



## Clostridial Dermatitis: A New Concern among Turkey Farmers

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### Abstract

*Clostridial dermatitis (CD) which was previously known with various names such as cellulitis, gangrenous dermatitis, malignant edema, spontaneous Clostridial myonecrosis etc. has come out as an emerging disease in Turkey bird farming. Gangrenous dermatitis was thought to be caused due to a number of organisms like Clostridium septicum, Clostridium perfringens type A, Clostridium sordelli, Staphylococcus aureus, Escherichia coli, and Streptococcus sp. But recently, more reports have been published in support of Clostridium spp. as the major causative agent of dermatitis. The clinical signs like reduced growth, deprived appetite, ataxia, and oedema in muscles of the lower abdomen and inner thighs are characteristics of this disease. Gross lesions includes excessive congested musculature accompanied by serosanguinous fluid accumulation and emphysema. There were areas of areas of gas crepitation on breast and thighs muscles and sloughing of skin. Mortality in farms recorded to increase in 17-20 week age group of Turkey birds. From 2008, it has been continuously ranked under top three diseases issue of turkey farms of US. Because of mortality at marketing age, increase condemnation of carcass and expensive medicinal treatment, turkey farmers have to suffer significant economic loss. Therefore in this article we have tried to discuss the risk factors, prevention and control of disease by managemental means and recent development of vaccines and other possible strategic control measures. It can be noted that as this issue is relatively new to Turkey industry, so there is less availability of conclusive published articles and various essential research are ongoing in different labs.*

**Keywords:** Clostridia, dermatitis, turkey, bacterin toxoid, noncytolytic alpha toxin vaccine.

### Introduction

Clostridial dermatitis in turkey birds was first reported on 1993 and by 2008, it earned third rank of disease in concern as per US Animal Health Association (USAHA). In recent reports it has given priority next to 'lack of approved efficacious drugs' as disease issue in US. Prevalence and severity of this disease has increased in last decade and has caught the attention among turkey farmers. According to a report of Animal and Plant Health Inspection Service (2012) of US Department of Agriculture<sup>1</sup>, overall 42.3 percent of turkey-grower farms had problem with clostridial dermatitis compared to central (48.4 percent) and eastern region (39 percent) of US. This report also highlights the mortality rate of 4 percent out of 17 percent due to clostridial dermatitis outbreak in US turkey farms. The disease found to be more severe at 16-17week age group of birds<sup>1,2</sup>. The turkey farmers have to bear huge economic loss not only due to bird mortality at marketable age but also due to increased condemnation rates, and expensive medication costs for treatment<sup>3,4</sup>. Clostridial dermatitis has become a major health problem in commercial poultry raised on deep litter systems in US farms. Economic losses ascribed to CD have been projected to be \$1.31 per affected bird<sup>5</sup>.

Clostridial dermatitis has given various names as cellulitis, gangrenous dermatitis, malignant edema, spontaneous clostridial myonecrosis, subcutaneous emphysema, tailitis, and wing rot<sup>6</sup>. A number of opportunistic bacteria including

*Clostridium septicum*, *Clostridium perfringens* type A, *Clostridium sordelli*, *Staphylococcus aureus*, *Escherichia coli* and *Streptococcus sp.* were previously believed to be the causative agent of gangrenous dermatitis as have all been isolated from affected tissues; however, various experimental challenge and government survey of CD in US turkey industry supports *Clostridium septicum* as major pathogen<sup>1,6,7,8</sup>. Tellez et al.<sup>9</sup> also confirms *Clostridium septicum* as the major pathogen in this disease occurrence by isolating and growing the organism in Cooked Meat Medium (CMM) and identifying antibody titer in ELISA. Similar results were also obtained from quantitative real time PCR estimation from affected poultry birds<sup>10</sup>. Whereas the role of *C. perfringens* for disease occurrence has not been conclusive<sup>1,10</sup>.

### Clostridial Organism

Clostridia are obligate anaerobic, spore-forming, gram-positive, catalase and peroxidase negative, rod-shaped bacteria. More than 83 species are included in this genus, out of which 14 species are identified as potential pathogen<sup>11,12</sup>. Members of this genus have ubiquitous distribution in environment. These organisms are found in soil, sewage, marine sediments and also constitute a part of normal microbiota of animals and birds. Major diseases caused by clostridial organisms in birds are clostridial dermatitis, necrotic enteritis, botulism and ulcerative enteritis<sup>5</sup>. *Clostridium septicum* are gram variable rods (gram negative in old cultures) with an oval shaped subterminal spore.

They usually produce a thick swarming growth in blood agar. They are negative for lecithinase, lipase, indole and urease tests<sup>13</sup>.

## Catastrophic Pathogenesis

Several theories has been proposed regarding the pathogenesis of clostridial dermatitis. Basically two accepted theories are “inside out” and “outside in” principles. According to “inside out” theory, pathogenic clostridia organism or toxins produced by them or both enters into blood circulation from intestine of birds through intestinal wall lesion and get deposited under skin and other muscular areas of birds to produce characteristic clinical signs and lesion<sup>14,15</sup>. As clostridia organisms are normal inhabitant of intestine, thus enteritis caused due to coccidiosis are thought to promote the systemic infection of these organism and progress towards dermatitis of turkey. However, increased environmental contamination of clostridium may also act as source of infection by oral route. Presence of clostridia organism in internal organs like liver and spleen samples justifies the haematogenous route of transmission of the disease<sup>1</sup>. Alternatively, “Outside in” theory purposes the direct invasion of clostridial organism through wounded, abraded, moist skin lesions of birds and produce toximia<sup>6,16</sup>. Some scientific community believe in “Outside in” theory as *Clostridium septicum* is reported as etiological agent for traumatic gas gangrene and myonecrosis in animals and poultry birds<sup>1,17,18</sup>. *Clostridium septicum* produces alpha, beta, gamma and delta toxins. The alpha-toxin of *C. septicum* is responsible for the lethal and necrotizing activities<sup>19-21</sup>. Beta toxins produced by *C. septicum* are of molecular mass of 45 kDa and have DNase activity<sup>22</sup>. The gamma-toxin is a hyaluronidase enzyme. This enzyme hydrolyzes glycosidic bonds between N-acetylglucosamine and glucuronic acid residues of hyaluronic acid<sup>23</sup>. The delta-toxin produced by these organisms is hemolysin. These toxins are responsible for haemolysis in blood agar medium and more potent haemolytic agent than alpha toxins<sup>12</sup>. These exotoxins are responsible for tissue damage and toximia in turkey. *Clostridium septicum* toxins were reported to be more potent than those of *C. perfringens* in causing clostridial dermatitis in turkeys<sup>6,8,24</sup>. Additionally, occurrence of Clostridial dermatitis has also been linked to immune suppression caused due to infectious chicken anaemia virus or bursal disease, nutritional deficiency, aflatoxicosis, or poor sanitation<sup>16</sup>.

## Clinical Signs And Necropsy Findings In Turkey Birds

Clostridial dermatitis is a disease problem in market age turkeys i.e., 17 to 20 week. However, disease problems seen to be more severe in flocks in which disease onset occurred when birds were less than 13 weeks of age in comparison to older birds<sup>1</sup>. Cellulitis in Turkey is acute diffuse infection of the skin with congestion, inflammation, edema and heterophil infiltration of the subcutis<sup>4,9,25</sup>. The clinical signs like reduced growth,

deprived appetite, ataxia, and oedema in muscles of ventral abdomen and inner thighs are characteristics of this disease. Gross lesions includes excessive congested musculature accompanied by serosanguinous fluid accumulation and emphysema. There were areas of gas crepitation on breast and thighs muscles and sloughing of skin<sup>26</sup>. Mortality in farms recorded to increase in 17-20 week age group of Turkey birds<sup>2,27</sup>.

Gross lesions consist of dark reddish purple to green, weepy areas of skin over abdomen, breast, wings, or legs<sup>18</sup>. Necropsy finding of affected turkeys revealed copious-serosanguinous to jelly-like fluid under epidermis. The musculature was severely affected, congested and necrotic<sup>2</sup>. The necropsy of liver and spleen showed slight enlargement and congestion<sup>2</sup>. Pathological lesions of enteritis have been observed in intestinal tracts of necropsied birds<sup>1</sup>. Clostridia organisms are reported to be isolated from the liver, spleen, intestine and muscles samples of necropsied turkey birds<sup>1,9</sup>.

## Risk Factors

Risk factors of this disease can be divided into animal, management and environment factors.

**Animal Factor:** Clostridial dermatitis is not a problem in young birds rather it affects late finisher birds. The severity of diseases is found to be more during 17 to 20 weeks age group. Mortality rate is also reported to be higher at marketing age group of birds. So disease susceptibility increases in older age group of birds. Additionally, healthy and well grown birds are likely to be more prone to CD<sup>1,2</sup>. Birds with compromised immunity because of infectious bursal disease, chicken anaemia virus, aflatoxicosis and poor nutrition status are also reported to be more susceptible to CD. Intestinal infections like enteritis due to coccidiosis are enlisted as a causative factor of outbreak of CD in Turkey flocks<sup>16</sup>. Therefore age group of birds, immunity status of birds and enteric infections are the important animal factors for occurrence of CD in Turkeys.

**Management Factor:** Poor farm management, insanitary farm practices and environmental factors may also predispose flocks to Clostridial dermatitis<sup>5,28-30</sup>. USDA<sup>1</sup> report conforms higher disease (CD) prevalence rate in those Turkey farms which compost litter or litter along with dead birds within 200 feet of poultry barns. Because litter composted from affected birds are likely to have more clostridium load. Moreover, dead birds composting along with litter also increases *C. septicum* spores. These spores could be mechanically carried to the poultry barns by workers of farm, dogs, rodents and insects. Airborne transmissions of clostridia spores also confirmed by various authors<sup>31-34</sup>.

Unhygienic practice like allowing the farm workers to enter the farm premises without scrubbing the footwear or without taking foot bath or disinfectant treatment also predisposes the farm to

disease outbreak. This may be reasoned by chance of introduction of disease (spores of *C. septicum*) from other locations or infected farms. However, reports also articulate that the farms which use some alternative methods like use of dry or liquid foot baths are at higher risk than farms that practise the foot scrubbing technique<sup>1,6</sup>.

Some more management practices like frequency of mortality removal, use of a cull pen, barn cleanout practices, litter tilling and dead bird disposal by composting are believed to have impact on disease occurrences but still need more statistical backing.

Environmental factors like seasonal variation, soil pH, moisture, wind flow and poor ventilation also play a crucial role in disease eruption at Turkey farms. Case incidence of clostridial dermatitis has been reported to be increased during summer and fall than spring or winter<sup>1</sup>. Higher soil pH i.e.,  $\geq 6$  is reported to be favourable for growth and toxin production by clostridia organisms. So the farms having higher soil pH are likely to be predisposed to dermatitis infection. Similarly higher moisture percentage in litter i.e., more than 60% predisposes Turkey flocks to CD. Moreover, high humidity in environment also reported to rise ill health bird population among Turkey flocks<sup>35</sup>. It may be suggested that increase in humidity may be responsible for higher moisture content of litter that ultimately affects CD incidence rate among Turkey farms. Additionally, airborne transmission of clostridia spores cannot be neglected and needs further research to determine the distance spores can travel.

## Prevention Control

Clostridia organisms are ubiquitous in environment. These organisms are also common inhabitants of intestine of Turkey birds. Therefore, controlling the clostridial dermatitis is not an easy task, particularly during their growth period<sup>1</sup>. Control strategy for clostridial dermatitis revolves around two factors i.e., reducing organism load in birds as well as environment and augmenting immunity in birds against clostridium spp.

Unluckily, no long term preventive measures programmes have been successful in preventing the disease recurrence in Turkey farms<sup>6</sup>. Still various management practices were reported to have beneficial effects but may not be suitable for all the farms. Spreading awareness of seriousness of the disease and economic loss it carries along with it is an important aspect of this. This will lead to prompt reporting of disease outbreak among farms. Farms should also be advised not to compost the litter or dead birds near the farm premises (<200 feet from barn). Farm must implicate sanitary practices like scrubbing footwear before entering to farm, remove the dead birds (may be for 2-3 times a day during outbreak), treating the litter of affected barn with litter acidifier or alkaliniser, spot on treatment of affected barn with disinfectant, etc. Efforts should be made to check the spilling

of water onto litter that increases the moisture of litter and effective ventilation facility in the barns.

Several reports also suggest providing acidified water or direct-fed microbial to birds may help to control or prevent CD by providing unfavourable condition for growth of clostridia organism in intestinal tract of Turkeys. Similar results were also recorded by addition of ionophore compounds in feed of birds and reason is needs further research<sup>1</sup>.

## Some new Advancements

Clostridial dermatitis is a relatively new problem in Turkey industry. Few scientific advancements have been achieved in prevention and control of this disease. Various essential researches are still ongoing at several laboratories in different parts of world. Not the less some important findings of these efforts were claimed to be useful for reducing economic loss of Turkey farmers.

*Clostridium septicum* (in particular) and *Clostridium perfringens* are deemed as the causal agents of cellulitis in turkeys. Therefore a bivalent toxoid was developed by taking both *C. septicum* and *C. perfringens* was found safe and effective in producing protective antibodies<sup>36</sup>. Same author also tried *C. septicum* bacterin-toxoid alone in turkey birds and reported safe and effective in eliciting antibodies against toxoid<sup>24</sup>. The authors also used this toxoid in commercial turkey farms and reported to achieve control over clostridial dermatitis via antibiotic treatments.

The cost of production *C. septicum* bacterin toxoid is high. Therefore a recombinant vaccine also developed by scientist which has low cost of production as well as have similar efficacy in combating clostridial dermatitis among birds. It is a recombinant noncytolytic *C. septicum* alpha toxin (NCAT) peptide and is safe at concentration as high as 1mg/ml<sup>37</sup>. As previously described alpha toxin produced by *C. septicum* has cytotoxic activity and immunogenic nature, so easily become a vaccine candidate. Authors confided that 78% to 95% of the vaccinated birds surviving challenge compared to 48% of alum-injected controls for various purified forms of NCAT.

Another new advancement includes supplementation of yeast with feed to combat CD in turkeys<sup>38</sup>. This study reported that inclusion of yeast was found to decrease the incidence of CD during 12–16 weeks of birds. They have reasoned it by proposing that yeast may have helped in improving the integrity of intestinal barrier and thereby prevented the dissemination of clostridial infection. This means it prevented CD infection by interfering with “inside out” theory of disease development. They also believed that stress has a role to play in harmful effect on integrity and permeability of skin<sup>38,39,40,41</sup>. However, they suggested that as yeast products can also protect the skin by increasing cutaneous hypersensitivity response<sup>42</sup> by hastening the skin wound healing process<sup>43</sup> and improving the innate

immunity response of keratinocytes<sup>44</sup>. So according to authors, yeast supplementation may provide protection to birds from CD by interfering both “inside out” and “outside in” theory of disease pathogenesis<sup>38</sup>. There experimentation also warned about potential hazardous effect of high vitamin D supplementation on disease severity.

## Conclusion

*Clostridium septicum* has been identified as the major causative agent of CD in Turkey birds. Birds manage mental practices and environmental risk factors predisposes the birds to CD. Prevention and control of CD in Turkey birds can be achieved by reducing bacterial load in birds and augmenting immunity in them. Bacterial load can be reduced by mangemental means like composting dead birds far away (>200feet) from barn, applying sanitary practices like scrubbing of feet before entry into farm, improving ventilation facility, picking up the dead birds 3-5 times a day, check the spillage of water on to litter, acidifying water, provide ionophore compounds, etc. Immunity can be augmented by use of (newly published) bivalent (*C. septicum* and *C. perfringens*) bacterin-toxoid or by single *C. septicum*bactein-toxoid or recombinant noncytolyticalphatoxin peptide vaccine. Beside these research progress in identification of etiology, disease development and prevention methods of closridial dermatitis, it is expected that ongoing researches will surely going to provide us some valuable tools in near future to combat *Clostridium* dermatitis in Turkey birds.

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