

HEMORRHAGE IN THE CHUCK OF BEEF CARCASSES

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DURING THE WINTER of 1957 and 1958, considerable loss was reported in prime and choice beef carcasses as the result of hemorrhage in the muscles of the chuck. The meat packers were concerned about this loss since approximately four percent of the heavy beef in some plants were showing these lesions. The incidence of the muscle lesions was highest in beef killed according to the Kosher ritual, and since this represents select beef, the loss was of considerable importance because the involved chucks were unsalable or were sold at a reduced price.

The cattle showing this lesion came, for the most part, from northeastern Iowa, southwestern Wisconsin, and northwestern Illinois. The usual beef feeding methods were used on the farms in this area. Examination of the handling methods employed by the stockyard and packing house workers as well as the equipment used revealed no particular variations from the methods used by most slaughtering establishments. Since the highest incidence of chuck hemorrhage was observed in the Kosher cattle, it was apparent the Kosher killing ritual exerted

an influence on the incidence of the disease.

A few muscle specimens were obtained from cattle showing chuck hemorrhage. The muscle tissue was fixed in alcohol-formalin, infiltrated and embedded in paraffin, sectioned, and the sections were stained with hematoxylin and eosin. Examination of the stained preparations revealed that, in addition to the hemorrhage, there was extensive coagulation necrosis of the muscles of the chuck.

As a result of the alterations found on preliminary examination, an attempt was made to determine how extensive the muscle damage was in cattle hanging on the rail. Since it was impossible to determine the exact farm from which the cattle originated, it was thought that if consecutively numbered carcasses were examined in various areas of the cooler, animals from the same truck lot or farm might be obtained. This might give some indication if the condition were a problem on certain farms. In addition to these, random samples were also taken throughout the cooler.

Histological examination of these specimens revealed that muscle necrosis was a prerequisite for hemorrhage. The following table shows the combinations of coagulation necrosis and hemorrhage which were noted on examination. The number of cattle showing each combination is indicated.

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TABLE 1.

# of cattle	Coagulation	necrosis	Hemorrhage
22	none		none
10	occasional	cell	none
7	slight		none
2	slight		slight
9	moderate		none
2	moderate		slight
1	moderate		moderate
1	moderate		extensive
16	severe		extensive

The results indicate that many of the beeves being slaughtered had coagulation necrosis of the muscles of the chuck. In those animals in which there was muscle necrosis the muscles were so fragile they ruptured at the time of slaughter. Hemorrhage occurred in the muscle as the result of muscle rupture.

The violence of Kosher killing methods would be very prone to bring about muscle rupture if necrotic muscles were present. It was suggested by the butchers that cutting the meninges with the point of the Kosher knife caused "bleeders." It is quite possible that this observation is correct as meningeal injury will cause violent convulsive muscle contractions.

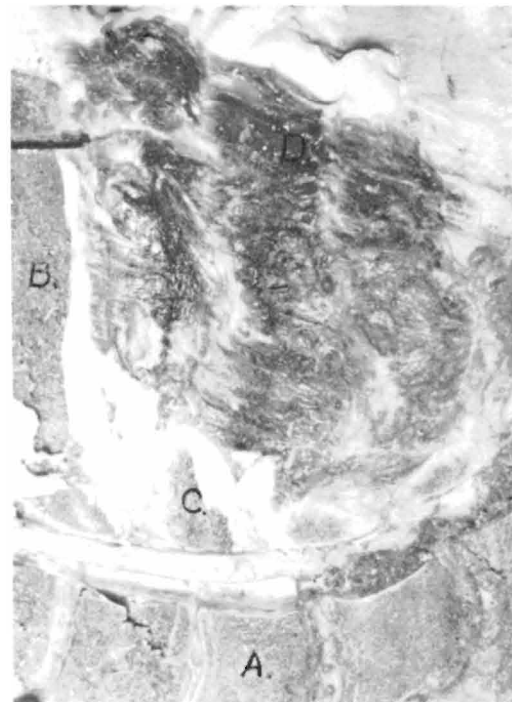
The spinalis dorsi was the muscle that showed the most extensive hemorrhage. This is one of the principal muscles that cause dorsal and lateral flexion of the neck and would be particularly apt to rupture if it were damaged. Hemorrhage was also present in the longissimus, multifidus cervicis, and multifidus dorsi muscles. Other muscles of the chuck also showed hemorrhages but the lesions were not as numerous.

The hemorrhage was most extensive in the vicinity of the branches of the deep cervical artery, particularly just after the vessel emerged from the thoracic cavity and entered the muscles of the neck. It is believed that the blood pressure is very high in the deep cervical artery as the animal is suspended from the ceiling prior to, during, and after the cutting of the animals' throat in the Kosher ritual. As a result, an injury to the muscles in the

region supplied by the deep cervical artery will cause extensive hemorrhage.

The coagulation necrosis of muscle observed in the chucks of these animals had occurred within a few hours or at most a few days prior to the time of slaughter. This supposition is based on the fact that there was no muscle repair or regeneration in the area indicating that the injury was so recent the process of repair had not progressed to the point where it could be recognized by cellular reaction in the area.

The hemorrhage in the chuck had occurred at the time of slaughter. Gross examination indicated this because the blood was bright-red in color and semi-clotted when first observed by the butchers. In addition, there was no imbibition with blood or discoloration of the surrounding area with the pigments associated with the disintegration of the erythrocytes and the decomposition of hemoglobin. Microscopic examination showed the erythrocytes were intact, retained



Hemorrhage in the muscles of the chuck. A. Body of a cervical vertebra. B. Spinous process of the seventh cervical vertebra. C. Spinous process of the sixth cervical vertebra. D. Diffuse hemorrhage in the muscle of the chuck.

their normal tinctorial properties, and were not being phagocytosed indicating the extravasations of blood had occurred recently.

Stiff cattle, as the result of muscle lesions, had not been reported in cattle on farms in the area from which the animals were obtained. The necrosis of muscle apparently occurred at some time after the animals left the farm and prior to their arrival on the killing floor. The muscle necrosis had to occur before the act of slaughter as sufficient time would not have elapsed for the muscle changes to take place once the Koshering ritual was initiated.

The evidence indicates that the relatively quiet cattle in the feedlot on the farm did not have muscle necrosis and hemorrhage. However, these animals were predisposed to muscle injury as the result of improper nutrition and management.

The muscles of these animals were not conditioned for excessive exercise. They had been kept quiet in the feedlot during the fattening procedure and the exercise they could obtain was limited. When these animals were loaded into trucks, hauled to the stockyards, unloaded into the pens, forced to climb the ramp to the killing floor, and finally slaughtered, violent muscular activity took place. As a result, the rate of muscle metabolism was greatly increased.

A regulator of muscle metabolism is required if catabolic injury of the muscle cell is to be prevented. Without this regulator of muscle metabolism, chemical reactions within the cell are so great that the protoplasm of the cell is damaged. It is estimated that the rate of muscle metabolism may increase as much as 400 percent. In other words the cell literally burns itself up and the result is coagulation necrosis.

The cause of coagulation necrosis of muscle has never been entirely determined. The reason is that the mechanism of cell metabolism has not been explained. There are a number of theories as to the cellular chemistry that is taking place within the muscle cell but none of these adequately explain the metabolic reac-

tions. It is known that certain substances do have a definite regulatory effect on the rate of muscle metabolism. Vitamin E and selenium are two of the substances that are of importance in the control of muscle metabolism. A deficiency of one or both of these substances in the ration may result in abnormal muscle metabolism. How many other substances influence cell chemistry and may cause similar alterations is not known.

Examination of the usual ration fed in the feed lot indicates there is danger of a vitamin E deficiency. This is especially apt to occur near the end of the feeding period when corn and poor roughage are the principle constituents of the ration. This deficiency is especially apt to occur when corn and other grains have been stored for a long period of time. Corn used in the feed lot has often been in storage for two, three, and even four years. This corn has little if any vitamin content. If poor roughage is fed and additional vitamin E is not added to the ration, a vitamin E deficiency will be present.

The role of selenium in muscle diseases in Iowa is not known. The selenium content of Iowa soil is low but whether there is a deficiency in certain areas has not been determined. Until the selenium content of the soil is known, its role in muscle lesions in Iowa cattle will remain unknown.

Whatever the underlying nutritional disturbance may be, exercise or some other stress factor plays a very important role in the production of muscle necrosis. Animals having a deficiency of one of the muscle metabolism regulating substances do not develop muscle lesions if they are at rest, but if these animals are forced to exercise or use their muscles excessively, muscle necrosis occurs. It would appear that this is the explanation for the coagulation necrosis and hemorrhage in the chuck of prime and choice beef carcasses.

End

In vitro studies show that detergents facilitate the penetration of hexylresorcinol into *Ascaris* spp.