

## Casings

### INTRODUCTION

Animal intestines can be used for a variety of different purposes, such as surgical sutures, collagen sheets (used for burn dressing), strings for musical instruments, sausage casings, human food, pet food, meat meal, tallow, or fertilizer. However, the product with the highest economic value and volume requirements would be sausage casings. Business may be tough for many meat companies during these turbulent economic times, but the demand for sausage products has been increasing significantly probably because it is an economic source of meat protein. The price of casings has increased over the last 5 years and natural casings are once again in great demand.

### HISTORY

**“Sausages are the oldest form of processed meat and may even be considered the world’s first true convenience food.”**

**Sausage Making** is a well respected and highly developed craft that in some areas has been practised for thousands of years. In many cases families carried this skill down through generations and across nations with each sausage maker creating new recipes, influenced by market demand and available ingredients.



**Uprising of Sausages and Hot Dogs by Sergey Tyukanov (2006)**

The intestines of sheep, cattle (not European cattle) and pigs (and sometimes goats and horses) are used to manufacture traditional sausage casings.

Increasing world population has meant some of the meat processors have changed to mass production and low costs. Today, literally thousands of varieties of traditional and ‘designer’ sausages are produced worldwide using three basic types of sausage casings. These are Natural, Collagen and Cellulose. Collagen and cellulose casings also known as artificial casings are the recent arrivals developed to meet the growing needs of the population. They have a more consistent shape and allow high volume sausage manufacturers to produce larger quantities of sausages, in less time, with less waste, more efficiently.

However, the more discriminating customer wants better quality sausages; with unique recipes and great taste, texture and provenance. Hence to stay ahead of the competition, the premium processors still maintain a huge market for natural casings. Although natural casings are more expensive, some believe them to be superior in texture and eating quality therefore worth the extra expense. Processors can attract a premium price for the increased “added value”.

## COMPOSITION OF NATURAL CASINGS <sup>1</sup>

The intestine is composed of five layers, which when labelled from inside to outside are:

### Pig and sheep casing

- 1 Mucosa – glands aid in secretion, digestion and absorption
- 2 Submucosa – collagen, and often fat
- 3 Circular muscle
- 4 Longitudinal muscle
- 5 Serosa – collagen, elastin

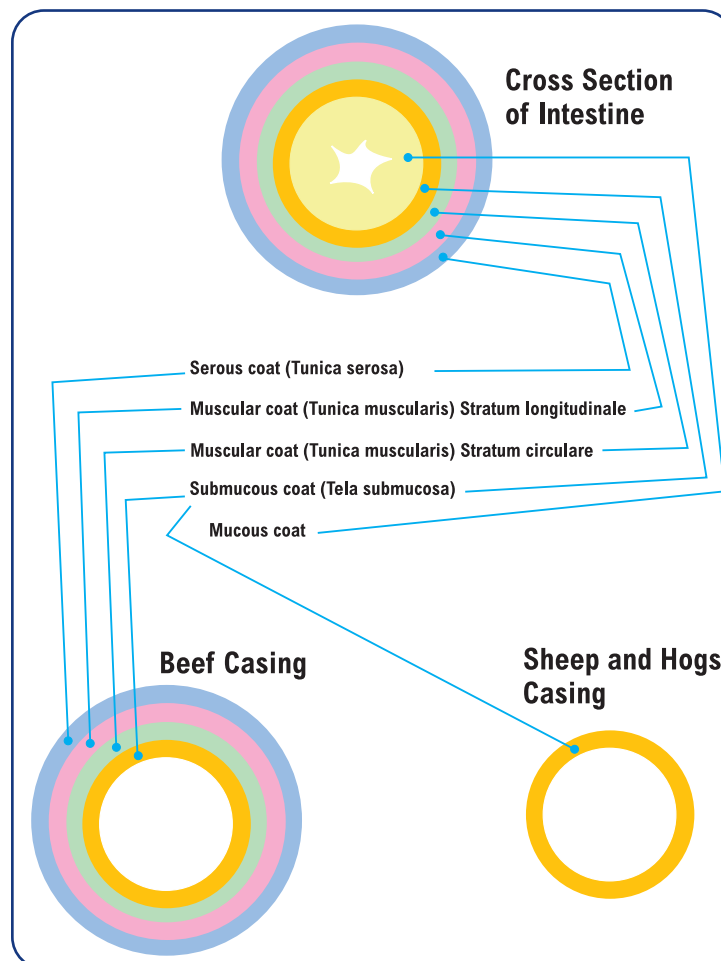
A diagrammatic cross section of the intestinal tract of animals is shown in Figure 1. This also indicates the areas that are removed from the intestinal tract in order to transfer the product into useable casings.

**Natural Casings** are made from the 'submucosa' – a largely collagen (the fibrous albuminoid constituent of bone, cartilage, and connective tissue) layer of the intestine. The fat and the inner mucosa lining are removed.

Parts of the animal which could be used to manufacture casings are the small and large intestine, weasand, urinary bladder, stomach, and rectum from most meat producing animals. The utilisation of these products varies tremendously from country to country and for different sausage types in which they are going to be utilised.

**Figure 1 Cross section of intestine and casing <sup>1</sup>**

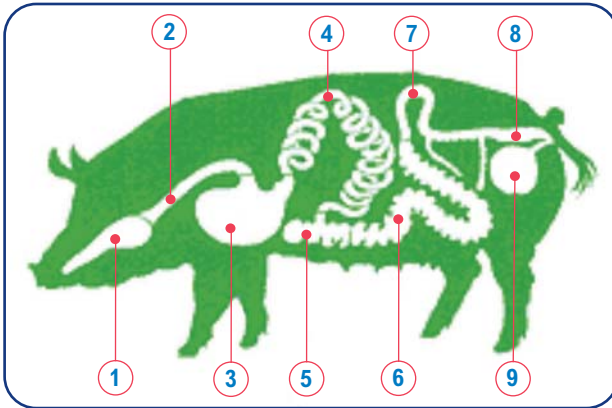
Fresh beef, sheep or pig casing consists of various layers



<sup>1</sup> Source: Ockerman, 1996. Chemistry of Meat Tissue, The Ohio State University, Columbus, OH, USA.

**PIGS**

Figure 2 Diagram of pig intestines

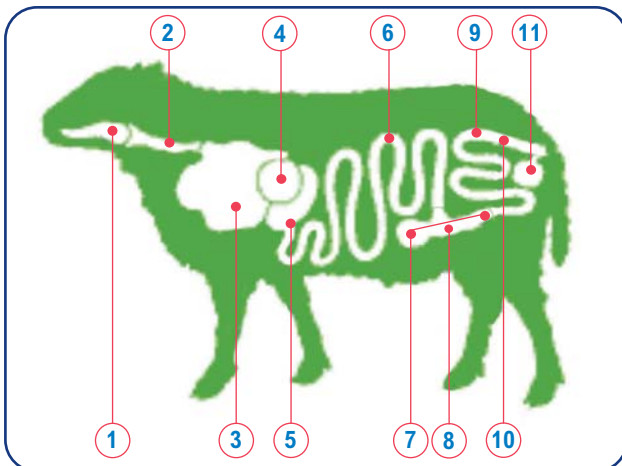


The entire pig intestinal tract is used to produce casings, specifically the small intestines (duodenum, jejunum, ileum), bung (caecum), large intestines (colon ascendens & transversum), afterend (colon descendens) and fatend (rectum).

- |                          |                         |
|--------------------------|-------------------------|
| 1 Tongue                 | 6 Chittering/pig middle |
| 2 Gullet or Weasand      | 7 Afterend              |
| 3 Stomach & Duodenum     | 8 Fatend or Pig Bung    |
| 4 Pig Rounds or Casing   | 9 Bladder*              |
| 5 Bung Cap or Middle Cap | * Is not used as casing |

**SHEEP**

Figure 3 Diagram of sheep intestines

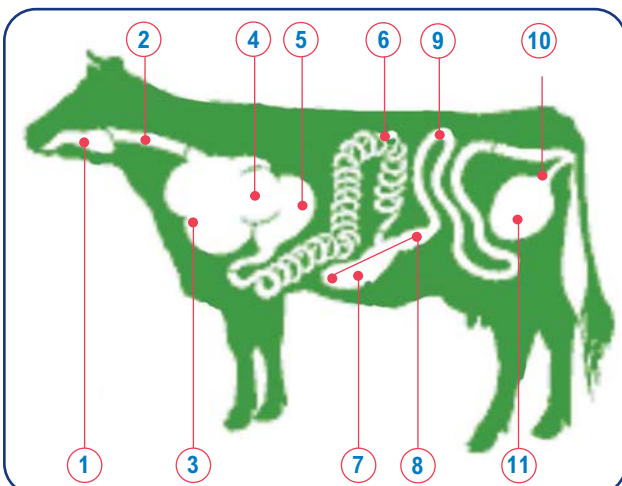


Only the small intestines of sheep are used, particularly the duodenum and jejunum. The ileum is now classified as specified risk material (SRM) and is removed and sent out as Category One animal by-products.

- |   |                         |
|---|-------------------------|
| 1 Tongue*   | 7 Bung                  |
| 2 Esophagus or Gullet   | 8 Afterend              |
| 3 Rumen and Reticulum*  | 9 Large Intestines*     |
| 4 Omasum*   | 10 Fatend               |
| 5 Abomasum or Rennet Bag*   | 11 Bladder*             |
| 6 Small Intestines or Runner (the ileum [or last 60cms] is removed) | * Is not used as casing |

**CATTLE**

Figure 4 Diagram of cattle intestines



In the UK all of the intestinal tract is classified as SRM and is not currently used. However in countries without BSE the entire intestinal tract with the exception of the ileum is used. See Figure 4 for the sections of the intestinal tract utilised from cattle. The shape of the runner is too variable after the jejunum to produce classic beef rounds and is therefore removed prior to the cleaning process. Foreign beef casings are produced from the weasand (oesophagus), small intestines (duodenum, jejunum) which are produced into beef rounds, bung (caecum), large intestines (colon) which are produced into beef middles, and bladders.

- |                              |                         |
|------------------------------|-------------------------|
| 1 Tongue*                    | 7 Afterend or Bung Cap  |
| 2 Weasand*                   | 8 Bung                  |
| 3 Tripe Rumen and Reticulum* | 9 Beef Middle           |
| 4 Omasum*                    | 10 Rectum or Fatend*    |
| 5 Abomasum or Rennet Bag*    | 11 Bladder*             |
| 6 Runner                     | * Is not used as casing |

## HEALTH AND QUALITY CONTROL

The intestinal tract as received from the slaughter hall is highly microbiologically contaminated. It is fragile and must be manure stripped immediately after slaughter. The longer this process is delayed the lower the quality of the casing. The cleaning and removal of various internal, and sometimes external layers, are necessary to convert this product into a useful casing.

The runner is then normally packed under controlled conditions. The product normally goes to a specialist casing cleaning company as many abattoirs do not have sufficient space to house a full cleaning line. The cleaning process also releases significant quantities of mucosa which can increase the effluent chemical oxygen demand (COD) levels above the agreed consent levels

Public health and hygienic problems are critical points in the practical production and use of casings. As a result casings imported into the UK from foreign countries are subject to veterinary inspections. The rigorous and controlled inspections check for microbial risks and also the possible uses of inedible salt and other inedible preservatives and additives.

**Table 1 Steps for the conversion of the digestive tract into sausage casing <sup>1</sup>**

1	Removing the intestine from the animal
2	Running - removal of loose mesentery fat
3	First stripping - squeezing to force out intestinal contents
4	Washed and cooled (10°C water). The casing can now be shipped to another company for further processing
5	Mechanical stripper or hand stripping
6	Brushes used to remove fat
7	Turning or slimming - removal of tissue layers - revolving drums and warm (45°C) water or hand slimming
8	Strippers or hand removal of mucous layers and rinsing
9	Stored overnight in ice and 15 to 20% saturated salt solution
10	Graded and sorting - species, size, quality
11	Cured - rubbing with salt; allow to set for 1 week
12	Removal from cure, shaken free of excess salt, rubbed with fine salt, and packed (40% salt)
13	Flushed prior to use

## REMOVAL OF THE VISCERA

The cleaning process of the small intestines can vary between species and geographical location of the cleaning operation. Care needs to be taken when splitting the animals and harvesting the eviscera as the knife could pierce or damage the intestines which can lead to contamination in the slaughter hall. The intestines are sent to the gut room (Please see *Common Topic 5 Tripe processing for adding value to the stomach*).

REMOVAL OF THE VISCERA

(cont'd)

- 1 The first step in casing preparation is removing the viscera and separating it from the internal organs.

**For pigs:** the viscera is placed on a table and separated from the mesentery fat. The puller usually will start at the stomach and pull the casing away from the ruffle fat. If the hand technique is used the operator tends to wear a cotton glove and can pull 60 to 70 intestines per hour. An easy casing can be pulled in 25 seconds but a thinner “more wormy” casing may require over 60seconds. Care is needed because if the operator does not have “the feel of the product” too much force can cause the runner to rip. Hand pulling normally produces a better quality with less “whiskers”, because the connective tissue is torn off directly from the casing. However it is labour intensive and not done in most of the Scottish plants.

**For sheep:** the intestines are removed from the stomachs. To ensure that all the ileum is removed, approximately 60cm of the terminal small intestines starting from the ileo-caecal junction upwards and away from the caecum should be removed and disposed of as SRM.

- 2 The next step in casing manufacturing is to run the casing through a manure stripper to squeeze out the liquid and manure using large rollers similar to a laundry ringer. These rollers are usually rubber and sometimes wrapped with burlap. The intestines are usually hung on a 10 hooked hanging device by the large intestines. When all 10 hooks are occupied the ends are taken and threaded through the manure stripping machine. This machine removes the small intestines from the mesentery fat and from the large intestines, strips (removes intestinal contents) and rinses the intestines. Although time consuming, this operation can be done by hand by pulling the casing through the fingers. Performing this activity manually seemed to cause more mistakes, including pulling too hard and causing the intestines to break. A great quantity of potable water is needed to wash the casings and to keep the operation clean. The casing should be soaked for approximately 30 minutes in 38°C to 42°C water. The average thickness of sheep casings is 0.11 mm.



Intestines waiting to be pulled through the manure stripping machine

The runners are tied into bundles of 50 lengths and then put into a barrel with salted cold water. Alternatively they are put in a lined dolavs with ice and salt ready for shipping to the casing cleaning company. This storage time will allow the mucosa to change state from a heavy viscous consistency to a more liquid state, allowing the roller pressure to be reduced.

*The following operations are normally performed by the casing cleaning company or in very large abattoirs, as smaller abattoirs do not possess the physical space to house a full cleaning line and the COD of mucosa has a significant effect on effluent discharges.*

- 3 **For pigs:** Tissue layers are removed from pig casings in the casing cleaning company. The stripping machine has various rollers that press out the contents of the intestine and the mucous membrane. A great quantity of lukewarm water (42°C) is used in this operation, to keep the casings supple and easier to process. This machine also has two adjustable rollers with eccentric bearings. Only the layer of connective tissue, the sub-mucosa, remains. Cleaned runners are sent in a brine solution to the casing selection factory. Today these selection factories are predominantly situated in China. The process is labour intensive and although some research has been done to try and automate the process nobody has yet come up with a machine that is as good or as sensitive as a well-trained operator.

**REMOVAL OF THE VISCERA – for pigs** (cont'd)

- 4 Next, the casing goes through a mucosa stripper, which looks essentially like the manure stripper. Again, water is used to keep the operation sanitary. There are markets for the mucosa and some of the more commercially aware companies are currently harvesting the mucosa which is used in the manufacture of Heparin.
- 5 The casing then goes through a finishing machine to remove any string-like material and remaining mucosa. Rollers again are used in this operation. In either system, large quantities of potable water are essential to keep the operation clean.

After finishing, the casings are soaked again in 10 to 16°C water and/or a salt brine tank to remove excess blood. The soaking time usually ranges from 30 minutes to overnight. After the soaking operation, casings usually are salted either by hand or again by machine. The salting and shaking of the casing usually are continued until the casings absorb 40% salt, at which point they are packed into a container. If the casings are packed in a slush container, the container will hold 10 to 15% salt water brine. The advantage of using a dry pack is that the casings become less tangled. Also, the casings will be darker in colour. Items such as pig bung, pig stomach, blind end or cecum, bladder, beef bung, and weasand are handled usually by hand, trimmed of excess material, and salted again. The average thickness of flushed pig casing is 0.32mm. The product removed from the casing can be used by the pharmaceutical industry as a raw material for medicines.



**Casing grading and selection in China**

Samples from each batch of runners are subjected to inspection and testing during the grading process. The casings are normally shipped to China for this process as it is time consuming requiring a skilled workforce. In the West these skills have been eroded and are nowadays almost completely lost.

**QUALITY AND VALUE**

Many factors influence the quality of a natural casing, such as species, breed, health, age of the animal, fodder consumed, conditions under which the animal was raised, portion of the intestinal tract utilized, and how the product is handled and processed after the animal is slaughtered.

1. **The type and breed of animal.** Australian animals are a different size to British animals, however their diet is a rougher forage with more grain. This seems to give a longer, wider casing, consequently the diameter and length of the runners are different and consequently attract different prices.
2. **Diet.** The differences in the fodder consumed by both sheep and pigs not only affects its taste but also the quality and thickness of the runners. An animal bred on grass has softer walls which are more prone to damage than those from animals fed on grain. Animals fed on a high protein tend to have smaller viscera.

QUALITY AND VALUE

(cont'd)



Runners are sized and graded by hand and eye into selected casings

The casings manufacturer will use the several factors for evaluating the quality of the casings and thereby the value such as the diameter, size range, number of yards in a hank or bundle, the amount of sausage that can be made with a casing unit, the number of casings actually shipped and invoiced, and quality factors of the casing. The world market for casings will affect pricing in a regional market.

GRADING PARAMETERS

**Cleanliness:** Casings should be clean and sound (no tears, cuts or even pinholes), free from stains, odours, fat particles, parasites, nodules, ulcers and other defects.

**Strength:** Casings should be strong enough to withstand the pressure exerted on them during filling, stuffing, and processing. Only the submucosa part of the intestine has adequate tensile strength for this purpose. Samples are tested by the casings company by filling with either air (cattle runners) or water (pig and sheep) to a specific pressure to test strength and soundness.

**Length:** The length from an animal will vary. The average lengths are given in the table below. The standard length for sheep and pig casings is 91.4 m (100yds) per hank. Beef rounds are usually purchased in bundles of 18m (59ft). The number of strands per hank varies according to country of origin. Likewise the length of intestinal container also varies depending on the customers' requirements and its proposed usage, e.g. whether it is going as a sausage casing or catgut for tennis racquets or violin strings. Beef rounds are packaged in bundles of 54 feet (18 meters), and tennis rackets and surgical strings in lengths of 9.24 feet (6 meters).

**Whiskers count and length:** Pig runners can be stripped and defatted by either hand or knife. Hand pulled casings do not have threads of connective tissue (whiskers) on the outside. They are more delicate and usually have shorter strands than knife cut runners but they may have more holes or weak spots. If a knife is used the operator tries to keep the knife as close to the casing as possible to remove the whiskers. Knife cut casings have small whiskers and have an extra membrane for strength. Their strands are usually longer and have fewer holes. However the fatty threads (7–15mm in length) can have a negative affect during further processing. They increase the friction during the quality checking process and cause problems during the preparation for the stuffing process. The threads of connective tissue on knife cut casings will melt off on smoked or cooked sausage.

**Caliber:** The diameter of the casing varies depending on the breed and age of animal as well its diet. The customer also dictates their own requirements dependent on the regional specialties and types of sausage it manufactures. Modern machinery used for making sausages requires a fairly uniform animal casing diameter to achieve maximum machine efficiency, good stuffing productivity and a uniform visually pleasing product to sell to meet their customers' demand.

**Curing:** Casings are normally cleaned and then salted. High quality, fresh and fine particle size salt is used for curing. In a few cases casings are dried, however there is only a small demand due to the loss of elasticity that occurs during the drying process. Intestines or ribbons of beef serosa for surgical catgut can be exported frozen although these will also be required salted.

GRADING PARAMETERS

(cont'd)



**Packaging:** A number of types of packaging are presently used, including wooden and plastic containers, dolavs (with and without plastic sacks), tin or plastic barrels. The large companies prefer the sealed plastic barrels which they use to ship their product around the world, because of the sanitary requirements and lower costs. Vacuum packaging is also available for extended shelf life and a reduction in storage space.

Table 2 Classifications of natural casings used for meat purposes <sup>1</sup>

	Natural casing	Location	Appearance	Sausage	Average yield/animal
<b>BEEF</b>	Round ≥35mm	Small intestine	Ring-like tougher, easily handled, less breakage	Ring bologna Polish sausage	30–45m or 90–135ft long
	Bung	Cecum		Capocolia, Salami	1.25 –1.6m (4-5ft) long
	Bladder	Bladder	Oval or moulded	Minced speciality, Mortadella	17–35 (7-14ins) wide
	Middles ≥55mm	Large intestine	Sewed, most expensive, adds iniformity	Bologna, Salami	6–7.5m (20–25ft) long
	Weasand	Windpipe			45–65cm (18–26ins) long
<b>PIG</b>	Round ≥24mm	Small intestine	May be eaten or peeled. Demand for over 35mm	Large frankfurter, pig sausage	13–16m (42–52ft) long
	Bung	Caecum	May be sewed	Braunschweiger	0.8–2.9m (30–72ins) long
	Middles	Large intestine	Curly	Chitterlings	
	Stomach	Stomach		Headcheese, souise	
	Bladder	Bladder			12–22cms (5–9ins) wide
<b>SHEEP</b>	Small intestine	Most tender, most breakage	Packed in salt or brine Rolled onto tubes or funnels. Specialised uses 16mm and under, the primary demand is for 20–24mm. Sometimes small caliber pig casings will be substituted for large bore sheep casings.	Small frankfurter, pork sausage, hot dogs, snack sticks, Slim Jims, pepperoni sticks, Bratwurst, barbecue sausages, Chipolata and Merguez sausages	24m or 9 ft long 91m (= 100 yards = 1 hank)

References

*Animal By-Product Processing & Utilization* by H.W. Ockerman & C. L. Hansen • Information from De Weid Corporation  
*Aspects of Quality Assurance in Processing Natural Sausage Casings* by Joris Winkler