Full Length Research Paper

Investigation of Some Species of *Salmonella* in Table Eggs sold at Different Markets in Jos South, Plateau State, Nigeria

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This study was carried out in order to investigate the incidence of *Salmonella* species in table eggs sold at different markets in Jos south, Plateau state, Nigeria. A total of 160 eggs were randomly sampled from four different markets. External shell swab samples of the eggs were processed and examined following standard cultural and biochemical procedures for *Salmonella* isolation. The results revealed that 52 (33.0%) of the samples were infected with *Salmonella gallinarum*, *S. typhimurium*, *S. typhi* and *S. pullorum* having infection of 6.9%, 8.1%, 15.0% and 2.5% respectively. Similarly, overall infection of 42.5%, 32.5%, 20.0% and 35.0% were obtained in Vwang, Zawan, Bukuru and Sabon-Pegi markets respectively. It was also revealed that other enterobacterial organisms were observed in 144 (90.0%) of the samples investigated. This suggests that the table eggs offered for sale in these markets were harbouring *Salmonella* and other microorganisms of public health importance. It is therefore recommended that wholesome eggs are made available to consumers.

Keywords: Eggs, enterobacterial organisms, incidence, Nigeria, *Salmonella* species, shell, swab

INTRODUCTION

The poultry farming in Nigeria has been seen as a lucrative business and has emerged as one of the major sources of the much desired animal protein over the years (Durojaiye and Adene, 2004). Total poultry population in Nigeria has been estimated at about 120 million (Awan, 1993). Out of these figures, only 8.0% are exotic breeds of poultry and over 90% are rural poultry of different species. Poultry meat and egg are the two main products marketed and widely consumed with vast majority of eggs produced for human consumption obtained from chickens as “table eggs” (Smith, 2001). David-West (1979) reported that about 90% of poultry meat and 73% of eggs were contributed by various rural poultry species in Nigeria compared to the 28% supply by exotic or commercial poultry.

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In Nigeria, despite these benefits derived from both local and exotic chickens, less attention is given regarding the possible level of contamination of these poultry products by disease causing microorganisms. These poultry products play a major role in the transmission of zoonotic diseases. Mondrell and Watchell (1999) reported that poultry products such as the table eggs are presumed to be major contributors to human food borne diseases due to their high frequency of contamination with microorganisms that are potentially pathogenic to humans. Notably, when Salmonella are ingested they invade intestinal mucosa and produce toxin (Buckner, 2000). The diseases produced by different species of Salmonella are known as “Salmonellosis” which manifest as self-limiting gastroenteritis (Anon, 2002).

Salmonella species have been found to contaminate poultry egg-shells and products containing raw eggs such as salad dressing, cookie dough and hollandaise (Cheng, 2002). Similarly, external contamination of egg-shells can occur with chicken faeces or other matter from the environment (Eva et al., 2000). Rock (2000) reported that external contamination of commercially purchased table eggs has been found to be as high as 9% and it is estimated that internal contamination with Salmonella spp. may occur in 0.01%-0.6% of all poultry egg shells.

Factual statistical figure from United States Egg Safety Action Plan reported a total of 796 outbreaks of Salmonella enteritis involving 28,689 illnesses, 2,839 hospitalization and 79 deaths between 1985 and 1998 (Buckner, 2000). More than 75% of these outbreaks were associated with foods containing eggs. Ishola et al. (1999) observed that common sources of infection with up to 70% of cases attributed to ingestion of meals prepared with contaminated raw eggs.

This study is aimed to investigate the presence of Salmonella organisms on the external shell of chicken table eggs in Jos-South, Plateau state, Nigeria, and enlightening the public on the potential source of Salmonella infection and the need to adopt aseptic measures during both handling and processing of table eggs.

MATERIALS AND METHODS

Study area

Jos South is one of the 17 local Government areas (LGA) of Plateau state, Nigeria. It has a land area of 1, 037 sq km and with a projected population of 311,371 people (NPC, 1991).

Jos South is located at 8° 45' East and 9° 43' North of Plateau state. Due to its altitude measuring over 1450 m above sea level, its climatic condition is cold. Average daily maximum temperature is 83.6°F (28.6°C), while average minimum daily temperature is 62.6°F(17°C). The average rainfall is between 1300mm-1500mm which extends right from March to early October, with July and August being the wettest months. Relative humidity of Jos South at noon varies between 14 and 74%.

Abound in this study area are livestock of various breeds and species which are farmed at both subsistence and commercial levels. Similarly, lots of Agro-based farms such as ECWA farms and feed mills, National Veterinary Research Institute (NVRI), Grand cereals and oil mills are located in the Jos-South LGA.

Data collection

A total of 160 table eggs of chickens were randomly obtained from various sale outlets in the study area. These sale outlets include Vwang, Zawan, Bukuru and Sabon Pegi. Forty table eggs were sampled from each of the outlets, with 5 table eggs from 8 different locations within an outlet. The table eggs were carefully handled in egg trays which were put into a suitable container box and transported to the diagnostic laboratory of NVRI, Vom for analysis.

Sample inoculation, incubation and sub culturing

All materials and media used in this work were provided by the diagnostic department of NVRI, Vom. The process of the inoculation started with dipping a sterile swab stick into a sterile normal saline after the swab stick got properly wetted in the normal saline. It was removed and rolled round the external shell of the table eggs making sure that the swab covers almost the entire surface of the egg shell. The swab stick was then immediately inoculated into a bottle containing Rappaport Vassiliadis (RV), an enrichment growth medium for Salmonella isolates. Excess end of the swab stick was trimmed off with a pair of sterile scissors to allow the cover of the bottle to be properly screwed back. The inoculated bottle was thereafter incubated at 37°C for 24 hours. This was done to enhance multiplication of the Salmonella organisms before sub-culturing for further investigation. This procedure was employed for all the remaining table eggs in an aseptic manner.

Dried sterile Mc-Conkey agar (MCA) plates were used for sub culturing. Sterile MCA plates were dried at 37°C for 30 minutes to remove possible water vapour. Using a sterile wire loop, a loop full of the RV broth culture was withdrawn and inoculated on the dried MCA plates. Streaking was done by flaming the loop at intervals so as to obtain discrete colonies. The whole preparation was incubated aerobically at 37°C for 24 hours (Cheesebrough, 2000).
Identification of *Salmonella* organisms

At the end of incubation, cultured plates were observed to have pure cultures, mixed cultures and scanty growth of various microorganisms. Mixed cultures were then further purified on fresh Mc-Conkey agar (MCA) plates. Colonies showing the characteristic of *Salmonella* species were then Gram-strained and stocked on agar slants pending completion of sampling before characterization of the tests were conducted (Bakar and Breach, 1980).

Characterization test

Characterization test carried out included Gram staining, motility, indole, citrate, urease and hydrogen sulfide (H₂S) production. Similarly, various biochemical sugar fermentation tests were done as described by Cowan and Steel (1974).

Table 1. Characterization of *Salmonella* species

<table>
<thead>
<tr>
<th>Species</th>
<th>Ind</th>
<th>Mot</th>
<th>TSI</th>
<th>Ur</th>
<th>Cit</th>
<th>Glu</th>
<th>Ino</th>
<th>Xy</th>
<th>Suc</th>
<th>Sal</th>
<th>Man</th>
<th>Dul</th>
<th>Mal</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Salmonella</em> typhi</td>
<td>-</td>
<td>+</td>
<td>+G</td>
<td>-</td>
<td>-</td>
<td>+A</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>d</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>S. pollurum</td>
<td>-</td>
<td>-</td>
<td>+G</td>
<td>-</td>
<td>d</td>
<td>+A/G</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>d</td>
</tr>
<tr>
<td><em>S. typhimurium</em></td>
<td>-</td>
<td>+</td>
<td>+H₂S</td>
<td>-</td>
<td>+</td>
<td>+A</td>
<td>d</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><em>S. gallinarum</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>d</td>
<td>+A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>


Table 2. Incidence of *Salmonella* species in table eggs

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of eggs examined</th>
<th>No. of eggs infected</th>
<th>Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. gallinarum</em></td>
<td>160</td>
<td>11</td>
<td>6.9</td>
</tr>
<tr>
<td><em>S. typhimurium</em></td>
<td>160</td>
<td>13</td>
<td>8.1</td>
</tr>
<tr>
<td><em>S. typhi</em></td>
<td>160</td>
<td>24</td>
<td>15.0</td>
</tr>
<tr>
<td><em>S. pollurum</em></td>
<td>160</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52</strong></td>
<td></td>
<td><strong>32.5</strong></td>
</tr>
</tbody>
</table>

Data analysis

The data obtained were subjected to descriptive statistics and percentages as described by Legates and Warwick (1990).

RESULTS

Characterization of *Salmonella* spp. is shown in Table 1. Out of the 160 raw table eggs sampled in this study, *S. typhi* had the highest incidence of 15.0 % (24 pieces of the sampled eggs), while *S. pollurum* recorded the lowest incidence of 2.5% (4 pieces of sampled eggs) (Table 2).

Similarly, data collected was analyzed in relation to location as presented in Table 3.

The result of the table eggs sampled from the four locations showed incidence of 42.5%, 32.5%, 20.0% and
Table 3. Incidence of *Salmonella* organisms in relation to locations

<table>
<thead>
<tr>
<th>Species</th>
<th>Location</th>
<th>Vwang</th>
<th>Zawan</th>
<th>Bukuru</th>
<th>Sabon-Pegi</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S.gallinarum</em></td>
<td>11(6.9)</td>
<td>4(10.0)</td>
<td>2(5.0)</td>
<td>2(5.0)</td>
<td>3(7.5)</td>
<td></td>
</tr>
<tr>
<td><em>S.typhimurium</em></td>
<td>13(8.1)</td>
<td>6(15.0)</td>
<td>2(5.0)</td>
<td>2(5.0)</td>
<td>3(7.5)</td>
<td></td>
</tr>
<tr>
<td><em>S.typhi</em></td>
<td>24(15.0)</td>
<td>7(17.5)</td>
<td>7(17.5)</td>
<td>4(10.0)</td>
<td>6(15.0)</td>
<td></td>
</tr>
<tr>
<td><em>S.pollurum</em></td>
<td>4(2.5)</td>
<td>0(0.0)</td>
<td>2(5.0)</td>
<td>0(0.0)</td>
<td>2(5.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>52 (32.5)</td>
<td>17(42.5)</td>
<td>13(32.5)</td>
<td>8(20.0)</td>
<td>14(35.0)</td>
<td></td>
</tr>
</tbody>
</table>

n=Sample size per location (40)
Figures in parenthesis indicate percentages

Table 4. Other bacterial isolates

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>No. of examined</th>
<th>No. of infected</th>
<th>Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteus</td>
<td>160</td>
<td>28</td>
<td>17.5</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>160</td>
<td>44</td>
<td>27.5</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>160</td>
<td>6</td>
<td>3.8</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>160</td>
<td>34</td>
<td>21.3</td>
</tr>
<tr>
<td>Lactobacillus</td>
<td>160</td>
<td>9</td>
<td>5.6</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>160</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td><em>Staphylococcus</em></td>
<td>160</td>
<td>19</td>
<td>11.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>160</td>
<td>144</td>
<td>90.0</td>
</tr>
</tbody>
</table>

35.0% in Vwang, Zawan, Bukuru and Sabon-Pegi respectively. Other bacteria isolates were also identified in the course of this study as shown in Table 4.

Result of the bacteria isolates revealed *Escherichia coli* with the highest incidence of 27.5% while *Pseudomonas* had the lowest incidence of 2.5%.

**DISCUSSION**

*Salmonella* incidence of 32.5% was obtained in this study. This result tends to agree with the findings of Gordon et al (1996) who reported incidence of 9.0% in Arkansas, United States. The higher incidence observed in this study may perhaps be attributed to differences in location and sample size. Additionally, a higher incidence of *Salmonella* contamination of 35.0% was reported by Ishola et al (1999). Similar observations were made by Humphrey (1994), Nester et al. (1995), Thorns (2000) and Cahill (2002) who described poultry and their products as important reservoirs and vehicles in the transmission of *Salmonella* organisms.

Similarly, the four species of *Salmonella* obtained in this study as contaminants of poultry products confirm a previous observation by Ojo (1998). Of interest is the higher incidence of 15.0% and 8.1% by *S. typhi* and *S. typhimurium*, while lower incidence of *S. gallinarum* and *S. pollurum* were observed. The first two species of *Salmonella* are the causative agents of human typhoid fever. This finding is in consonance with reports by Ojo (1998), Boden (1999) and Ishola et al (1999) who showed that the first two species of *Salmonella* are the main faecal contaminants of poultry products. In addition, Adene (2004) demonstrated that *S. pollurum* is mainly a problem in young chicks and hatchery management. Furthermore, faecal contamination as observed by Mercks (2001) and Hutchison et al (2003) is considered to be the most likely source of *Salmonella* that have been isolated from egg shells.

Based on location, Vwang recorded higher incidence of 42.5% than the other three locations. This is not surprising because Vwang is relatively more rural, therefore poor handling and subsequent contamination of these eggs through poor hygienic practices by attendants could be responsible. This finding is in line with the report of WHO (1993), which indicated that egg contamination by *Salmonella* among other factors could be due to poor
handling and unhygienic practices by poultry attendants especially in rural settings.

The presence of other micro bacterial isolates in this study is not uncommon. Merck (2001) and Hutchison et al (2003) have identified similar micro bacteria isolates which they reported as being associated with egg spoilage and food poisoning.

The findings made in this study confirmed that egg shells of table eggs sold at Wang, Zawan, Bukuru and Sabon-Pegi were contaminated with different species of Salmonella and other microorganisms. Though the level of contamination differs according to species and location of sale outlets, the presence of these microorganisms on the egg shell of the table eggs suggested that these eggs can serve as vehicle for transmission of Salmonella infection to both humans and other poultry. In addition, following the use of the egg content, disposal of the raw contaminated egg shells will result in the contamination of the environment, and scavenging chickens might also eventually feed on the egg shells which could result in Salmonella infection especially the fact that the scavengers are not given prophylaxis. Furthermore, exposure of humans to contaminated table eggs of chickens result in high risk of salmonellosis infection especially with the recent up surge in poultry farming business.

In conclusion, effective biosafety measures in the control of salmonellosis infection on basic hygienic practices during collection and handling of eggs is recommended. This will certainly reduce the bacterial load on the eggs. Poultry birds especially pullets should be vaccinated promptly or treated in the event of disease outbreak before they come to lay. Similarly, public awareness to back yard poultry farmers, commercial farmers and consumers on the implication of salmonellosis should be routinely carried out by relevant Government agencies and other public health workers.

REFERENCES


