

Article

Quality and Safety of Beef From Cattle Infected with Theileriosis

V.M. Doskulov¹

1. Samarkand State University of Veterinary Medicine, Livestock and Biotechnologies.

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Abstract: This study investigated the effect of theileriosis on the organoleptic and physicochemical characteristics of beef obtained from cattle in the Samarkand region of Uzbekistan. Veterinary and sanitary examinations were conducted during 2024–2026, covering a total of 580 cattle. Theileriosis was detected in 26 animals, corresponding to an overall prevalence of 4.5%, with the highest prevalence recorded in summer (6.3%). For detailed meat quality assessment, cattle were divided into an early-stage theileriosis group (n=20), a severe theileriosis group (n=6), and a clinically healthy control group (n=10). The examination included assessment of meat color, odor, consistency, pH, copper (II) sulfate reaction, and peroxidase activity. Compared with the control group (pH 5.7 ± 0.2), the mean meat pH increased to 6.1 ± 0.3 in cattle with early-stage theileriosis and to 6.4 ± 0.3 in animals with severe disease. Pronounced changes in meat color, turbidity, consistency, and biochemical reactions were also observed in the affected groups. The findings demonstrate that theileriosis is associated with deterioration of several organoleptic and physicochemical quality indicators of beef, particularly in cases of severe disease. Comprehensive ante-mortem and post-mortem veterinary and sanitary inspection is therefore essential for determining the suitability of meat obtained from affected animals for human consumption and ensuring food safety.

Keywords: Theileria annulata, theileriosis, cattle, beef, meat quality, veterinary and sanitary examination, pH, copper (II) sulfate reaction, peroxidase, organoleptic characteristics, food safety.

Introduction

In recent years, extensive reforms have been implemented in Uzbekistan to develop the livestock sector, increase the number of farm animals, expand the production of meat and other livestock products, and meet the population's demand for safe and high-quality food products. Meat

and meat products play an important role in human nutrition as valuable sources of high-quality proteins, minerals, vitamins, and other essential nutrients. Therefore, ensuring the quality and safety of food products of animal origin is one of the important objectives of veterinary and sanitary control [1], [2].

Infectious, invasive, and parasitic diseases affecting cattle may have a significant impact not only on animal health and productivity but also on the quality characteristics of products obtained from affected animals, particularly meat. Pathological processes associated with disease may cause disturbances in blood circulation, metabolism, immune responses, and biochemical processes. Such changes can influence the physiological condition of animals and the veterinary and sanitary characteristics of meat obtained after slaughter [3].

Among the blood-parasitic diseases of cattle, theileriosis is one of the diseases of considerable veterinary and economic importance. Theileriosis is a protozoan disease caused by intracellular parasites of the genus *Theileria* and is mainly transmitted by ixodid ticks. In cattle, the most important pathogenic species include *Theileria annulata* and *Theileria parva*, while *T. annulata* is considered the principal causative agent of tropical theileriosis [4], [5].

Severe forms of theileriosis are characterized by high fever, enlargement of lymph nodes, loss of appetite, weakness, weight loss, anemia, jaundice, and respiratory distress. Infection with *Theileria annulata* may cause erythrocyte damage and hemolytic processes, resulting in anemia and, in some cases, jaundice [6]. Recent clinicopathological studies have demonstrated that cattle affected by theileriosis may develop anemia, thrombocytopenia, alterations in biochemical parameters associated with liver and kidney function, as well as pathological changes in lymph nodes, liver, spleen, and other organs [7].

Theileriosis is also an important parasitic disease of cattle in Uzbekistan. Studies have reported the occurrence of *Theileria annulata*-associated theileriosis in several regions of the country, including Samarkand, Jizzakh, and Navoi regions. In particular, local strains of *T. annulata* have been isolated in the Samarkand region, indicating the epidemiological importance of the disease for cattle production in the area [8][9].

The anemia, intoxication, metabolic disturbances, and deterioration of the general physiological condition associated with theileriosis require careful veterinary and sanitary assessment of meat obtained from affected animals. The suitability of meat for human consumption is determined through a comprehensive assessment that includes the clinical condition of the animal before slaughter, pathological and anatomical changes detected after slaughter, as well as the appearance, color, odor, consistency, and other quality characteristics of the meat [10]. An important principle of veterinary meat inspection is the examination of animals before slaughter and carcasses after slaughter in order to determine their suitability for human consumption [11].

It should be emphasized that theileriosis itself is not considered a zoonotic disease. According to the World Organisation for Animal Health (WOAH), there is no evidence that *Theileria* species affecting ruminants cause infection in humans [12]. Nevertheless, veterinary and sanitary examination of meat obtained from diseased animals remains important for ensuring food safety, particularly for assessing the general condition of the animal and identifying pathological changes in meat and internal organs.

Therefore, the study of the organoleptic and physicochemical characteristics of meat obtained from cattle affected by theileriosis, comparison of these characteristics with those of meat obtained from clinically healthy animals, and assessment of its veterinary and sanitary suitability are of considerable scientific and practical importance.[13]

The aim of this study was to investigate the quality and safety characteristics of meat obtained from cattle affected by theileriosis, evaluate its organoleptic and physicochemical properties, and determine its suitability for human consumption from the perspective of veterinary and sanitary examination.[14]

Materials and Methods

The study was conducted during 2024–2026 at the Samarkand State University of Veterinary Medicine, Livestock and Biotechnologies and at the “Sam Teri Tayyorlov” and “Sifat Go’sht Savdo” slaughter facilities. A total of 580 cattle were subjected to veterinary and sanitary examination during the study period. After slaughter, the carcasses, skeletal muscle tissues, and internal organs of each animal were subjected to a comprehensive veterinary and sanitary assessment in accordance with the established veterinary and sanitary requirements.

Based on the clinical and laboratory findings, cattle selected for the experimental study were divided into three groups:

Group I (early-stage theileriosis group) – 20 cattle diagnosed with theileriosis at the initial stage of the disease and subsequently slaughtered for veterinary and sanitary examination;

Group II (severe theileriosis group) – 6 cattle diagnosed with a severe clinical form of theileriosis and subjected to slaughter and subsequent examination;

Control group – 10 clinically healthy cattle that showed no apparent clinical signs of infectious, parasitic, or other diseases.

Following slaughter, samples of muscle tissue and carcass material were collected for organoleptic and biochemical examination. The assessment was performed to determine the effect of theileriosis on the quality characteristics of beef and to establish its veterinary and sanitary suitability.

Organoleptic examination. The organoleptic properties of the meat were evaluated according to its color, odor, and consistency. Particular attention was paid to changes in the appearance and characteristic odor of the meat, as well as alterations in tissue consistency associated with pathological processes.

Physicochemical and biochemical examination. The pH value of the meat was determined as an indicator of changes occurring in muscle tissue after slaughter. In addition, a copper (II) sulfate reaction and a peroxidase reaction were performed to assess the freshness and biochemical condition of the meat. The results obtained from cattle affected by theileriosis were compared with those of the clinically healthy control group.

The laboratory examinations were performed in accordance with the requirements of GOST 34567–2019 and the applicable veterinary and sanitary regulations of the Republic of Uzbekistan. All observations and laboratory results were systematically recorded and subjected to statistical analysis. The obtained data were summarized and compared between the experimental and control groups to determine differences in the quality and safety indicators of beef obtained from cattle affected by theileriosis.[15]

Results and Discussion

During the study, a total of 580 cattle were subjected to veterinary and sanitary examination. Theileriosis was diagnosed in 26 animals, corresponding to an overall prevalence of 4.5%. Analysis of seasonal distribution showed that the highest prevalence was recorded during the summer (6.3%; 10 out of 160 animals). The prevalence was 5.0% in spring (7/140), 3.1% in autumn (4/130), and 3.3% in winter (5/150) (Table 1).

Table 1. Seasonal prevalence of theileriosis in cattle

Season	Number of cattle examined	Number of infected cattle	Prevalence (%)
Spring	140	7	5.0
Summer	160	10	6.3
Autumn	130	4	3.1
Winter	150	5	3.3
Total	580	26	4.5

The obtained data indicate a seasonal pattern in the occurrence of theileriosis. The relatively higher prevalence observed during the summer months may be associated with the seasonal activity

and abundance of ixodid ticks, which serve as the principal vectors of *Theileria* spp. The relatively elevated prevalence recorded in spring may also be related to the beginning of increased tick activity. In contrast, lower prevalence rates were observed during autumn and winter.

The assessment of meat quality revealed distinct differences between the control and theileriosis-affected groups. Meat obtained from clinically healthy cattle in the control group had a normal appearance, characteristic odor, and firm consistency. The mean pH value was 5.7 ± 0.2 . The copper (II) sulfate reaction showed the expected positive color change, while the peroxidase reaction was also positive.

Meat obtained from cattle diagnosed with theileriosis at the initial stage demonstrated certain changes in organoleptic and physicochemical characteristics. The meat appeared relatively turbid, and sediment formation was observed in some samples. The mean pH value in this group was 6.1 ± 0.3 . The negative peroxidase reaction indicated a reduction in enzymatic activity compared with the control group.

More pronounced changes were observed in meat obtained from cattle affected by the severe form of theileriosis. These included a yellowish discoloration, increased turbidity, and alterations in consistency. The mean pH value increased to 6.4 ± 0.3 , while the peroxidase reaction was negative. These findings suggest that the severity of the pathological process in the animal was associated with more pronounced changes in the biochemical and organoleptic characteristics of the meat.

The data presented in Table 2 demonstrate a gradual increase in meat pH with increasing clinical severity of theileriosis. The mean pH was 5.7 ± 0.2 in the control group, compared with 6.1 ± 0.3 in cattle with early-stage theileriosis and 6.4 ± 0.3 in cattle with severe theileriosis. Thus, compared with the control group, the pH increased by approximately 0.4 and 0.7 pH units, respectively.

Table 2. Organoleptic and biochemical characteristics of meat obtained from healthy and theileriosis-affected cattle

Group	Number of animals	Organoleptic characteristics	Copper(II) sulfate reaction	Peroxidase reaction	pH (mean $\pm$ SD)
Control group (healthy)	10	Normal color, clear, no sediment	Positive (+), blue-green to brownish color change	Positive (+)	5.7 ± 0.2
Group I (early-stage theileriosis)	20	Turbid, sediment present	Negative (-), direct brown coloration	Negative (-)	6.1 ± 0.3
Group II (severe theileriosis)	6	Yellowish, turbid, degenerative changes	Negative (-), direct brown coloration	Negative (-)	6.4 ± 0.3

The increase in meat pH may be associated with alterations in post-mortem glycolysis and biochemical processes within muscle tissue. The anemia, systemic intoxication, metabolic disturbances, and deterioration of the general physiological condition associated with theileriosis may influence post-mortem biochemical changes and the maturation process of meat.

The differences observed in the copper (II) sulfate and peroxidase reactions between the control and experimental groups further indicate alterations in the biochemical condition of meat obtained from affected animals. However, these reactions should be interpreted as complementary indicators within a comprehensive veterinary and sanitary assessment, rather than as independent evidence of specific biochemical mechanisms such as increased protein degradation or oxidative processes.

Overall, the findings indicate that theileriosis was associated with changes in the organoleptic and physicochemical characteristics of beef, with more pronounced alterations observed in animals affected by the severe form of the disease. The combination of changes in meat appearance, consistency,

pH, and biochemical reactions highlights the importance of considering disease severity during veterinary and sanitary meat inspection.

The results further demonstrate the importance of conducting both ante-mortem clinical examination and post-mortem veterinary and sanitary inspection when evaluating meat obtained from cattle affected by theileriosis. In cases where pronounced pathological changes are identified, the final decision regarding the suitability of meat for human consumption should be made in accordance with applicable veterinary and sanitary regulations.

Conclusion

The study conducted during 2024–2026 involved the veterinary and sanitary examination of 580 cattle, of which 26 animals (4.5%) were diagnosed with theileriosis. The highest prevalence was recorded during the summer (6.3%), which may be associated with the seasonal activity of ixodid tick vectors responsible for the transmission of *Theileria* spp.

Meat obtained from cattle affected by theileriosis demonstrated noticeable changes in its organoleptic and physicochemical characteristics compared with meat from clinically healthy animals. The mean pH increased from 5.7 ± 0.2 in the control group to 6.1 ± 0.3 in cattle with early-stage theileriosis and to 6.4 ± 0.3 in cattle with severe disease. Increasing disease severity was accompanied by more pronounced changes in meat color, turbidity, and consistency.

The copper (II) sulfate and peroxidase reactions also differed between the control and theileriosis-affected groups, indicating alterations in the biochemical characteristics of the meat. These findings confirm the importance of using a combination of organoleptic, physicochemical, and biochemical parameters for the veterinary and sanitary assessment of meat obtained from diseased cattle.

In general, the results demonstrate that theileriosis is associated with changes in the quality characteristics of beef, particularly in animals with severe clinical disease. Therefore, early diagnosis of theileriosis, systematic control of ixodid tick vectors, timely veterinary intervention, and strict ante-mortem and post-mortem veterinary and sanitary inspection are important measures for maintaining the quality and safety of meat products.

Further studies involving a larger sample size and additional parameters, including microbiological, histopathological, and detailed physicochemical analyses, would be valuable for establishing the relationship between the severity of theileriosis and changes in meat quality more precisely.

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