stage of production are considered in the context of the following typical periods: neonatal period, the weaning, the growing and the fattening phase. In addition to these categories, age and weight differences are used within and between Member States during the entire production period. The problems in the different production systems have been described previously in Table 1.

1.6.2.1. Neonates

Many cases of death within the first days 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, and these conditions may have the consequence of increasing the age at slaughter.

1.6.2.2. Under 6 weeks of age (weaning)

Diarrhoea

Lambs and goat kids that need to adapt to the new environment, the stress of travel and dietary change can develop diarrhoea.

Diarrhoea caused by *Cryptosporidium parvum* can occur, but is generally self-limiting and resolves naturally. Likewise coronavirus and rotavirus also can occasionally cause diarrhoea and *Cryptosporidum parvum* may occur or allow *Enterobacteriaceae* to multiply.

Respiratory problems

Lung infections are usually multifactorial, caused by *Mycoplasma* spp., viruses with *Mannheimia* (*Pasteurella*) spp.

1.6.2.3. Growing period – from weaning through to fattening stage

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 1.6.2.2), continue to represent the most common health problems, mainly atypical pneumonia.

Arthritis caused by *Mycoplasma* spp. and *Erysipelothrix rhusiopathiae* can occur.

1.6.2.4. Fattening period

During this period, lambs and goats can be fed at an intensive level, and receive both roughage and compounded foodstuffs.

Diarrhoea occurs very rarely, but it is mostly associated with endoparasitism.

Atypical pneumonia by *Mycoplasma* spp. is frequent in housed lambs.

Sudden death can also occur, with pathological findings including bloody gut contents in which, microscopically, an unusually high number of *Clostridium* spp. can be observed. Lambs may also sometimes die from a gut torsion, which can be caused by fermentation of the colon contents.

Pathologies other than those affecting the lungs have a variable frequency, normally less than 2%. But it may be up to 8% as there is an

association with region and parasitic cysts. Total condemnation of carcasses is rare and is linked almost exclusively with severe emaciation, and occasionally, septicaemia, arthritis and colour anomalies.

1.6.3. Zoonotic agents associated with slaughtered lambs and goats

Human health hazards acquired from sheep and goats include zoonotic agents: a) shed by healthy animals and contaminating carcasses during slaughter, b) causing disease in animals that can be transmitted to humans *via* food, and c) causing disease in animals that can be transmitted to humans *via* direct contact.

Zoonotic agents potentially causing human infections *via* foods

Pathogenic bacteria such as enterohaemorrhagic *Escherichia coli* (VTEC) including O157:H7 serotype, *Campylobacter jejuni*, *Salmonella* spp. and *L. monocytogenes* can be shed by healthy sheep/goats. Public health relevance of sheep/goat carcass contamination with those agents during slaughter and dressing is the same as in case of other food animals.

Mycobacterium bovis, the etiological agent of tuberculosis is very rare, but it was reported in several EU countries in sheep, particularly in flocks in very close proximity to tuberculosis-positive cattle herds. Tuberculosis caused by *M. bovis* has been reported in goats, but not in kids (EC, 2001). The *post-mortem* lesions in sheep/goats usually resemble those in cattle i.e. primarily in lymph nodes draining head and lungs. For pre-slaughter diagnosis of tuberculosis, the tuberculin skin test can be used as in cattle, but this is not done on a routine basis.

Pseudotuberculosis (or caseous limphadenitis) by *Arcanobacterium pyogenes* is rare in young lambs and its zoonotic potential is not fully demonstrated.

Brucellosis (*Brucella melitensis*) is present in sheep/goats, most frequently in adult animals, in parts of the EU with 0-14.2% infected holdings (EC, 2001). Uterine discharge and milk from infected animals contain the pathogen. Some viable offspring from infected females may be infected but seronegative. Available diagnostic blood tests include ELISA, Rose Bengal Test (RBT) and/or agglutination. Human infection usually occurs *via* milk, but also *via* handling of slaughtered infected animals by abattoir workers. Consumption of meat is of little importance as an infection route, as the pathogen in meat does not remain viable for long after cooking.

Listeriosis in sheep/goats can be caused by *L. monocytogenes* or *L. ivanovii*, usually the condition presents as meningoencephalitis but also placentitis with abortion in adult sheep, whilst septicaemia occurs primarily in neonates and lambs. The infection often occurs from contaminated feeds, with poor quality (insufficiently acidic) silage playing a major role. Human foodborne infections *via* dairy foods from sheep/goats have been reported (Hall, 1988), but the meat can also be contaminated (Farber and Peterkin, 1999), so the meat-borne risks probably cannot be excluded.

Cryptosporidiosis (*Cryptosporidium parvum*), can cause diarrhoea in lambs and goat kids (10-20 days of age). Human infections can occur *via* contact with animal faeces, drinking contaminated water, or consumption of foods (vegetables, salads) contaminated by such water.

Johne's disease (paratuberculosis) caused by *Mycobacterium paratuberculosis* (*M. avium* subsp. *paratuberculosis*, *M. johnei*) affects primarily adult sheep and goats. It results in enteritis and/or enlargement of mesenteric lymph nodes often with haemorrhages. Although the infection mostly occurs in the first few weeks or months (kids) via in-utero transmission, faecal contamination, or colostrum/milk, there may be a significant period (up to 3 years) of sub-clinical shedding before development of clinical disease. Diagnosis of paratuberculosis by blood tests, e.g. Complement fixation test (CFT), Agar gel immunodiffusion test (AGIDT) and Enzyme-linked immunosorbent assays (ELISA) is possible. Human infection would have occurred primarily *via* milk, although there is still a controversy whether association between Johne's disease (in animals) and Crohn's disease (in humans) really exists.
Rift Valley fever (Virus family *Bunyaviridae*, genus *Phlebovirus*) is a disease in sheep/goats in Africa, but is not present in the EU. Clinically, lambs show fever with mortality rates of 20% (>1 week age) to 90% (<1 week), with *post-mortem* findings including focal or generalised hepatic necrosis, widespread cutaneous haemorrhages, lesions on lymph nodes, and haemorrhagic enteritis. This result in a major zoonoses in affected areas, and human infections occur *via* nasal discharge, blood, vaginal secretions, infected meat, as well as *via* mosquitoes.
BSE, if it should be found under natural conditions in sheep and goats, would constitute a significant risk to human health. In susceptible genotypes, the whole animal should then be considered as risk material.

Zoonotic agents potentially causing human infections *via* other routes

Q-Fever is a disease, primarily causing abortions in adult sheep, caused by *Coxiella burnetii.* Aborted lambs and placentae contain high numbers of organisms, and human infection usually occurs *via* inhalation of contaminated dust (afterbirth, urine, faeces) but *via* milk as well.

Toxoplasmosis (*Toxoplasma gondii*, a protozoan parasite) is a cause of abortion in sheep. The occurrence of sheep/goat meat-borne human infection is unclear, but the foetus and placenta contain high numbers of *Toxoplasma* and should be handled with safety measures.

Ovine chlamydiosis (enzootic abortion of ewes, possibly in goats) is relatively frequent. Of the two species that may affect sheep, *Chlamydophila abortus* and *C. pecorum*, only the former is transmissible to humans *via* infected afterbirth.

Erysipelothrix rhusiopathiae occurs rarely but an outbreak of related septicaemia with post mortem lesions of abscesses in liver and lungs has been described, as well as cases of related arthritis. Humans are normally infected by direct contact with the infected tissues.

Ringworm (dermatophytosis, *Microsporum gypseum*) is a skin fungal disease in sheep similar to that in cattle. Humans can become infected by spores (either from animal skin or from livestock equipment) entering skin through cuts/abrasions.

Similarly, infections by contact with other zoonotic organisms from sheep/goat skins, such as orf (*Poxviridae*, Parapoxvirus; Sore Mouth, Contagious Ecthyma), *Arcanobacterium pyogenes*- or *Staphylococcus aureus* – caused dermatitis, are possible.

Anthrax (malignant pustule; charbon; malignant oedema), caused by *Bacillus anthracis*, is an acute infection of sheep/goats, other animals and humans, which may be rapidly fatal. Human infection can occur *via* contact with infected animals or their products (e.g. blood, skins, wool and bones). Therefore, it is recognised as an occupational hazard for farm workers, veterinarians, knackerman, wool-sorters, etc.

Some zoonotic parasites (e.g. *Echinococcus, Fasciola hepatica*) can be present in tissues/organs of sheep/goats, as these hydatid organisms play a role in the parasites' lifecycles, but human infections occur *via* routes other than meat/milk.

Compliance with the TSE regulations with respect to controls on farm and in the abattoir is mandatory as are the requirements of any eradication scheme. This includes the taking of any samples for monitoring and surveillance of TSE in the sheep and goat population.

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1.6.4. Farm to slaughter phase: public health risks

Farm-to-slaughter handling of animals can have detrimental effects on meat quality (e.g. fatigue and/or mechanical injuries) and reduce meat safety. The latter includes induction/spread of specific animal diseases and surface contamination of animals with pathogens not causing clinical diseases in animals.

The effect of transport on the infection/spread of diseases in animals has been highlighted previously (SCAHAW, animal welfare in transport, 2002; SCVPH, veal calves inspection, 2003). A variety of stressors are associated with transport and by decreasing the efficacy of the immune system, they can enhance the susceptibility of animals to infection and disease. 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. Transport also can increase the level and/or duration of shedding of pathogens, as well as the surface contamination of animals with pathogens *via* animal-animal or animal-environment-animal contacts in the vehicle, on the market, or in the lairage. Therefore, it can be assumed that the food/meat safety risks increase as the number/frequency of movements of animals between farm and slaughter increase (SCVPH, veal calves inspection, 2003). Routine cleaning and sanitation of transport vehicles and/or lairages to a visually clean standard is necessary, but may not entirely eliminate pathogens e.g. *Salmonella* spp. or VTEC O157:H7 from related surfaces (Oosterom *et al.*, 1983; Swanenburg *et al.*, 2001; Small *et al.*, 2002).

For the above reasons, several EU Member States have used a visual rating system to assess the cleanliness of sheep/goats as a measure to reduces fleece-to-carcass cross-contamination. Whilst slaughter of clean sheep/goats reduce total bacterial contamination of carcasses, overall, no quantitative correlation between visual cleanliness and presence/levels of pathogens on animal coats has been clearly demonstrated.

1.7. Slaughtering and dressing background information

A significant proportion of food animals can carry pathogenic microorganisms in their gastrointestinal tract and/or on coat without any signs of disease *ante-mortem*,

or visible lesions *post-mortem*. During slaughter and dressing procedures, these pathogens, including *E. coli* O157 and other VTEC, *Salmonella* spp., *C. jejuni* and *L. monocytogenes* can be, directly or indirectly, transferred onto the meat surface but will not be visible to the meat inspection staff during conventional meat inspection of sheep/goats. There is little doubt that carcass meat safety is, to a large extent, affected by the hygienic status of the fleece (Empey and Scott, 1939; Gerrand, 1975; Gustavsson and Borch, 1989).

Surface carcass contamination is primarily a hygiene process issue, and can be reduced through a more preventative approach based on systematic development and implementation of: a) general hygiene measures (GMP, GHP); and b) specific measures based on the HACCP system. Some generic CCPs (Critical Control Points) applicable to all sheep/goat abattoirs include: i) acceptance of clean/ suitable animals for slaughter; ii) pelt removal (probably the most relevant); iii) evisceration; and iv) meat chilling. The relevance of coat cleanliness was mentioned previously (1.6.4).

Depelting systems for sheep (SCVPH, 2001) and goats include:

a) "Cradle" pelting system is normally used only in small abattoirs. Cross-contamination of lamb carcasses occurs primarily due to the pelt "tucking under" or the dirty fleece hanging over the edge of the pelt onto the carcass. For cradle systems, mean total viable count of 3.65-4.3 log CFU cm^2 on the carcasses was reported (Tinker *et al.*, 1999).

b) With conventional pelting line system, the pelt is freed manually from tail to head. For conventional line system, mean total viable counts can range 3-4.5 log CFU cm^2, with the highest bacterial counts on peri-anal area, hind hock and flap, followed by foreleg (Bell and Hathaway, 1996). Other studies did not find great differences in bacterial levels between hindquarter and shoulder regions (Cenci Goga *et al.*, 1996; Trevisani *et al.*, 1996).

c) With inverted pelting, used in medium and large abattoirs, the pelt is removed head to tail largely mechanically. As the depelting operation starts at the cleaner end of the carcass, mean total viable counts with the inverted system can be 0.5 to >1.0 log CFU cm^2 lower than with the conventional system (Bell and Hathaway, 1996), however, other studies did not confirm this finding (Cenci Goga *et al.*, 1996; Trevisani *et al.*, 1996).

At the point of evisceration, the main control measures consist of sealing the ends of the alimentary tract e.g. 'rodding' of oesophagus and bagging of anus, so as to prevent carcass contamination with ingesta.

Due to TSE control measures, there is legislation on specified risk materials (SRM) from ovines and caprines, which comprise the head including brain and eyes (excluding tongue and horns), spinal cord, and tonsils from animals over 12 months, as well as spleen and ileum from animals of all ages (Regulation (EC) 999/2001[4]; Regulation (EC) 1139/2003[5]). These SRMs and specified solid waste

[4]Council Regulation 999/2001 of May 2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies *Official Journal L147, 31/05/2001 P. 1-40.*

collected in the drainage system must be removed and handled in the same manner as disposal Category 1 Animal By products (ABP) from the EU legislation.

At the end of the slaughter line, but before carcass chilling, the operators have to check regularly the microbiological status of carcasses in the context of HACCP (EU Commission Decision 2001/471/EC). The acceptable, marginal and unacceptable values (as mean log cfu/cm^2) are <3.5, 3.5-5.0 and >5, respectively, for total viable count of bacteria (TVC), and <1.5, 1.5-2.5 and >2.5, respectively, for *Enterobacteriaceae.* Where unacceptable levels are found, intervention maybe required.

At the point of chilling, the carcass temperature must be reduced to $\leq$7^{o}C, and that of edible offal to $\leq$3^{o}C, so to prevent pathogens' growth (EU Directive 64/433; as amended).

2. MEAT INSPECTION PROCEDURES FOR LAMBS AND GOAT KIDS

2.1. Lambs and Goats at slaughter

2.1.1. Post-mortem findings in slaughtered lambs and goats

At the slaughterhouse the main pathologies observed are pneumonia-pleurisy, liver cysticercosis, arthritis and icterus and in decreasing order of frequency according to available data, the following diseases:

- Kidney:
  - Lambs: hydronephrosis, nephritis, pyelonephritis, petechiae.
  - Goats: hydronephrosis, nephritis, pyelonephritis, petechiae.
- Lungs:
  - Lambs: inflammation of the lungs and pleura, mainly in a chronic form; *Echinococcus*, verminous bronchopneumonia (*Strongylidae*), while pseudotuberculosis does not affect organs in lambs (see note for lymph nodes), pleuropneumonia (*Mycoplasma* spp. and *Haemophilus* spp.), lungworms (*Muellerius capillaris* and *Protostrongylus rufescens)*.
  - Goats: inflammation of the lungs and pleura, mainly in a chronic form: *Echinococcus* spp.
- Heart:
  - Lambs: pericarditis fibrinosa: (*Pasteurella* spp., *Streptococcus* spp., *Cysticercus ovis*).

[5] Council Regulation 1139/2003 of June 2003 amending Regulation (EC) 999/2001 of the European Parliament and of the Council as regards monitoring programmes and specified risk material *Official Journal L160, 27/06/2003 P. 22-32.*

  - Goats: pericarditis (also caused by *Clostridium novyi)*.

- Liver:
  - Lambs: *Cysticercus tenuicollis* fatty change, abscesses, hepatic distomiasis, *Dicrocoelium dendriticum*, cholangiohepatitis.
  - Goats: fatty change, abscesses.
- Bowel:
  - Lambs: enteritis, *Clostridium perfringens* (enterotoxiaemia), total condemnation of carcass.
  - Goats: enteritis.
- Spleen: hypertrophy (splenomegalia).
- Heads: abscesses.
- Tongue and pharynx injuries; raised lesions on palate, dental pad and lips – contagious ecthyma (orf), in malignant form the infection spreads to buccal cavity, with gengivitis and stomatitis with extension to oesophageal mucosa rumen and abomasum (total condemnation of carcass).
- Carcass: icterus, fever (septicemia), emaciation and/or muscular oedema, icterus, chronic arthritis (acute and chronic, non-septic and septic), transport injuries, septicaemia, colour anomalies.
- Lymphnodes: lymphadenitis caseosa (*C. pseudotuberculosis*) in young animals only superficial lymphnodes (prescapular, precrural, prescapular, inguinal, popliteal) and occasionally omphalophlebitis and septicaemia.
- Oesophagus: Sarcocystosis (*Sarcocystis gigantea-ovifelis* condemnation if generalised).
- Abcesses, often related to lymphadenitis caseosa (*C. pseudotuberculosis*), or injection abscesses.

Total condemnation of carcasses is rare and is linked nearly exclusively to severe emaciation, arthritis and occasionally septicaemia and colour anomalies.

Table 2 summarises the current meat inspection requirements as laid down in Council Directive 64/433 and as amended and updated.

2.2. *Post-mortem* findings at meat inspection

For the production of the opinion, rejection data from a number of countries was taken into consideration.
The following Tables 3, 4, 5 and 6 collate the diseases that can be diagnosed on *post-mortem* inspection of lambs and goats. 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.
Pathological conditions of the lymph nodes (inflammatory, degenerative, hyperplasia) 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 carcass. The pathological change seen with generalised lymphadenitis could be related to septicaemia if acute and to toxic pathologies if chronic. Both cases imply a potential risk for public health. Routine incision of pancreatic, gastric and mesenteric lymph nodes is not advisable, due to the risk of spreading bacterial contamination.

Abscesses can be suspected on 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 lambs due to wounds derived from the roughage used for feeding.

Table 2: Mandatory meat inspection measures in sheep and goat kids under Council Directive 64/433 as amended and updated

Parts to be inspected	Observation	Palpation	Incision	Remarks
Skin and carcass surface	+		(▲)	
Head	+			Flayed previous
Throat	(▲)			Examination not required if heads are excluded from human consumption
Mouth and fauces	(▲)			
Tongue	(▲)	+		
Retro-pharyngeal lymph nodes	(▲)			
Parotid lymph nodes	(▲)			
Lungs	+	+	(▲)	
Trachea	+		(▲)	
Oesophagus	+		(▲)	
Bronchial lymph nodes		+	(▲)	
Mediastinal lymph nodes		+	(▲)	
Pericardium and heart	+		(▲)	
Diaphragm	+			
Liver	+	+	+	Incision of gastric surface of the liver 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 Except of observation for the penis, if already discarded?
Udder and its lymph nodes	+			
Blood	+			
Muscles	+		*(▲)*	
Connective and fatty tissue	+			
Umbilical region (in young animals)	+	+	(▲)	In event of doubt, umbilical region must be incised
Joints (in young animals)	+	+	(▲)	In event of doubt, joints must be opened

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

Actinobacillosis in lambs and goat kids is normally confined to the head (tongue, mouth, masseters muscles, and 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. Visual inspection will alert and allow proper palpation and incision if required.

The lung lesions most frequently observed are the inflammatory ones, normally with no public health implications for the carcass. *Echinococcus* cysts will be visible. 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 with previous opening of the pericardium, to diagnose inflammatory, infectious lesions, is not indicated for the heart,. However, findings that suggest

septicaemia need to be followed by a detailed general inspection of the carcass (lungs, joints, liver, etc.).

Pathological conditions frequently observed in the liver are those linked with feeding practices (fatty change from glycogen storage, 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. Fat discoloration due to defects in carotenoid metabolism, may warrant condemnation on aesthetic grounds.

Echinococcosis and cysticercosis (*Cysticercus tenuicollis*) are more commonly reported in liver and lungs and they are usually detected by observation. Hydatid cysts may only be present in older lambs. These are probably not detected in lambs less than 6 months old. *C. tenuicollis* is not a condition of public health concern.

Distomatosis (fascioliasis) and dicroceliosis may be present in the livers of lambs and goats liver but they are not of public health concern in the developing countries. The importance of their detection is derived more from a point of view of quality or aesthetics than in relation to public health. Although the most serious cases may be accompanied by cholangitis, detectable by visual inspection, in the other cases incision of bile ducts is necessary for its detection. These conditions are present only in animals that graze at moist pastures in determined periods of the year.

Conditions of the gastro-intestinal tract which are of concern 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 the meat's destination depends on the complete 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 condition or to animal health (petechial haemorrhages from infectious diseases). Unless the fat and kidney capsule are removed, the presence and extent of lesions in the kidney may not be identified.

Inspection of the umbilical region has to be carried out by visual inspection first and related to possible systemic involvement, such as multiple metastasised abscesses, of 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 lambs and require, therefore, a routine visual inspection followed by incision, where necessary, 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* could give clues as to the distinction between rickets and arthritis, whereas a detailed examination of the carcass and offal is needed for a final diagnosis. The finding of an abnormal joint(s) requires the carcass to be removed from the line before further investigation and the part of the leg removed before the suspect joint is opened.

General systemic pathologies, like emaciation, oedema, colour changes, tumours, haemorrhages, bruises, etc. can be diagnosed by observation following enucleation. 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 viscera to ascertain/exclude public or animal health related pathologies. Any abnormal muscle colour may indicate physiological conditions that in addition to welfare implications must be differentiated from fevered meat. Tumours and malformations may occur in any organ.

Bacterial contamination of the carcass and offal can be considered the primary reason of public health concern. Any case of contamination of carcass or edible organs by faecal, digestive, or bile material 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.

In Table 3, the possible findings on meat inspection have been considered excluding *ante-mortem* findings.

Table 3: Possible findings on *post-mortem* meat inspection of the carcass of lambs and goats

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) malformations	a,b,c,d,e,f,g,h, i,j,k,l,	h,l	b,h,l
Skin and carcass surface	(a) Skin wounds- fresh or chronic (CLA)	a		
Blood	(a) clotting ability, (b) discolouration	a,b		
Muscles	(a) abscesses, (b) oedema/inflammation, (c) white muscle myopathy	a,b,c	a,b	a, c
Bones	(a) Fractures are frequent	a		a
Connective and fatty tissue	(a) oedema inflammation	a	a	a
Joints	(a) Arthritis (local, chronic, generalised, septic), (b) joint ill	a,b	a,b	
Umbilical region	(a) Abscesses	a	a	a

Table 4: Possible findings on *post-mortem* meat inspection of the head and throat of lambs and goats

Parts to be inspected	Diseases/conditions detectable	Detectable by observation	Detectable by palpation	Detectable by incision
Head and throat	(a) inflammation (b) suppuration including abscess	a		b
Submaxillary lymph nodes	(a) abscess,	a		a
Retro-pharyngeal lymph nodes	(a) abscess,			a
Parotid lymph nodes	(a)) abscess			a
Mouth and fauces	(a) orf	a		
Tongue				

Table 5: Possible findings on *post-mortem* meat inspection of the thorax of lambs and goats

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) bleeding problems, regurgitation, (f) parasites (g) hydatid	a, b, c, d, f, g	b, f	b, d, e, f
Oesophagus	Sarcocysts (a)	a		
Bronchial lymph nodes	Reaction in case of pulmonary lesion (a)	a		a
Mediastinal lymph nodes	(a) Reaction in case of pulmonary lesion	a		a
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	b		a, b
Pericardium and heart	(a) inflammatory lesions in pericardium, (b) myocardium, endocardium,	a		a, b
Pleura	(a) Pleurisy	a		

Table 6: Possible findings on *post-mortem* meat inspection of the abdomen of lambs and goats

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 (e.g. jaundice, congestion, degeneration), (e) changes in consistency of parenchyma	a,b,c,d	a,b,e,	a,b,c,e
Gastro-intestinal tract and mesentery	(a) Inflammation/ enteritis , congestion, peritonitis	a		
Gastric and mesenteric lymph nodes	(a) Hypertrophy, inflammation, congestion	a	a	a
Spleen	(a) Splenomegaly	a	a	a
Urinary system	(a) Hydronephrosis, (b) nephritis (may originate from omphalophlebitis), (c) pyelonephritis, (d) cystitis, (e) urolithiasis, (f) petechiae	a,d,e, f	a	a,b,c,d,f
Renal lymph nodes	(a) inflammation			a
Peritoneum	(a) inflammation / peritonitis, (b) septicaemia, (c) *Cysticercus,* (d) blood splash in muscles	a,b,c,d		

Consideration of the above tables indicates that in many cases evidence of lesions and disease is provided by 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. See Section 4.3.

An essential component of meat inspection is the accurate recording of findings and possible reasons for rejection as unfit for human consumption. 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 to animal or public health considerations. There is always a balance between meat inspection, animal health, public health and industry. However, quality labels, certification and HACCP all contribute to the hygiene of production.

2.2.1. 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, their skins and carcasses, both under farm- and abattoir-related circumstances. Infection 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 the possible introduction of exotic diseases highlight the need to maintain surveillance and vigilance to all zoonotic diseases and agents. This is reflected in Directive 2003/99/EC on zoonoses, which addresses and the need for coordinated collection of data on the occurrence of zoonoses and zoonotic agents along the food chain i.e. in feeds, animals, foods, and humans. Such chain information

would significantly help ranking of animals sent for slaughter according to the public health risk they pose.

Priority of the inspection process should be given to ensuring consumer and public health protection. Lamb and goat kids health and product integrity also deserve consideration: exclusion of sick animals and of some types of lesions or areas 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 lamb/goat products. However, such treatments do not reduce the risk due to recontamination. Risk reduction cannot be attained with thermoresistant contaminants, especially bacterial spores and chemical contaminants.

An essential component of any future meat hygiene approach is to avoid the introduction of significant levels of microbiological pathogens onto any carcass, and to prevent them from growing, is the HACCP approach. The European Commission's Decision (2001/471/EC) requires the implementation of HACCP principles in fresh 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 appropriate 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 carcasss for the presence of microbial contamination. Validated HACCP plans that prevent contamination entering the system therefore provide the best assurance for food safety.

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

Discussion on the efficiency of lambs and goat kids inspection with or without palpation and incision may include a "what if" element regarding the potential of detection of the main zoonotic diseases (see table 1-4). Lambs and goats 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. However, some apparently healthy animals can be asymptomatic carriers, and/or have some lesions that are too small to be detectable by visual inspection, palpation and incision. The zoonotic character of the infections may be undiagnosed or misdiagnosed in the 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 infected animals, in the absence of visible symptoms and lesions, cannot be detected by organoleptic inspection, but are much more common than diseased animals. As an example, it would be wise to isolate animals from farms known to be contaminated with *Salmonella* spp.

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

Due to the limited availability of relevant data, it was not always possible to quantify and categorise the risk for the consumer if current procedures are omitted.
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. However, bacterial-cross contamination of tissues will be reduced. Such cross-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 that 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 require to be implemented for both public and animal health reasons.

Palpation and incisions are options that apply when performing meat inspection and accordingly should remain among the procedures of inspection of lambs and goat kids: they should be used by inspectors in any suspect case or new context.

3. ALTERNATIVE METHODS TO CURRENT MEAT INSPECTION MEASURES

Some reports indicate that the *post-mortem* inspection of pigs and other animals that appear healthy at pre-slaughter detects only 20% of all the macroscopic lesions that are actually present in 1% or less of animals (Harbers, 1991; Berends *et al.*, 1993). In addition, the most relevant public health hazards today include pathogens derived from faeces/coats of healthy animals contaminating the carcasss without causing any organoleptically detectable changes. Obviously, some modified approaches (additional, alternative, or their combination) are needed so to improve the efficacy of the conventional *post-mortem* inspection. Such approaches could include three main groups: a) veterinary herd health actions implemented during pre-harvest phase to reduce/prevent public health hazards in animals to be sent for slaughter (Snijders and van Knapen, 2002); b) actions to reduce/prevent spread of public health hazards *ante-mortem* during transport-market-lairage phase; and c) alternative methods for detection of public health hazards *post-mortem*.

- Ideally, the first group would include on-farm production systems, monitoring/surveillance, diagnostic methods, immunisation, and traceability, that would prevent either onset of a given disease, or presentation of animals with public health relevant conditions for normal slaughter. At present, such on-farm measures for sheep/goats appear to be insufficiently developed and applied, and therefore cannot fully replace the *post-mortem* inspection yet.

- The second group would include measures to minimize transfer of public health hazards (due to diseases or surface contamination) from a given animal to other animals, both *via* direct contact and *via* contact with previously contaminated environment, during transport, marketing and lairaging. Ideally, this approach would require a single transport of a single batch of animals directly from farm of origin to the abattoir (with markets preferably avoided), with sanitation regimes efficiently eliminating pathogens from all the associated environments. This approach has not been developed for sheep/goats sufficiently yet, and thus cannot replace some aspects of *post-mortem* inspection.

- Potential alternative methods from the third group would include measuring of acute phase proteins (indicators of acute inflammation or tissue damage) in blood of animals at slaughter. They include C-reactive protein (CRP), serum amyloid (SAA) and haptoglobin (Hp). Significant differences in the acute phase protein response profile exist both between animal species and disease types, which indicates that applicability of these tests in meat inspection should be determined individually for each species (Eckersall, 2000). At present, information on use of these tests in sheep/goat inspection is lacking. Generally, the efficacy of acute phase protein measurements still needs to be improved, through standardizing the tests, establishing reliable reference values for healthy animals, and better correlating the elevated test values with the disease/pathology. Thus, at present this approach cannot replace aspects of conventional *post-mortem* inspection. Other methods from the third group would include using of automated image analysis/machine vision techniques to detect abnormal conditions on organs/carcasses (Van Hoof and Ectors, 2002, Hsieh *et al*. 2002, Chao *et al*., 2002, Park and Chen, 2000). However, the methods to date have been applied primarily in poultry, and not in sheep/goats.

Today, no single alternative method is available to fully replace the conventional *post-mortem* inspection of sheep/goats. Nevertheless, a combination of approaches such as those indicated above may help to identify low-risk and higher-risk animals when presented for slaughter; with the former group probably requiring a simplified *post-mortem* inspection only.

Meat inspection should also be recognized as a major source of information on the occurrence of animal and public health hazards in primary production and also of the prevalence of hazards entering the food chain. In the future, collection of this information will be one of the key functions of the meat inspection procedure, since it will provide information enabling appropriate risk management interventions in the food chain.

4. CONCLUSIONS

The conclusions take note of the previous opinions in the series (Opinions on fattening pigs, Species and Categories and Veal Calves) and confirm the requirement for an integrated system (see definition in the Annex) with the alternative *post-mortem* meat inspection part of the integrated system.

- The production systems for lambs and goat kids in EU member states are complex and involve different production stages conducted at different farms (as described in paragraphs 1.2 to 1.5) and may require lambs to move from one farm to another for different stages of production. Nevertheless, integrated production of lambs and goat

kids, incorporating an integrated quality assurance implemented along the entire chain, is possible. It should provide traceability (*via* ear-tag identification), certification, and the chain data to the official veterinarian prior to animals going for slaughter, as well as facilitating appropriate feed back to the farm.

- In such a system, lambs and goat kids that do not go direct from farm of birth to slaughter could be moved on one occasion to another farm (for rearing/fattening/) prior to going for slaughter. Where one vehicle collects a number of lots of lambs or goat kids from a number of farms *en route* to the abattoir, the identification of the lot will remain as a physical separate group, until the *post-mortem* inspection of each lot is complete. The regulated assembly centres could be used between the farm of origin and the rearing/fattening farm, as well as between these farms and slaughter.

- Today, the outcomes of the traditional meat inspection of lambs and goat kids appear more important for the detection of animal health-related conditions, and less so for detection of the most important public health hazards. This is because clinical manifestation of zoonotic diseases in lambs and goat kids held under integrated systems, as defined in the "Opinion on Species and Categories of Animals that might be suitable for Alternative system of meat inspection", is rare. With an integrated production system, given the age at slaughter, lambs and goat kids are less exposed to infective agents, and are not or less likely to develop the lesions seen at slaughter in older animals.

- However, apparently healthy lambs and goat kids may carry and/or excrete zoonotic pathogens. The major concern is contamination during production, transport, slaughter and dressing stages. In addition, *post-mortem* inspection of animals as required under 64/433/EEC and as amended by Directive 91/497/EEC carries a significant risk of cross-contamination, as the cutting and palpation during meat inspection of tissues with potentially pathogenic agents (e.g. lymph nodes) can contaminate the inspection utensils and hands. Therefore the omission of current mandatory palpation/incision practices (as identified in Table 2) in non-suspect animals, in the context of integrated production systems would reduce this risk and improve public health. However, this aspect should be dealt with through auditing and verification activities by the competent authority.

- The important pathological conditions seen at the meat inspection of lambs and goat kids, such as emaciation, oedema, colour changes, septicaemia, tumours, haemorrhages, bruises, arthritis etc., can be diagnosed by visual inspection on its own. Adoption of such a simplified, alternative system would enable more rational disposition of resources, including hygiene/inspection staff, and better exploitation of the chain information. However, the finding of any abnormality would require further detailed examination of the carcass and offal including, where appropriate, taking of samples for further investigation.

- On the other hand, there is no evidence, at this time, that a single currently available alternative method can fully replace meat inspection procedures. Laboratory measurements, however, can add information to surveillance data.

- It should be kept in mind that apparently healthy lambs and goat kids may carry and/or excrete zoonotic pathogens, and the major public health concern is the spread of contamination during production, transport, slaughter and dressing stages. The application of the GHP and HACCP principles to all stages of production and slaughter are useful in reducing this risk. Compliance with the TSE regulations with respect to controls on farm and in the abattoir is mandatory as are the requirements of any eradication scheme.

- Cross-contamination is due not only to meat inspection, but also to manipulation by workers, which will remain unchanged. However a proportion of the cross-contamination will be prevented by less manipulation of the product by meat inspectors.

- Overall, within an integrated system and solely in the case of non-suspect lambs and goat kids, as based on the chain information and the results of both the *ante-mortem* inspection and the *post-mortem* visual inspection, the risks of cross-contamination due to palpation/incision would exceed the risks from not detecting hazards by visual inspection only. Generally, it is considered that the public health benefits from the simplified inspection would significantly outweigh potential public health risks from the latter possibility.

- The necessary training of the inspection staff is a normal part of GHP and Continuing Professional Development (CPD) systems.

5. RECOMMENDATIONS

The advantages of an integrated production system, incorporating an integrated quality assurance implemented along the entire chain, should be exploited so as to simplify *post-mortem* meat inspection and reduce meat inspection-mediated cross-contamination. In this this regard, the following aspects are particularly relevant:

(1) Thorough *ante-mortem* inspection of lambs and goat kids is an essential part of the integrated system.

(2) Application of GHP and HACCP principles at all stages of slaughter and processing chain is essential in order to reduce the risk of pathogens being carried or excreted by apparently healthy animals and transmitted to other animals or to meat/meat products.

(3) Full recording systems need to be implemented that allow the flow of data both to and from the abattoir, to promote public health

(4) For the *post-mortem* inspection of non-suspect lambs and goat kids reared in an integrated system, efficient visual inspection may be sufficient, subject to the following conditions:

   (a) Adequate conditions and facilities for an efficient visual inspection are provided.

(b) Indication(s) of possible abnormal conditions are followed by a detailed inspection of the carcass and offal.

(c) Provided that the data from the farm of origin and/or the results of meat inspection of previously slaughtered batches do not indicate possible problems either of animal or public health significance e.g. Salmonellosis, liver fluke, hydatid, *Toxoplasma gondii* or Cys*ticercus ovis* or *tenuicollis* cysts).

(d) Incision and palpation may be necessary in some cases. The decision to incise and palpate has to be made on scientific grounds. The Official Veterinarian plays an important role in decision making whether to incise/palpate and/or to take samples for further laboratory examination.

(e) Any public meat inspection system must include other hygiene and inspection activities including auditing of GHP and HACCP systems, as well as related microbiological testing.

(5) In addition, following introduction, the competent Authority is to audit and verify that the new meat inspection system is at least equivalent to the conventional old one with respect to the demonstration of zoonotic diseases detectable by incision/palpation.

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7. ANNEX

7.1. Glossary

Assembly centre Place where animals from different previous premises of origin may be grouped together from onwards or sold to the next stage of the rearing/fattening process or sent for slaughter. Full traceability is maintained.

GHP Good Hygiene Practices focuses attention on the hygienic measures that are a prerequisite for other management techniques such as HACCP.

Good Hygiene Practice principles relate to general, basic conditions for hygienic production of a foodstuff including requirements for hygienic design, construction and operation of the plant, hygienic construction and use of equipment, scheduled maintenance and cleaning, and personnel training and hygiene. A developed and implemented GHP programme is a pre-requisite for HACCP system.

GMP Good Manufacturing Practices cover the principles needed to design plant layouts, equipment and procedures for the production of safe food. This includes hygienic operation and cleaning and disinfection procedures. The codes and requirements may be formally specified by e.g. Codex Alimentarius Committee on Food Hygiene.

(The UK-FSA definition) - The combination of manufacturing and quality control procedures aimed at ensuring that products are consistently manufactured to their specification.

HACCP Hazard Analysis and Critical Control Points system to identify, evaluate, and control hazards which are significant for food safety.

HACCP plan A document prepared in accordance with the principles of HACCP to ensure control of hazards which are significant for food safety in the segment of the food chain under consideration.

Control (verb) To take all necessary actions to ensure and maintain compliance with criteria established in the HACCP plan

Control (noun) The state wherein correct procedures are being followed and criteria being met.

Control measure Any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Lot **(**for the purposes of this Opinion) A group of lambs or goat kids that prior to being taken to an assembly centre or slaughter plant have been kept together with the same husbandry and management system. At a regulated assembly centre several lots of animals may be joined for the next stage of the rearing/fattening stage but full traceability must be maintained to enable full trace-back and identification for all animals in the new grouping.

7.2. Integrated system

An integrated inspection and monitoring system, including effective traceability of animals and carcasses, is mandatory in order to assure that the outcome of the control and inspection system is "safe meat". Therefore revised meat inspection systems have to be based on an integration of all facets of modern animal husbandry taking into account biological and toxicological public health risks as well as animal welfare issues. Pre- and post-harvest control measures should be merged into one single holistic procedure (SCVPH, 2000).

Requirements of an integrated system

From Farm to Chilled Meat

An integrated system is one that operates in an integrated manner from birth through the rearing phase to slaughter. An integrated system therefore requires information to be transferred backwards and forwards between the farm and the abattoir. The good functioning of an integrated system requires full accountability, and transparency in all parts.

Parts of the integrated system that must be considered includes the following:

Animal (associated criteria): origin source, pre-wean, weaned or equal, production stage (eggs, milk – fattening – end of production), identification and documentation and use of feed-forward / -back data;

Good Practice Farming (GPF): identification and farm registration, (building construction, including climate, separation of units within the farm, quarantine facilities, animal density, medication practices, medical records (including disease, treatment, vaccination and medicated feed), performance monitoring, consumption of feed/water (indicators), cleaning/disinfection, pest control, waste control (e.g.: manure handling);

Production system related: husbandry, housing, feeding: feed/water, origin source, feed (processing, storage, additives), transport, lairage /slaughter, inspection procedures, end products control; overall cleanliness, pest control, documentation;

Records including documentation of e.g.: indicators of performance in that system animal movement, medical records;

Transport: loading/unloading, loading density, cleaning/disinfection practices, transport time, documentation, climate, mixing of animals or of groups of animals from different origins;

Lairage: cleaning/disinfection, resting time, animal driving system, climate, animal density, record of result of ante mortem inspection, isolation area (suspect animals and rejects from *ante-mortem* inspection whose fate must be recorded);

Slaughter: systematic analyses of potential hazards (including microbiological monitoring), implementation of appropriate control, documentation and feed-back, identification and trace back retained/maintained; trace forward with notification of appropriate authorities; product recall strategy in plan;

Processing/chilling: capacity of cooling, separation of units, type of chilling, hygiene and cleaning and disinfection.

The above list is not complete and only intended to be a basis for consideration of each species/category.

Integrated systems have to provide data from the living animal, including information about the "on farm" circumstances through to the chill and processing stage. The information required will include the data from primary production concerning the environment and management, the transport, the lairage, abattoir data and through to the chilled meat stage.

Guidelines for establishing an integrated production system

The following points could be considered to give guidance in establishing an integrated production system:

The ability to assess the system within a singular epidemiological frame that could utilise all information collected along the food/feed chain and to maximise food safety.

The integrated system should be possible to describe in the sense that all parties or stakeholders to this system must be clearly defined and identifiable. In other words whether or not potential partners are party to the system should be clear. Furthermore it would in some situations be desirable to define these integrated production systems geographically e.g. the husbandry systems in that geographical region along with evidence of a properly functioning integrated system in place.

No participant should be able to enter or leave without a clearly defined procedure, ensuring that those entering are fulfilling all the requirements of the system. Those that leave should do so completely avoiding any “half in” or “half out” participation.

There should be a free flow of information and transparency between all parties in the system.

It should be ensured that no feed is allowed to enter the production system or animals go to slaughter, unless they originate from holdings or feed that

comply with the systems' requirements. The farms or animal holdings must not deliver animals to abattoirs outside the system to ensure the holding is monitored as a whole and no animal(s) must be lost to allow a better monitoring result than in reality. If abattoirs take deliveries from holdings outside the system, those animals should be separated all along the food chain, and safeguards put in place to protect the integrity of the integrated system.

No foodstuff (meat or meat products) should leave the system unless complying with the system requirements.

There should be a comprehensive veterinary supervision of the complete system and the responsibilities and accountability for the good functioning all along the system should be unambiguously allocated. The supervision of the system would be that of an epidemiological unit rather than its particular parties. The supervision must include the possibility of withdrawing the approval or recognition of the integrated system.

Those responsible for the epidemiological monitoring of the system should be clearly identified. Furthermore, that responsibility would include collecting all the information and analysing those data to estimate the risks in the system. Therefore there must be an ongoing risk assessment that should give indications of necessary risk management measures to be taken if needed.

Monitoring and Traceability

For the above system to function it is essential that a continuous flow of information from and to safety assurance personnel involved is established. A prerequisite for this is the creation of a failsafe animal identification and registration system allowing traceability of foods of animal origin to the source of production. On the basis of this documentation the competent authority will be in a position to better assess the public health risks involved in the pre-harvest production, slaughter, further processing and marketing of foods of animal origin. To allow the primary producer to be 'pro-active' in terms of human and animal disease prevention, post mortem findings need to be fed back from the inspection authorities.

7.3. Description of some of the husbandry systems

The newborn lambs needs primary care such as cleaning the mouth and the nostrils of amniotic fluid. It is of great importance to feed the lamb colostrum in the first hours of life and this should continue for at least 18 to 36 hours. The period from the lamb being fed on **colostrum** to being fed on either natural milk or milk replacer (change phase) in natural suckling is gradual and only after two to three days should the lamb be suckled on milk alone. In the transition phase the lambs are extremely susceptible to neo-natal infections.

Once the initial colostrum phase is finished the newborn lamb must be **suckled**. This phase normally last 5 or 6 weeks. The lamb is fed exclusively (agnello da latte in Italy) or almost exclusively milk (from the mother or other ewes or milk replacer). The newborn lamb cannot digest other types of feed at this stage of life. Until the lamb is completely weaned, its feeding behaviour is very similar to that of monogastric animals as only the abomasum is working and its volume is 70% of the total gastric apparatus. Milk bypasses the forestomachs through the closure mechanisms of the reticular groove which connects the oesophagus directly with the abomasum.

In the natural **suckling system** (used on farms with low production) the lambs suckle dam's milk directly throughout the whole suckling period either following the ewe during pasture or spending the night with the mother (if they are separated). The suckling phase only uses the ewe's milk in the early part of her lactation period as then the lamb is either slaughtered while still suckling or is weaned once it reaches a suitable weight.

For **artificial suckling** either natural milk or a milk replacer may be used. The milk replacer must fulfil the lambs feeding requirements adequately. Usually the formulation of the replacer is completed with the addition of fat-soluble vitamins (A 60,000 – 100,000 UI/kg, D 5,000 – 15,000 UI/kg, E 12-20 mg/kg). Water soluble vitamins (B1, B2), mineral (Mg, Co, Cu), amino acids (lysine, methionine) may be added. Antibiotics (virginyamicin, flavomycin, bacitramycin, spiramycin) are added to prevent neonatal infections. Weaning is the transition period when the animals move from a diet of milk to solid feed. This may be forage such as grass, silage or hay, or concentrates. It may be also the moment when the lamb is separated from the ewe as in the case of natural suckling, but not necessarily. In artificial suckling, the lamb is separated from the ewe at the end of the colostrum phase, i.e. a few days after birth. Weaning may be gradual with 15-20 days of adaptation or brusque. Weaning varies according to the system of farming used.

In the **semi-extensive** system with the natural suckling it begins after 5-6 weeks. Until that age the lamb normally follows the ewe to pasture and takes the milk. For the next 2-3 weeks the lamb accompanies the ewe to pasture but is separated at night when it is given hay and concentrates. It ends in the 8th week (body weight 9-12 kg).

In **semi-intensive** farming with use of replacer, weaning lasts about 2 weeks (5th and 6th). Then the milk replacer is gradually replaced with hay and concentrate (gradual weaning) or abruptly stopped and solid food supplied in the 5th week (brusque weaning). Only 2-3% of the males and 50% of females are selected for replacement, those not chosen are slaughtered at 4 to 6 weeks as traditional suckling lambs or as heavy lambs (agnelli pesanti in Italy), fat lambs or prime lambs (agnelloni in Italy). A smaller number of lambs are fattened for at least 100 days (up to 6-8 months) to produce heavy lambs.

There are different **grazing methods** which can be used to achieve the following objectives:

- the sward is in a condition to recover after grazing
- the sward is kept in a "young leafy" state to minimise the loss in nutritional value which takes place during the life cycle
- the persistence of the sward is maximised by reducing the spread of weeds and facilitating of annual self-seeding forage
- the parasite burden of grazers is reduced
- the environmental impact is minimised.

The methods used in the Mediterranean area are the continuous stocking and the rotational stocking. Other types of rotational stocking are creep grazing and leaders-followers. Rationed grazing may also be used.

Housing

Housing ranges from simple protections to integrated structures. Generally, there are indoor facilities, semi-closed facilities, and simple roofs.

The most frequent ingredients of concentrates are cereals, mainly barley, corn, and soy. In many countries as in France, the systems of production of meat are varied and the schemes of feed are very diversed.

Table 7: Square meters floor space suggested per animal

	Fixed	Free range	Indoor at night
Ewes	1-1.2	0.8-1	0.5-0.6
Rams	3	2-3	1-2
Lambs (replacement)	0.5-0.8	0.4-0.6	0.3-0.4
Suckling lambs	0.3	0.3	0.2

For "sheepfold lambs" "lambs 100 days old", the lambs are reared in specialized farms. They represent 50% of lamb meat produced in France. They stay in sheepfold for all the fattening period.

The other lambs stay in fields with their dam.

Period from birth to weaning: the diet is exclusively milk, for example: lambs born from milking ewes receive milk for 25 days. Sometimes the milk is powder replacer milk (twin lambs for example).

Period of rearing: from weaning to slaughter for lambs less than 6 months, the animals receive powder replacer milk, according to the date of separation from the dam, then concentrated feed, grass or hay. The composition of

concentrated feed is the following: seeds and co-products of cereals, co-products of sugar refinery, co-products of oil seeds, proteinaceous seed and co-products, hay and minerals.

In Spain, lambs and goat kids are with their mother from birth to the weaning time (1 month in milk flocks and 1-45 days in meat breeds). During this time lambs and goat kids are commonly housed indoor and in the first weeks they suckle twice at morning and night. After, more or less from 2 weeks, they only suckle once per day. Mothers leave the stable for grazing during the day and came back to the farm at night for suckling their lambs. Lambs are stabled in pens, grouped 10- 50 or more lambs per pen. They have straw and start feed from 15 days of age.

In the fattening units lambs are grouped in lots of similar age and/or weight of 50-200 animals

7.4. Examples of certification/ Assurance systems

7.4.1. The Spanish system

Currently in Spain the developing of quality labels in the lamb meat market is important. At present there are 4 quality labels of lambs: "Lechazo de Castilla y León", "Ternasco de Aragón", "Cordero manchego" y "Cordero de Extremadura" and a new quality label "Cordero de Navarra" is proposed. These quality labels have specifications that must be fulfilled by the farmers. These quality labels are regulated by official rules of the autonomic Governments and ratified by the Ministry of Agriculture, Fisheries and Food. Meat to be used for "quality labels" must come from livestock farms registered at the Regulatory Council.

Other specifications are: animals must only be slaughtered in specific abattoirs, the time of resting at slaughterhouse pens, characteristics of dressing, chilling and of the carcasses (weight, colour, no defects, etc.). All animals must have an individual identification number and the carcasses are labelled and numbered.

Table 8: Example of specifications of two Spanish Quality labels (Adapted from Alfonso *et al*, 2001)

	Ternasco de Aragón	*Lechazo de Castilla y León*
Breeds	Raza Aragonesa	Curra, Castellana
	Ojinegra	Ojalada

	Roya bilbilitana	
Sex	Non castrated males and females	Without distinction concerning sex
Age at slaughter	70-90 days	> 35 days
Carcass weight	8.5-11.5 kg	4.5-4 kg (with omental fat)
Feeding systems	Ewe's milk at least 50 days	Ewe's milk
	Concentrate	No weaning
	White straw *ad libitum*	

7.4.2. The Italian system

In Italy the most important Italian breeds are:

High specialization: Appenninica (meat/milk), Bergamasca (meat/wool), Comisana (milk), Gentile di Puglia (wool/meat), Sarda (milk), Sopravissana (wool/meat).

Low specialization: Barbaresca (meat/milk), Leccese (milk), Massese (milk)

Characteristics of Italian meat breeds: Bergamasca (large size, good prolificacy), Appenninica (large size, good prolificacy), Barbaresca (large size, good prolificacy), Laticauda (large size, good prolificacy), Gentile di Puglia (large size, average prolificacy).

White colour, pink skin, the head of Barbaresca breed has black spots (Biellese, Fabrianese e Varesina are similar but smaller). La Sopravissana and Gentile di Puglia are Merino derived. Barbaresca and Laticauda belong to the asiatic-northafrican fat-tailed strain.

*Example of specification of **Bergamasca breed**.*

age 1° parturition	15 months
prolificacy	150 %
weight at birth	3.5 - 5 kg
weight male lamb at 30d	12 - 14 kg
weight male lamb at 60d	25 kg
weight male lamb at 100d	32 - 34 kg
weight male lamb at 150d	8 kg
daily uptake	50 - 300 g/d
production at slaughter lambs 30 d	63 %
production at slaughter lambs 100 d	58 %
production at slaughter sheep	48 %
weaning	rarely 1 month, usually 3-4 months
weight male adults (3 years)	90 - 110 kg
weight female adults	65 -75 kg

Classification of sheep and goat carcasses.

Regulation EEC 338/91, Regulation EEC 2137/92, Regulation EEC 461/93, Regulation EEC 1278/94. A common adopted rule divides carcasses into two categories: carcasses heavier than 13 kg and carcasses weight up to 13 kg.

Production is divided into the following categories:

Heavy lambs from meat breeds slaughtered at 100+ days: carcass weight > 13 kg

Light lambs from meat breeds slaughtered within 100 days: carcass weight 10-13 kg

Light lambs from milk-meat breeds slaughtered at 30-60 days: 7-10 kg

Lambs from milk breeds: milk breeds slaughtered at 25-30 days: < 7 kg

7.4.3. The French system

Currently in France, the developing of quality labels in the lamb market is important with 13 “red labels”, 12 labels of certification of product and 3 IGP. These quality labels are regulated by official rules published. They have strict specifications concerning feed, housing, treatments, age and weight for slaughter.

Table 9: What is the potential of detection of the main zoonotic diseases and contaminants of lambs and goats by *post mortem* inspection (not exhaustively listed) (Herenda, 1994).

Disease (*Agent*)	Ante mortem (farm + slaughterhouse)	Post mortem	Hazard	Differential diagnostic	Remarks and comments
1. Bacterial infections					
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 lambs: diarrhoea caused by infections (such as rotavirus, coronavirus, 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 lambs 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.
Q fever (*Coxiella burnetii*)	No clinical signs of this disease in lambs.	No gross lesions are reported in lambs (and in adult sheep).	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 lambs. 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					
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					
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, TSE.	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.

4. Parasites					
Hydatid disease (Hydatidosis, Echinococcosis) (*Echinococcus granulosus*)	No symptoms of significance	Cysts detectable only in older lambs. 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 tenuicollis*, 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 diarrhoea	Infestation compromises immunity (possible secondary infections). No visual detection in abattoir. 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.

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