Original Research Article

Bacterial pathogens associated with cellulitis in chickens

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ABSTRACT

Cellulitis is a serious problem for the poultry industry because of increased condemnations, carcass downgrading at processing, and higher labor costs to process affected flocks. In the present study, the prevalence of cellulitis was studied in 240 broiler chickens. The correlation between cellulitis and other systemic lesions of the same bird was investigated also. Moreover, identification of the causative bacterial agents was conducted focusing on \textit{E. coli} and \textit{Salmonella} isolates. The prevalence rate of cellulitis in examined broiler chickens was 38.3%. Cellulitis without systemic lesion was observed in 14.2% of birds while 24.2% of birds had cellulitis associated with other systemic lesions in the internal organs while hepatitis was the most frequent. The bacteriological examination revealed that of 253 samples collected, a total of 157 bacterial isolates were recovered (62.1%). Among the recovered isolates, \textit{E. coli} was the most prevalent (126 isolates; 80.3%) as well as 4 \textit{Salmonella} species (2.5%), 9 \textit{Proteus} species (5.7%), 7 \textit{Pseudomonas aeruginosa} (4.5%), 3 \textit{Enterobacter} species (1.9%) and 8 \textit{Staphylococcus aureus} (5.1%). Serogrouping of \textit{E. coli} isolates revealed that O\textsubscript{125} was the most prevalent; 32%, followed by serogroups O\textsubscript{55}, O\textsubscript{58} as 24%, 12%, 10%, respectively, then both O\textsubscript{1} and O\textsubscript{8} 6% for each, and finally O\textsubscript{15}; 4%. Antibiogram of \textit{E. coli} isolates showed a high sensitivity against enrofloxacin only (81%) while they were moderately sensitive to apramycin (65.9%) and colistin sulphate (61.9%) as well as ciprofloxacin and cefotaxime sodium (56.3% and 55.6%, respectively). On the other hand, high moderate degrees of resistances were observed against the other antimicrobials. \textit{Salmonella} isolates showed complete sensitivities to ciprofloxacin and enrofloxacin while they were completely resistant to most of antimicrobials.

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Introduction

Avian cellulitis is a serious problem for the commercial broiler industry because of increased condemnations, carcass downgrading at processing, and higher labor costs to process affected flocks. Between 1986 and 1996, condemnations for coliform cellulitis increased almost 12-fold in Canada. In 1996, more than 2.6 million broilers were condemned for the disease, which represented 0.568% of all birds processed and approximately 30% of total condemnations (Kumor et al., 1998). Estimated annual losses to the U.S. broiler industry due to cellulitis have increased from $20 million in 1991 to more than $80 million in 1998 (Singer et al., 1999). Condensation rates due to cellulitis increased; especially coliform cellulitis, during the past 15 years (Umar et al., 2015) till cellulitis becomes now one of the major causes of condemnation in broiler chickens in slaughterhouses all around the world, which makes it a source of major financial losses (Fard et al., 2007).

Cellulitis; also known as necrotic dermatitis, was firstly reported by Randall et al. (1984) in England. Cellulitis refers to inflammation of the subcutaneous tissue and is typically seen adjacent to the lower abdomen and thigh of broiler chickens (Barnes and Gross, 1997). The affected animals usually do not show any clinical signs, and the lesions are sometimes only detected at the slaughter plant (Gomis et al., 2001). The animals are infected through skin lesions (Elfadil et al., 1996b), but symptoms are probably only seen if a minimum infection pressure of avian pathogenic E. coli (APEC) and possibly also other predisposing factors are present in the house (Onderka et al., 1997). Cellulitis was referred as a consequence of overpopulation and poor house hygiene rather than a specific disease (Glünder, 1990).

E. coli has been reported as the predominant microorganism isolated from cellulitis lesions in previous studies (Randall et al., 1984, Eterradossi et al., 1989 and Messier et al., 1993). Other agents such as Pasteurella multocida, Pseudomonas aeruginosa, Proteus vulgaris, Enterobacter agglomerans, Staphylococcus aureus, Streptococcus dysgalactiae, Aeromonas, Citrobacter ferundi and Aerobacter have been isolated but are not believed to be significant (Glünder, 1990; Messier et al., 1993; Norton, 1998; Singer et al., 2000 and Fard et al., 2007). Moreover, Actinomyces pyogenes (Derakhshanfar and Ghanbarpour, 2002) and Erysipelothrix rhusiopathiae (Derakhshanfar et al., 2004) have been considered as a causative agent of avian cellulitis, with public health hazards. The more recent field situation in broilers is specifically associated with anaerobes such as Clostridium species. C. colinum C. septicum, C. perfringens and C. sordelli can cause cellulitis (Fard et al., 2007 and Umar et al., 2015).

E. coli is the principal infectious agent and it is considered the cause of coliform cellulitis in chickens (Saif et al., 2003). E. coli of many different serogroups may be isolated from cases of cellulitis, but serogroups O78, O1, and O2 were the most predominated isolates (Glünder, 1990; Allan et al., 1993; Messier et al., 1993; Peighambari et al., 1995b; Gomis et al., 1997 and Fard et al., 2007), which are serogroups typically associated with pathogenicity in poultry. Large groups of non-serotyped E. coli isolates, which collectively outnumber those which can be serotyped, have also been isolated from cellulitis lesions (Macklin et al., 1999).

Although antimicrobials are valuable tools to treat clinical disease and to maintain healthy and productive birds, antimicrobial drug use in livestock production has been implicated as a risk factor in the development and dissemination of drug resistance from livestock production farms (Gosh and LaPara, 2007). Food animals and their production environments are reservoirs of both resistant bacteria and resistance genes that could be transferred to humans either by direct contact between animals and humans or indirectly via the food production chain (WHO, 2011); or as a result of
the spread of animal waste on land (Heuer and Smalla, 2007). Therefore, the appropriate antibiotic should better be selected on the basis of its sensitivity which could be detected by laboratory examination.

The present study aimed to investigate the prevalence of cellulitis in chickens with detection of the causative bacterial pathogens.

**Material and Methods**

2.1. Chickens. A total of 240 broiler chickens of different ages (3-5 weeks) from different farms in Beni-Suef and El-Fayoum Governorates were subjected to the present study during the period from January 2014 up to December 2014. These chickens were subjected to clinical and postmortem examinations to detect cellulitis.

2.2. Samples. Samples were collected from 92 broiler chickens suffered from cellulitis with or without septicaemia signs. A total of 253 samples were collected from the affected tissues. Samples from the muscles of the lower abdomen and thigh; in case of cellulitis, as well as the other internal lesions; airsacculitis, pericarditis and hepatitis, were collected. Heart blood samples were collected from all cases either cellulitis associated with septicaemic lesions or not.

2.3. Bacteriological examination. The collected samples were cultivated under aseptic condition into Tryptone Soya broth and MacConkey broth then inoculated aerobically at 37°C for 24 hrs. Then loopfulls from the inoculated broth were streaked onto Tryptone Soya agar (TSA) and MacConkey's agar then, incubated aerobically at 37°C for 24-72hr. All the recovered isolates were identified morphologically and biochemically according to schemes described by Kreig and Holt (1984), Collee et al. (1996) and Quinn et al. (2002).

2.4. Serological identification. Randomly selected 50 E. coli isolates as well as 4 Salmonella isolates that were preliminarily identified morphologically and biochemically were subjected to serological identification.

2.4.1. Serogrouping of E. coli isolates. E. coli serogroups were identified serologically by slide agglutination test using standard polyvalent and monovalent E. coli antisera according to Quinn et al. (2002).

2.4.2. Serotyping of Salmonella. Four Salmonella isolates; 2 from muscles and 2 from heart blood of two birds, were identified serologically by slide agglutination test using diagnostic polyvalent and monovalent O and H Salmonella antisera according to Kauffman-white scheme (Kauffmann, 1974).

2.5. Antibiotic susceptibility testing. All E. coli (126 isolates) and Salmonellae (4 isolates) recovered from cellulitis chickens were tested for their antimicrobial susceptibility to 14 different antimicrobial discs including; apramycin (15µg), ciprofloxacin (15µg), cefotaxime sodium (30µg), colistin sulphate (10µg), sulphamethoxazol-trimethoprim (1.25+23.75µg), doxycycline HCl (30µg), enrofloxacin (5µg), lincomycin (10µg), spectinomycin (100µg), fosfomycin (300µg), gentamycin (10µg), florophenicol (30µg), streptomycin (10µg) and spiramycin (100µg) (Oxoid, Basing Stoke, UK). Antimicrobial susceptibility testing was performed using disc diffusion method on Muller Hinton agar according to CLSI (2012). The antibiotic susceptibility was based on the induced inhibition zones according to the guidelines of the CLSI (2012).

Resistance to more than four antibiotics was taken as multidrug resistance (MDR). MDR index (MDRI) of individual isolates was calculated by dividing the number of antibiotics to which the isolate was resistant by the total number of antibiotics to which the isolate was exposed (Chandran et al., 2008). Isolates with MDRI values of more than 0.2 or 20% were considered highly resistant.

\[
\text{MDR index} = \frac{\text{Number of antibiotics resisted} \times 100}{\text{Total number of antibiotics used}}
\]

**Results**

3.1. Prevalence of cellulitis in the examined broiler chickens. Out of 240 broiler chicken, 92 birds (38.3%) showed cellulitis (inflammation...
of the muscles of the lower abdomen and thigh) in PM examination (Table 1). Of them, 34 birds (14.2%) had cellulitis only while 58 birds (24.2%) had cellulitis associated with septicaemic lesions in the internal organs (at least one organ was affected). The affected organs included liver (n=51), air sacs (n=11) and pericardium (n=7). On the other hand, 148 (61.7%) had no cellulitis symptoms.

### Table (1): Prevalence of cellulitis in the examined broiler chickens.

<table>
<thead>
<tr>
<th>No. of birds</th>
<th>Cellulitis only</th>
<th>Positive Cellulitis</th>
<th>Total</th>
<th>Negative Cellulitis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>240</td>
<td>34</td>
<td>58</td>
<td>24.2</td>
</tr>
</tbody>
</table>

%: was calculated according to the number (No.) of birds.

### 3.2. Bacteriological examination.

Out of 253 samples collected from different lesions of broiler chickens with cellulitis; with and without septicaemia, a total of 157 bacterial isolates were recovered with a rate of 62.1%. Bacterial isolation was distributed as follows; 73 bacterial isolates (79.3%) from muscle samples, 30 (32.6%) from heart blood samples, 41 (80.4%) from liver samples, 7 (63.6%) from air sacs and 6 (85.7%) from pericardium (Table 2).

### Table (2): Results of bacteriological examination of different samples collected from broiler chickens with cellulitis/septicaemic lesions.

<table>
<thead>
<tr>
<th>Samples (lesion)</th>
<th>No. of samples</th>
<th>Bacterial isolation No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulitis</td>
<td>92</td>
<td>73</td>
<td>79.3</td>
</tr>
<tr>
<td>Heart blood</td>
<td>92</td>
<td>30</td>
<td>32.6</td>
</tr>
<tr>
<td>Hepatitis</td>
<td>51</td>
<td>41</td>
<td>80.4</td>
</tr>
<tr>
<td>Airsacculitis</td>
<td>11</td>
<td>7</td>
<td>63.6</td>
</tr>
<tr>
<td>Pericarditis</td>
<td>7</td>
<td>6</td>
<td>85.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>253</strong></td>
<td><strong>157</strong></td>
<td><strong>62.1</strong></td>
</tr>
</tbody>
</table>

%: was calculated according to the number (No.) of the samples.

### 3.3. Prevalences of different bacterial pathogens recovered from cellulitis/septicaemic lesions in broiler chickens.

The recovered bacterial isolates (157) were identified as follow; 126 *E. coli* isolates with a prevalence rate of 80.3%, 4 *Salmonella* species (2.5%), 9 *Proteus* species (5.7%), 7 *Pseudomonas aeruginosa* (4.5%), 3 *Enterobacter* species (1.9%) and 8 *Staphylococcus aureus* (5.1%) (Table 3). Concerning muscles’ bacterial isolates (n=73), 59 isolates (80.8%) were *E. coli*; of which 55 (93.2%) were single and 4 (6.8%) were mixed with other bacteria (2 isolates were mixed with *S. aureus*, one isolate was mixed with *Proteus* and another isolate was mixed with *Enterobacter*). Moreover, 2 *Salmonella* (2.7%), 3 *Proteus* species (4.1%), 3 *P. aeruginosa* (4.1%), 2 *Enterobacter* species (2.7%) and 4 *S. aureus* (5.5%) were identified. Out of 30 bacterial isolates recovered from heart blood, 24 (80%) were *E. coli*, 2 *Salmonella* (6.7%), 2 *Proteus* species (6.7%), one isolate (1.33%) for both *Enterobacter* species and *S. aureus*. Concerning the liver isolates (n=41), they were represented as 34 *E. coli* (82.9%), 2 *Proteus* species (4.9%), 2 *P. aeruginosa* (4.9%) and 3 *S. aureus* (7.3%). Belonging the air sac (n=7) and pericardium (n=6) isolates, *E. coli* represented 5 (71.4%) and 4 (66.7), respectively while *Proteus* species represented one isolate for both with prevalence rate of 14.3% and 16.7%, respectively. Also, one isolate of *P. aeruginosa* was recovered from both sites with a rate of 14.3% and 16.7%, respectively.
lincomycin, spectinomycin, florphenicol, streptomycin and spiramycin. MDR was detected among All Salmonella isolates (MDRI= 100%) which observed as resistance for four or more antimicrobials of different categories.

**Discussion**

Avian cellulitis, sometimes referred to as Inflammatory Process (IP), is a serious problem for the commercial broiler industry. It is a diffuse spreading, edematous, infective inflammation of the deep subcutaneous tissues, occasionally extending into the muscle, which is characterized by sheets of caseated and fibrinoheterophilic exudates in subcutaneous tissues located in the skin between the thigh and midline (Peighambari et al., 1995b; Ghanbarpour et al., 2003 and Saif et al., 2003). The condition occurs primarily in broilers and less in turkeys (Ghanbarpour et al., 2003). Cellulitis is caused by damages to the skin in 2-3 week-old chickens, by introduction of bacteria and yielding plaque-like lesions under the skin. The mortality in mild and sporadic cases, without septicemia is very low (Elfadil et al., 1996a and Ghanbarpour et al., 2003). It is difficult to detect birds with cellulitis in the live flock, because the lesions are not readily apparent, as the affected sites of the skin are covered with feathers and the infected birds show no clinical signs of disease (Gomis et al., 1997).

There are some different related factors such as farm management, breed and sex, chick quality, heat stress, nervousness of flocks, environmental and temperature conditions, density, lighting programs, wet and unsuitable litters, ventilation, nutritional entities, calorie/protein ratio, feed additives, amino acids and vitamin deficiency could be associated with an increase in skin scratches that could lead to cellulitis (Elfadil et al., 1996a). The severity of the disease is related to genetic status and immunosuppressive diseases (Peighambari et al., 2003).
Other observations have suggested that any insult to the integrity of the skin, regardless of when it occurs, should be considered a significant route of cellulitis pathogenesis (Peighambari et al., 1995b and Norton et al., 1999).

Condemnation rates due to cellulitis increased; especially coliform cellulitis, during the past 15 years (Umar et al., 2015) till cellulitis becomes now one of the major causes of condemnation in broiler chickens in slaughterhouses all around the world, which makes it a source of major financial losses (Fard et al., 2007). The increased incidence of cellulitis over the past several years is probably related to various factors. Considering different results, it seems decreasing the age of slaughtering, upgrading immunity status and improvement the welfare and management policies of broiler flocks lead to less carcass condemnations (Fard et al., 2007).

Many bacterial agents; either Gram positive or Gram negative, were isolated from cellulitis lesions and considered as a cause for cellulitis but still E. coli is the principal infectious agent and it is considered the cause of coliform cellulitis in chickens (Saif et al., 2003).

In the present study, the prevalence of cellulitis was studied in 240 broiler chickens. The correlation between cellulitis and other systemic lesions of the same bird was studied also. Moreover, identification of the causative bacterial agents was conducted focusing on E. coli and Salmonella isolates.

The data illustrated in table (1) revealed that the prevalence rate of cellulitis in examined broiler chickens was 38.3%. Cellulitis without systemic lesion was observed in 14.2% of birds while 24.2% of birds had cellulitis associated with other systemic lesions in the internal organs (at least one organ). The affected organs included liver (n=51), air sacs (n=11) and pericardium (n=7). These results were nearly similar to that obtained by Gomis et al. (1997) and Gomis et al. (2001) who remarked that prevalence rate of cellulitis with other systemic manifestations in broilers were 30.5% and 34.6%, respectively. This observation was also in agreement with that previously described (Eterradossi et al., 1989) and Morris (1991) and suggested that the occurrence of cellulitis and other diseases especially caused by E. coli may be related. The relationship between cellulitis and other lesions; especially colibacillosis lesions, of the different organs in broilers appears to be complex and varies from flock to flock. The present results suggested that common predisposing factors may exist for both types of disease. The occurrence of multiple lesions may be underestimated, because other types of lesions in conjunction with cellulitis may not be detected at the time of inspection, as birds condemned for cellulitis are not examined further.

Usually, an affected bird has only skin lesions, but concurrent lesions of systemic colibacillosis occasionally can be found, suggesting that cellulitis may result from systemic spread or, conversely, that localized lesions in the skin can be a source for systemic disease (Saif et al., 2003). Other previous findings have proved that the bacteria entering through the skin sometimes find their way into the blood circulation and caused septicaemia (Peighambari et al., 1995a). The latter is inversely correlated with age (i.e., the younger the bird, the more likely it is to develop systemic disease) (Johnson et al., 2001).

From other point of view, the present results showed that hepatitis was the most frequently associated with cellulitis while airsacculitis and pericarditis were less frequent. These findings were opposed to those of Gomis et al. (1997) and Gomis et al. (2001) who found that airsacculitis and pericarditis were more frequent than hepatitis.

The previously obtained and discussed results in table (1) were reinforced by the data illustrated in table (2) which studied the bacteriological examination of samples collected from different lesions of broiler chickens with cellulitis either associated with septicaemic lesions or not. Samples were collected from the muscles of the lower abdomen and thigh; in case of cellulitis, as well as the other internal lesions; airsacculitis, pericarditis and hepatitis. Heart blood samples were collected from all cases either cellulitis associated with septicaemic lesions or not. The results revealed that out of 253 samples collected, a total of 157 bacterial isolates were recovered; with a rate of 62.1%. The isolates were distributed in samples from 92 muscle, 92 heart blood, 51 liver, 11 air sacs and 7 pericardium as follow; 73 isolates (79.3%), 30 isolates (32.6%), 41 isolates (81.4%), 7 isolates (63.6%) and 6 isolates (85.7%), respectively. The reasons for the negative isolation of bacteria from birds with gross lesions are not known, but it is
possible that birds were able to clear the infection completely, while fibrin deposits of inflammation remain (Gomis et al., 2001).

Detailed data of the previous results were illustrated in Table 3 which showed the results of identification and the prevalences of different bacterial pathogens recovered from broiler chickens with cellulitis. Among the recovered isolates (n=157), E. coli was the most prevalent as 126 isolates were identified with a prevalence rate of 80.3%. This result coincided with the previous studies reported E. coli has been as the predominant microorganism isolated from cellulitis lesions (Randall et al., 1984; Eterradossi et al., 1989; Messier et al., 1993; Derakhshanfar and Ghanbarpour, 2002; Saif et al., 2003; Abd El-Latif, 2004 and Fard et al., 2007). Most of cellulitis cases resulting from an infection by E. coli associated with litter (Schrader et al., 2004). Mannan Oligosaccharides, and to a less extent lignin, can be used to reduce E. coli proliferation in poultry litter and this would offer an opportunity for dietary control of the cellulitis problem (Baurhoo et al., 2007). Moreover, other bacteria have been identified including 9 Proteus species (5.7%), 7 P. aeruginosa (4.5%), 3 Enterobacter species (1.9%) and 8 S. aureus (5.1%). These results run were similar to other authors who recovered the same agents (Glünder, 1990; Messier et al., 1993; Norton, 1998; Singer et al., 2000 and Fard et al., 2007). Additionally, in the current study there was an unprecedented result where 4 Salmonella species (2.5%) were recovered from cellulitis lesions and that is considered; as we believe, the first record for Salmonella as a cause of cellulitis.

Belonging the bacterial isolates from muscles, E. coli was the most frequent representing 59 isolates (80.8%); of them 55 (93.2%) were single and 4 (6.8%) were mixed with other bacteria (2 isolates were mixed with S. aureus, one isolate was mixed with Proteus and another isolate was mixed with Enterobacter). These results were coincided with those of Derakhshanfar and Ghanbarpour (2002) who reported that 91.1% of E. coli isolates were the single isolate recovered while the remainders were mixed with S. aureus and other bacteria. Their study confirmed the frequent association of E. coli with cellulitis lesions in broiler chickens, along with isolation of S. aureus. Moreover, in the present study, 2 Salmonella (2.7%), 3 Proteus species (4.1%), 3 P. aeruginosa (4.1%), 2 Enterobacter species (2.7%) and 4 S. aureus (5.5%) have been identified.

Moreover, out 30 bacterial isolates recovered from heart blood, E. coli was the most prevalent; 24 isolates (80%), followed by both Salmonella and Proteus species; 2 isolates (6.7%) for both, then both of Enterobacter species and S. aureus; one isolate (1.3%) for both. On the other hand the liver isolates (n=41) were represented as 34 E. coli (82.9%), 2 Proteus species (4.9%), 2 P. aeruginosa (4.9%) and 3 S. aureus (7.3%). Belonging the air sac (n=7) and pericardium (n=6) isolates, E. coli represented 5 isolates (71.4%) and 4 isolates (66.7), respectively while Proteus species represented one isolate for both with prevalence rate of 14.3% and 16.7%, respectively. Also, one isolate of P. aeruginosa was recovered from both sites with a rate of 14.3% and 16.7%, respectively.

Serogrouping of E. coli isolates was conducted on randomly selected 50 isolates representing the entire affected organs. Results of serogrouping of E. coli isolates showed that 7 O-serogroups were obtained. Serogroups O125 was the most prevalent represented 16 isolates (32%) followed by serogroups O158, O55, O78 as 12 (24%), 6 (12%), 5 (10%), respectively, then both O1 and O8; 3 (6%) for each, and finally O152; 2 (4%). Moreover, there were 3 isolates (6%) were untyped with the available antisera. Although only 40% of the isolates were serogrouped, the distribution of O antigens was nearly similar to that reported in previous studies (Valvano et al., 1992; Messier et al., 1993; Gomis et al., 2001 and Schouler et al., 2012) who recovered nearly the same serogroups; beside other serogroups, from cellulitis lesions. On the contrary they differed from those obtained by Tana et al. (2013) how recovered 8 different serogroups E. coli including O2, O8, O15, O73, O86, O102, O115 and O139, and Wang et al. (2010) who recovered 8 serogroups; O65, O78, O8, O120, O2, O22, O108 and O26. On the other hand, Serogroups O125 was the most prevalent followed by serogroups O158, O55. These results were completely different from several authors who reported that O78, O2 and O1 were the main serotypes in different disease types; cellulitis, septicaemia, and airsacculitis, (Cloud et al., 1985; Glünder, 1990; Allan et al., 1993; Dozois et al., 1992; Peighambari et al., 1995b; Gomis et al., 1997; Fard et al., 2007; Abd El-Hamid and Hebib, 2008). Others reported that O78 was the most frequently isolated (Messier et al., 1993; Derakhshanfar and Ghanbarpour,
2002; Zhao et al., 2005 and Ammar et al., 2011). Additionally, Ngeleka et al. (1996) found that O_{35} and O_{8} were the most frequently observed while Wang et al. (2010) and Tana et al. (2013) found that O_{35} and O_{8} were the most prevalent serogroups, respectively. Moreover, Onderka et al. (1997) isolated 85 E. coli strains from cases of cellulitis, which belonged to 19 different O-types. Nevertheless, there is frequently also a great diversity of O-types in the isolates.

Serotyping of Salmonella isolates recovered from cellulitis in broiler chickens was also applied on 4 isolates from 2 birds; 2 from cellulitis lesions and 2 from heart blood of the same birds. These 4 isolates were preliminarily identified morphologically and biochemically as Salmonella and subjected to serological identification to detect their serotypes. The results of serotyping revealed that, all the isolates were serotyped as Salmonella Kossen. This result; as we believe, was an unprecedented and was considered the first record for Salmonella as a cause of cellulitis.

Antimicrobial therapy is one of the primary control for reducing both the incidence and mortality associated with avian colibacillosis therefore reducing their enormous losses in the poultry industry (Blanco et al., 1997). However, resistance to existing antimicrobials is widespread and of concern to poultry veterinarians (Allan et al., 1993 and Peighambari et al., 1995b). In vitro antimicrobial susceptibility testing of veterinary pathogens can provide valuable guidance to the veterinarian in the choice of appropriate chemotherapy (Blanco et al., 1997). Moreover, it is very useful to detect the multidrug resistant isolates.

In the present work, all the recovered E. coli (n=126) and Salmonella (n=4) isolates were subjected to in-vitro antibiotic sensitivity tests against 14 different antimicrobial drugs to detect the drug of choice for treatment as well as to detect MDR isolates for further analyses of the isolates. The results of antibiotic of E. coli isolates showed that a high sensitivity was observed against enrofloxacin only (81%) while they were moderately sensitive to apramycin (65.9%) and colistinsulphate (61.9%) as well as ciprofloxacin and cefotaxime sodium (56.3% and 55.6%, respectively). On the other hand, high resistances were observed against lincomycin (87.3%), streptomycin (78.6%), spiramycin (75.4%) and trimethoprim-sulphamethoxazol (73%) while moderate resistances against fosfomycin, spectinomycin and florophenicol were also recorded; 58.7%, 54.8% and 54%, respectively. These results agreed with several previous reports (Allan et al., 1993; Peighambari et al., 1995b; Negeleka et al., 1996; Blanco et al., 1997; Gomis et al., 2001; Fard et al., 2007; Hammoudi and Agaad, 2008 and Radwan et al., 2014) which have indicated increasing incidences of antibiotic-resistant E. coli strains isolated from chickens with cellulitis and other lesions to several of the antibiotics frequently used in the poultry industry. Also, Sharadaet al. (2001) found that no single antimicrobial drug was effective by 100% against E. coli isolates, which might be due to development of resistance due to indiscriminate use of antibiotics. Moreover, in the present study, multidrug resistance (MDR) was detected among 116 E. coli isolates (MDR index was equal to 92.1%) which observed a resistance to 4 or more antimicrobials of different categories. This result was similar to that of Radwan et al. (2014) who reported that MDRI was 90.4% for E. coli isolates. Moreover, about half (54.6%) exhibited resistance to four or more antibiotics, as observed in previous work of Yang et al. (2004); Zhao et al., (2005) and Ozawa et al., (2008). Moreover, Blanco et al. (1997); Chen and Wang (1997) and Hammoudi and Agaad (2008) found high levels of resistance to antibacterial drugs in pathogenic strains of E. coli isolated from chickens ensuring that multiple drug resistance was common.

On the other hand, the results of antibiogram of Salmonella isolates showed complete sensitivities to ciprofloxacin and enrofloxacin. On the other hand, they were completely resistant to colistinsulphate, trimethoprim-sulphamethoxazol, lincomycin, spectinomycin, florophenicol, streptomycin and spiramycin. These results coincided with those reported by Yoshida et al. (1993); Yah and Eghafona (2007); Khan et al. (2010) and Fallah et al. (2013) who reported the high resistance of Salmonella isolates chicken against most of these antimicrobials. Moreover, in the present study, multidrug resistance (MDR) was detected among All Salmonella isolates (MDR index was equal to 100%) which observed a resistance to 4 or more antimicrobials of different categories. Yah and Eghafona (2007) and Fallah et al. (2013) reported lower values of MDRI for Salmonella recovered from chickens; 42.6% and 34.1%, respectively. Antimicrobial-resistant Salmonella is a public
health concern since resistance in *Salmonella* limits the therapeutic options available to veterinarians and physicians in the treatment of human salmonellosis (Witte, 1998).

Our field observations indicated that the abusive and anarchic use of antibiotics is probably the cause of the high percentages of resistance detected and these finding agreed with those report by Blanco et al., (1997) who attributed the development of drug resistance to frequent usage of drugs in veterinary practices at sub-optimal concentrations. Since the use of these antimicrobial agents may cause cross-resistance with human enteric pathogens, prudent use of them in veterinary medicine is highly recommended.

Concerning selection of the drug of choice for treatment either in both of *E. coli* and *Salmonella*, the obtained results revealed that fluoroquinolones were recommended. These results supported by what recorded by García-Rodríguez et al. (1995) and Raemdonck et al. (1992) who reported that fluoroquinolones were class of antimicrobials that exhibit excellent activity against Gram negative bacilli, although their use in poultry may be inappropriate because of cross-resistance with fluoroquinolones used for treatment of important human enteric infections (García-Rodríguez et al., 1995 and Piddock et al., 1990).

**Conclusion**

Avian cellulitis is a serious problem for the commercial broiler industry causing great economic losses. The prevalence rate of cellulitis in examined broiler chickens was 38.3%. Cellulitis may be associated with other systemic lesions in the internal organs. *E. coli* is the most prevalent bacterial agent causing cellulitis.

**References**


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