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Influence of different treatment procedures on morphological structure of beef intestines

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ABSTRACT

After manual and machine cleaning of beef intestines, the structure of the intestinal layer was examined. Examination was performed using a histological technique and included 60 intestinal sets of fattened beef (Simmental breed), 10 months of age and with an average slaughter weight of 248.05 kg. Intestines are considered to be edible by-products and therefore are used as natural casings for high quality sausages. The aim of this study was to determine differences between duodenum and colon layers that remain after manual and machine cleaning. Our results showed that machine cleaning is a better method of intestinal treatment than manual cleaning. Machine cleaning yields better results in uniformity of cleaned intestines and in an absence of lesions in the muscular layer. These criteria of technological treatment were absent when cleaning was conducted manually.

Key words: beef, intestines, processing, histology

Introduction

Industrial processing of intestines of slaughter-treated animals is an important field of animal by-product technology. Most natural beef and hogs intestines are considered to be edible by-products due to their efficient digestibility and are used either indirectly in animal nutrition, or directly as sausage casings.

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The supply of natural casings is inadequate in meat processing industries and intestines are therefore mostly processed in fodder products. Natural casings are accepted and utilised in modern automatic lines due to their quality and dimensions (YOKOYAMA, 1974). Furthermore, due to insufficient technical-technological treatment, natural casings show decreased viability. The growth of putrid microflora is the reason for the decreased viability of primarily unprocessed intestine (BARTENSCHLÄGER-BLASSIN, 1979). Hence, prerequisites for high-quality intestine treatment are evisceration, washing, cleaning, chilling and preservation. Evisceration must be conducted immediately after slaughter and without mechanical lesions of the intestines.

After sorting, calibration and preservation, beef intestines are mainly used in the processing of high-quality sausage products (BENTLER and KEIM, 1981; PANZER, 1977; PARISI et al., 1979). There is increased demand for natural casings in markets. The key task of this study was to determine whether manual or machine treatment caused more serious microlesions of the intestinal layer.

Materials and methods

Our study required intestinal sets of 60 fattened beef cattle (Simmental breed) from the "Sljeme" breeding farm in Zagreb, Croatia. Beef cattle were 10 months old with an average mass of 248.05 kg.

After evisceration, duodenum, jejunum, ileum, caecum, colon and rectum were separated on the slaughter line (Table 1). Separation was conducted by anatomical-morphological procedure. Separated intestines

Table 1. Parts of small and large intestines of beef used as casings in sausage production

Sausage products	Small and large intestines
Cooked smoked sausages	Duodenum, jejunum, ileum, colon
Semy-dry sausages	Duodenum, jejunum, ileum, colon, caecum
Dry-sausages	Caecum, colon, rectum
Cooked sausages	Duodenum, jejunum, ileum

were roughly cleaned and washed, followed by machine cleaning using STRIDHS MASKINER TYPE-7-B 600 (Stridhs, Gothenburg, Sweden). Parallel, manual treatment of cleaning was carried out using the same intestinal sets.

To prepare histological slides, samples were taken from each part of the small and large intestines and fixed in 10% formalin. After fixation, samples were washed out with water and treated with alcohol. Alcohol was added in an increased concentration range (70%, 80%, 90% and 100%). Afterwards, samples were inserted in formalin, cut with a microtome into 8 μm thin sections and dyed with hematoxylin and eosin after Meyer (ROMEIS, 1968).

Results

Histological slides of uncleaned duodenum of beef show that all intestinal wall layers are present: tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa. Tunica mucosa contains villi intestinales covered with simple columnar epithelium, and some goblet cells. Intestinal

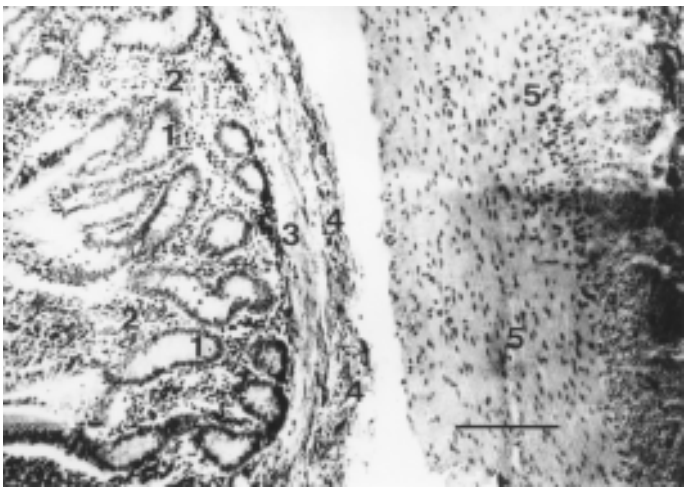

Fig. 1. Small intestine (duodenum) of beef – uncleaned. Tunica mucosa (1-3), tunica submucosa (4), tunica muscularis (5); H&E; 6.3×10; scale bar = 100 μm.

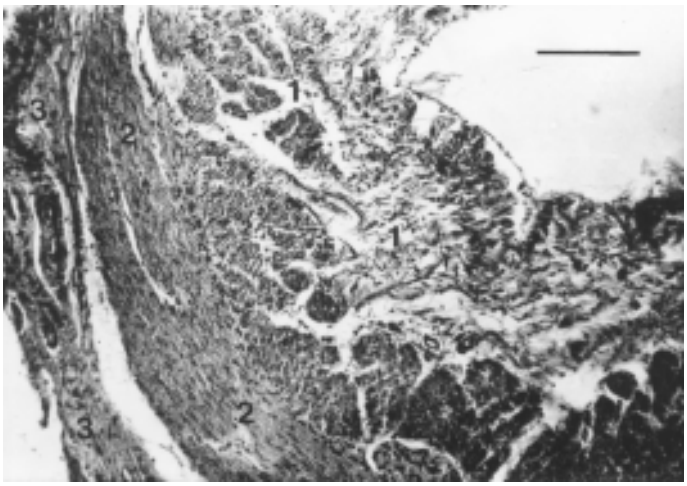

Fig. 2. Small intestine (duodenum) of beef – machine treatment.
Tunica submucosa (1), tunica muscularis (2), tunica serosa (3);
H&E; 6.3×10; scale bar = 100μm.

glands or Crypts of Lieberkühn are clearly shown within thin connective tissue (in lamina propria). Lamina muscularis mucosae are relatively thin. Tunica submucosa is filled with loose connective tissue. Within connective tissue blood and lymphatic vessels are clearly visible. Duodenal glands (or Brunner's glands) are not visible because the duodenum sample was taken from the glandless part of intestine. Tunica muscularis is built of muscular fibres containing circular and longitudinal layers. Tunica muscularis is preceded by tunica serosa (Fig. 1).

The small intestines sample (duodenum), after machine cleaning is shown in Figure 2. Tunica mucosa is totally removed. Tunica submucosa, tunica muscularis and tunica serosa are visible.

The small intestine sample after manual cleaning is shown in Figure 3. Lamina muscularis mucosae, tunica submucosa, tunica muscularis (circular and longitudinal layers) and tunica serosa are visible.

The histological slide of bovine uncleaned colon shows well-formed tunica mucosa with deep Crypts of Lieberkühn and well-formed lamina

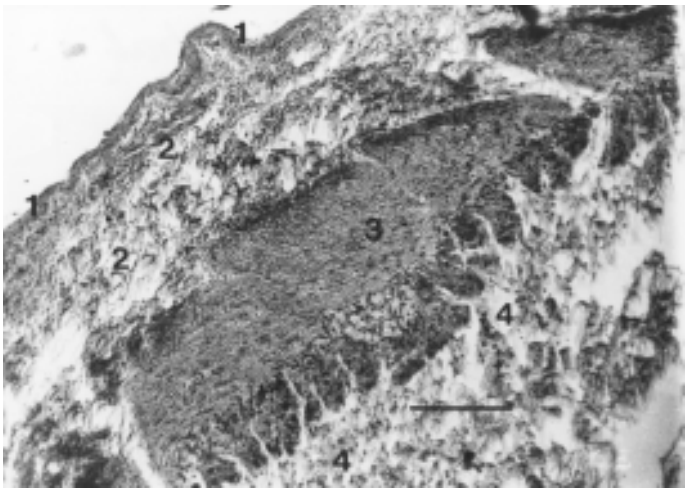

Fig. 3. Small intestine (duodenum) of beef – manual treatment. Lamina muscularis mucosae (1), tunica submucosa (2), tunica muscularis (3), tunica serosa (4); H&E; 6.3×10; scale bar = 100 μm.

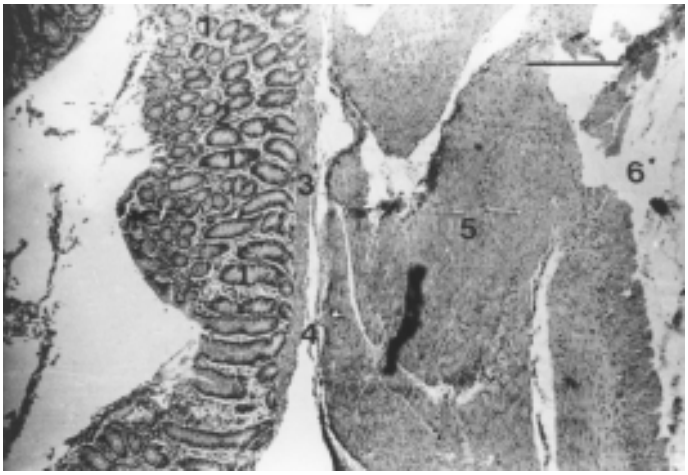

Fig. 4. Large intestine (colon) – uncleaned. Tunica mucosa (1-3), tunica submucosa (4), tunica muscularis (5), tunica serosa (6); H&E; 6.3×10; scale bar = 100 μm.

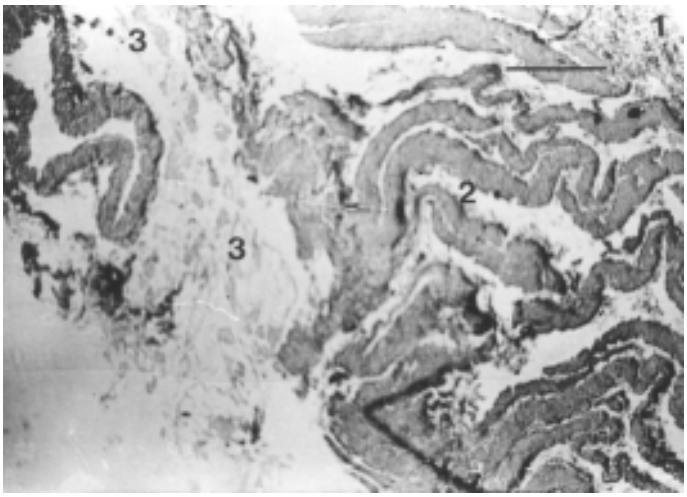

Fig. 5. Large intestine (colon) – machine treatment. Tunica submucosa (1), tunica muscularis (2), tunica serosa (3); H&E; 6.3×10; scale bar = 100 μm

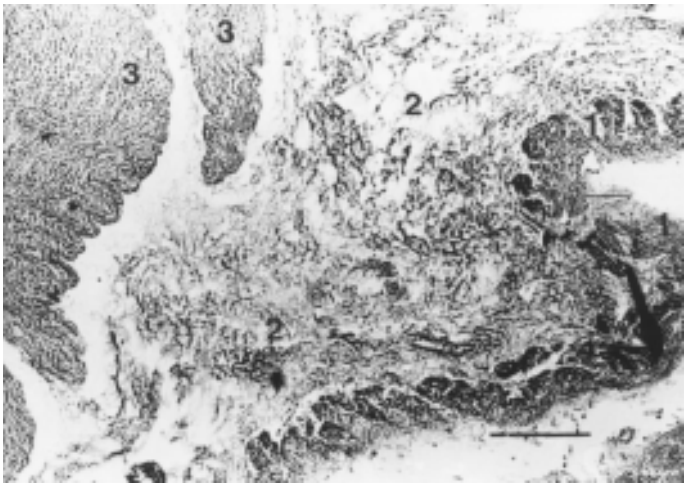

Fig. 6. Large intestine (colon) – manual treatment. Lamina muscularis mucosae (1), tunica submucosa (2), tunica muscularis with micro lesions (3); H&E; 6.3×10; scale bar = 100 μm.

muscularis mucosae. Tunica mucosa is preceded by strong tunica muscularis (Fig. 4).

The histological slide of bovine colon sample after machine treatment is shown in Figure 5. Tunica mucosa is totally removed. Tunica submucosa and tunica muscularis are partially visible. Tunica serosa is clearly visible.

The histological slide of manually cleaned colon shows that some layers of tunica mucosa are removed. The removed parts are lamina epithelialis and lamina propria. The remaining layers are clearly visible: lamina muscularis mucosae, tunica submucosa, tunica muscularis and tunica serosa. Rupture of muscular fibres is visible in tunica muscularis. These ruptures are not visible in machine treated samples (Fig. 6).

Discussion

As mentioned in the introduction, beef intestines are used in processing high-quality sausage products (after sorting, calibration and preservation) (BENTLER and KEIM, 1981). Sausage products include cooked smoked sausages, semi-dry sausages, dry sausages and cooked sausages (Table 1).

The qualities of the casings and final products are influenced by intestinal set treatment. Treatment is associated with microscopic and macroscopic visible lesions of the intestines. The appearance of the lesions depends on the age, nutrition and breed characteristics of animals as well as the method of technological treatment.

A high technical quality of intestines (used as casings) will be attained if parts of layers of tunica submucosa, tunica muscularis and tunica serosa remain after cleaning (BARTENSCHLÄGER-BLASSIN, 1979).

Examination of the microscopic slides of cleaned small and large intestines of beef show differences in thickness between manual and machine cleaning of intestines. Machine treatment, as well as manual treatment, requires removal of tunica mucosa. The presence of tunica mucosa (or of some of its parts) after cleaning depends on the arm pressure of the worker (manual cleaning) and on the adjustment of rollers (machine cleaning). Well-trained workers are able to fulfil the above-mentioned criteria, but this depends on a subjective evaluation of the workers.

According to our results, machine treatment fulfils all technological criteria required in using intestines as natural casings (if adjustments of rollers are accurate). Fulfilling the terms mentioned above, machine treatment provides uniformity of cleaned intestines, which is imperative for their quality. In contrast to manual cleaning, microlesions of intestinal wall are not observed after machine cleaning. Micro-lesions apparently appeared after manual cleaning as the result of rough manipulation during treatment.

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SAŽETAK

Na crijevima 60 tovnih goveda simentalske pasmine, u dobi od 10 mjeseci i prosječne klaoničke mase 248,05 kg, istražena je uz pomoć histološke tehnike građa dijelova crijevne stijenke nakon ručnog i strojnog čišćenja. Budući da se crijeva kao jestivi nusproizvodi sve više rabe kao prirodni ovitci za izradu visokokvalitetnih kobasičarskih proizvoda, naša su istraživanja bila usmjerena na utvrđivanje razlika u slojevima stijenke tankoga (duodenum) i debeloga (colon) crijeva preostalih

nakon strojne i ručne obrade. Rezultati naših histoloških analiza upućuju na činjenicu da je strojna obrada crijevnih kompleta pokazala bolje rezultate u smislu uniformnosti očišćenih crijeva bez pojave mikrooštećenja u mišićnom sloju što je od bitnog značenja za njihovu kakvoću u odnosu na histološku sliku crijevne stijenke nakon ručne obrade koja nije ispunila navedene kriterije tehnološke obrade.

Ključne riječi: govedo, crijeva, prerada, histologija