Safety of street vended meat products - chicken and beef suya

A. D. Ologhobo¹, A. B. Omojola¹*, S. T. Ofongo¹, S. Moiforay¹ and M. Jibir²

¹Department of Animal Science, University of Ibadan, Ibadan, Nigeria.
²Department of Animal Science, Usmanu Danfodiyo University Sokoto-Nigeria.

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Suya chicken (A) and beef (B) samples classified according to state: TA₁ B₁ - raw; TA₂ B₂ - spiced; TA₃ B₃ - spiced and roasted; TA₄ B₄ - left over, unheated, spiced and roasted suya of the following day, TA₅ B₅ - leftover, heated, spiced and roasted suya of the following day, were collected from three locations in Ibadan metropolis, to identify the specific microorganisms in street vended chicken and beef suya and measure the microbial count at each stage of handling from the raw state to marketing and consumption. The plate count of *Escherichia coli* in raw chicken (10⁸/g) and beef suya (10⁷/g) dropped to 10⁶ and 10³/g, respectively after processing from the University staff suya spot. In the Sabo area suya spot samples, *E. coli* counts were observed in processed chicken suya (10⁴/g), before and after heating the second day (10⁷ and 10⁵/g, respectively). However, neither *E. coli* nor *Salmonella* nor *Shigella* sp. was isolated from both types of “suya” samples from the General gas area. On the whole, *E. coli* counts were highest in spiced beef (3.3 x 10⁷/g) and chicken suya (3.4 x 10⁷/g) before roasting, whilst second day after heating gave *E. coli* counts of 3.3 x 10⁷/g. *Staphylococcus aureus* was isolated from chicken suya (10⁵ and 10⁷/g and beef suya (10⁷/g) before and after heating the following day from the University Staff Club suya spot. *S. aureus* was also isolated from raw, spiced, before and after heating the second day beef suya samples from Sabo. It was again isolated from the General gas area processed chicken suya (10³/g), the second day before (10⁵/g) and after heating (10⁶/g). On the whole, *S. aureus* counts the second day after heating produced in beef suya 3.3 x 10⁷/g. *Shigella, Salmonella* and *Klebsiella* sp. were not isolated from the University of Ibadan staff club suya. The situation differed from that of Sabo. *Klebsiella* sp. counts of 10⁶ and 10⁷/g from raw and spiced chicken suya dropped to zero after processing and before and after heating the second day. Beef suya microbial counts showed a high prevalence of *Klebsiella* sp. in raw beef suya (10⁷/g), but then dropped after spicing and processing. It was however observed in beef “suya” the second day before and after heating (10⁵ and 10⁷/g, respectively). Neither *Salmonella* nor *Shigella* was isolated from both types of suya. Generally, the results showed that *Klebsiella* sp. had the highest count of 6.7 x 10⁵/g in raw chicken suya samples. It was observed that microbial counts of chicken and beef suya were at levels that pose health implications for consumers.

Key words: Suya, microbial count, safety, street vended meat, beef, chicken.

INTRODUCTION

Chicken and beef suya are common delicacies to many Nigerians. Chicken and beef suya vendors are found in almost every neighborhood with a dense population for various daily formal or informal economic activities. Suya is a street processed, roasted and vended meat product (Son, 1996). In Nigeria, sale of beef suya first started before that of chicken, which emerged just recently and is not as widespread as the former. These foods are bought and eaten without further processing or cooking. Street vending of foods is a common characteristic of countries with high unemployment, low salaries and poor social security programme (Bryan et al., 1988). However, consumers of street vended meat are little aware of the high health risks they face. Street foods are
exposed to various forms of contamination at every stage of handling. Etok (1998) identified insufficient roasting /heating duration, uneven temperature distribution and exposure to unhygienic environments as crucial factors of infection and contamination. It is the aim of the vendors to minimize shrinkage of the meat during roasting to maximize profit but at the same time satisfy the demand and appetite of the buyers. So the foods are usually prepared in a rush when the buyers are in a rush, or they are roasted, kept exposed and cold to await would-be consumers. Whichever way, the suya would not be properly roasted or kept under safe condition for consumption.

Several workers had reported mean total plate counts and coliform MPN levels of $6.24 \times 10^3$ - $7.4 \times 10^3$ and $8.5 \times 10^6$ - $2.0 \times 10^7$ cfu/g, respectively in “suya” products (Igene, 1983; Igene and Abulu, 1984). Idio (1995) reported total plate count and coliform level of $6.5 \times 10^6$ - $8.0 \times 10^6$ and $3.0 \times 10^6$ - $3.62 \times 10^6$ cfu/ml in roasted meat. Harris et al. (1975) had earlier reported on pathogens like Salmonella, Shigella, Staphylococcus and entero-pathogenic Escherichia coli in beef suya. These values far exceeded the recommended total count ($10^5$g) and coliform level ($10^5$g) for delicatessen products. Thus, contamination of suya with pathogens is inevitable.

Therefore, the objective of this paper is to identify the specific microorganisms in street vended chicken and beef suya and measure the microbial count at each stage of handling from the raw state to marketing and consumption.

MATERIALS AND METHODS

Sample collection and experimental design

Chicken and beef suya samples were obtained from three locations in Ibadan metropolis, Oyo State: the University of Ibadan staff club, Sabo (a major suya spot) and General gas suya spot. Five treatments in a completely randomized design of collected samples of chicken (A) and beef (B) suya were placed in sterile sample bottles and labeled accordingly; TA1, B1 - raw; TA2, B2 - spiced; TA3, B3 - spiced and roasted; TA4, B4 - left over, unheated, spiced and roasted suya of the following day, TA5, B5 - leftover, heated, spiced and roasted suya of the following day. Each sample was taken immediately to the laboratory for analysis after collection.

Microbial identification and assessment

50 g of each sample was homogenized in 100 ml nutrient broth and dilutions of 1:10, 1:100 and 1:1000 made in the same broth. 50 ml of the homogenate dilutions was added to 50 ml of Selenite F broth with ingredients at double strength. The microbial cultures were incubated for 24 h at 37°C and 43°C, respectively. The cultures were plated out on deoxycholate citrate agar (DCA) and brilliant green Mac Conkey agar and incubated at 37°C.

Grown colonies of bacteria on the agar media were examined microscopically after 24 and 48 h of incubation at 37°C. Colony morphology, shape, size, elevation, color and odor were noted. Smears were made from the colonies on clean slides and examined under the microscope using the oil immersion objective for Gram reaction determination. The plate counts of the dilutions were carried out on blood and Mac Conkey agar by incubating the plates aerobically for 18 h at 37°C, followed by examination of the colonies.

Biochemical tests

Biochemical tests including sugar fermentation (lactose, glucose, manitol, sucrose, salinan and ducito), citrate utilization, urea decomposition and oxidase tests were performed on gram negative bacillus to differentiate between lactose and non-lactose fermenting ability on Mac Conkey agar. Growth in peptone water was used for indole and mortality tests. Methyl red, Voges Proskauer (VP) and nitrate reduction tests were also carried out according to Cowan and Steel (1974).

Bacterial counts (surface viable counts)

The plates were dried for 2 h at 37°C prior to inoculation. Ten fold dilutions - 1:10, 1:100 and 1:1000 of the bacterial suspension were made and 0.2 ml of each set pipetted onto the surfaces of three plates (Blood agar, Mac Conkey agar and DCA). These were immediately spread out with a sterile glass spreader. The viable count was calculated from the average colony count/plate and a total of 1000 per gram or less was considered satisfactory.

Statistical analysis

Results obtained were subjected to analysis of variance (ANOVA) using the generalized linear model (GLM) procedure (Snedecor and Cochran, 1989) and to Duncan’s multiple range procedure to determine the significant differences among treatments.

RESULTS AND DISCUSSION

It was evident that street vended chicken and beef suya get infected with micro organisms, which might pose health hazards to regular consumers. E. coli, S. aureus and Klebsiella sp. were isolated from suya samples collected as shown in Tables 1 to 4.

The fact that street food consumption has serious health implications for such consumers has been presented in other reports (Harris et al., 1975; Tjoa et al., 1977; Eriscon et al., 1980). The authors implicated poultry foods as major vehicles of disease transmission in countries with surveillance program. Results obtained from this study are in agreement with those reported by Igene (1983) and Igene and Abulu (1984). According to the authors, the mean total count and coliform MPN levels of $6.24 \times 10^3$ - $1.4 \times 10^4$ and $8.5 \times 10^6$ - $2.0 \times 10^7$g were observed in suya products, emphasizing that Enterobacteria are good meat contaminants.

The plate count of E. coli in raw chicken ($10^6$g) and beef suya ($10^7$g) dropped to $10^5$ and $10^6$g, respectively after processing for the University staff suya spot. In the Sabo area suya spot samples, E. coli counts were observed in processed chicken suya ($10^5$g), before and after heating the second day ($10^7$ and $10^5$g respectively). E. coli counts of $10^7$g was observed in spiced and
processed beef suya. However, neither *E. coli* nor *Salmonella* nor *Shigella* sp. was isolated from both types of suya samples from the General gas area most probably because the area was less populated and rate of pollution was low. On the whole, *E. coli* counts were highest in spiced beef \((3.3 \times 10^7/g)\) and chicken suya \((3.4 \times 10^5/g)\) before roasting, whilst second day after heating gave *E. coli* counts of \(3.3 \times 10^6/g\).

The prevalence of *E. coli* could be attributed to the use of contaminated water during the different stages of processing. On the other hand, hands, utensils and knife used in processing the suya could be implicated as mediums for cross contamination of processed suya. The initial contaminated water used for washing the raw meat is also used for washing hands and utensils used in production. Water is a major means by which *E. coli* are spread. Insufficient heating of the suya during processing and just before selling to the consumer is a possible reason for the survival of these pathogens in suya Thus, the possibility of food poisoning outbreaks is highly probable (Mermeistein, 1993). In addition, the processed suya is always kept exposed while awaiting buyers, making it naturally vulnerable to infection with different pathogens. Besides, not all consumers are patient enough to wait for the vendor to re-heat the suya before purchasing.

*S. aureus* was isolated from chicken suya \((10^5\) and \(10^7/g)\) and beef suya \((10^7/g)\) before and after heating from the University Staff Club suya spot. No *S. aureus* was isolated from all category of beef suya, samples from Sabo while the only *S. aureus* isolated from the General gas area beef suya was from processed ready eat product \((10^7/g)\). Chicken "suya" from the same spot however contained \(10^5/g\) and \(10^7/g\) and beef suya \((10^7/g)\) before and after heating from the University Staff Club suya spot. No *S. aureus* was isolated from all category of beef suya, samples from Sabo while the only *S. aureus* isolated from the General gas area beef suya was from processed ready eat product \((10^7/g)\). Chicken "suya" from the same spot however contained \(10^5/g\) and \(10^7/g\) and beef suya \((10^7/g)\) before and after heating from the University Staff Club suya spot.

Although *S. aureus* was not found in the raw suya samples, subsequent contamination might
Table 3. Microbial count of the “General Gas” area chicken and beef “suya”.

<table>
<thead>
<tr>
<th>Sampling stage</th>
<th>Escherichia coli</th>
<th>Staphylococcus aureus</th>
<th>Klebsiella sp.</th>
<th>Salmonella/Shigella</th>
<th>Total aerobic plate count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beef</td>
<td>Chicken</td>
<td>Beef</td>
<td>Chicken</td>
<td>Beef</td>
</tr>
<tr>
<td>Raw meat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10⁷</td>
</tr>
<tr>
<td>Spiced meat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10⁵</td>
</tr>
<tr>
<td>Processed (ready-to-eat)</td>
<td>0</td>
<td>0</td>
<td>10²</td>
<td>10³</td>
<td>10³</td>
</tr>
<tr>
<td>Processed (2nd day before heating)</td>
<td>0</td>
<td>0</td>
<td>10²</td>
<td>10³</td>
<td>0</td>
</tr>
<tr>
<td>Processed (2nd day after heating)</td>
<td>0</td>
<td>0</td>
<td>10⁴</td>
<td>10³</td>
<td>0</td>
</tr>
</tbody>
</table>

Total aerobic plate count (colonies/g).

Table 4. Microorganisms isolated from the three locations for both “suya”.

<table>
<thead>
<tr>
<th>Sampling stage</th>
<th>Escherichia coli</th>
<th>Staphylococcus aureus</th>
<th>Klebsiella sp.</th>
<th>Salmonella/Shigella</th>
<th>Total aerobic plate count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beef</td>
<td>Chicken</td>
<td>Beef</td>
<td>Chicken</td>
<td>Beef</td>
</tr>
<tr>
<td>Raw meat</td>
<td>3.3 x 10⁶</td>
<td>3.3 x 10⁷</td>
<td>0</td>
<td>0</td>
<td>6.7 x 10⁶</td>
</tr>
<tr>
<td>Spiced meat</td>
<td>3.3 x 10⁶</td>
<td>3.3 x 10⁷</td>
<td>3.3 x 10⁴</td>
<td>0</td>
<td>3.0 x 10⁴</td>
</tr>
<tr>
<td>Processed (ready-to-eat)</td>
<td>3.3 x 10⁴</td>
<td>3.4 x 10⁷</td>
<td>3.3 x 10²</td>
<td>3.3 x 10²</td>
<td>3.3 x 10²</td>
</tr>
<tr>
<td>Processed (2nd day before heating)</td>
<td>0</td>
<td>3.3 x 10⁴</td>
<td>3.3 x 10⁴</td>
<td>6.7 x 10⁴</td>
<td>3.7 x 10⁵</td>
</tr>
<tr>
<td>Processed (2nd day after heating)</td>
<td>0</td>
<td>3.3 x 10⁶</td>
<td>3.4 x 10²</td>
<td>3.3 x 10³</td>
<td>3.7 x 10⁷</td>
</tr>
</tbody>
</table>

Total aerobic plate count (colonies/g).

be due to improper handling by the vendor. *Staphylococcus* observed in the second day before and after heating could be as a result of the old news papers used in wrapping the previous day’s suya before storage. These newspapers must have passed through many hands before eventually getting to the suya vendors. It could also be due to improper heating on the second day. Likewise, careless sneezing and coughing among vendors can result in contamination of the products. In addition, hand picking of nose and improper washing of such hands before handling suya or utensils could also be a good source of contamination.

*Shigella, Salmonella and Klebsiella sp.* were not isolated from the University of Ibadan staff club suya. The situation differed from that of Sabo. *Klebsiella* sp. counts of 10⁶ and 10⁷/g from raw and spiced chicken suya dropped to zero after processing and before and after heating the second day. Beef suya microbial counts showed a high prevalence of *Klebsiella* sp. in raw beef suya (10⁷/g), but then dropped after spicing and processing but was however observed in the product the second day before and after heating (10⁶ and 10⁵/g, respectively). Neither *Salmonella* nor *Shigella* was isolated from both types of suya. In the General gas area samples, *Klebsiella* sp. was isolated from raw beef suya (10⁷/g), spiced (10⁷/g) and second day before (10⁵/g) and after heating (10⁶/g); that obtained for chicken suya was 10⁷/g - raw, 10⁷/g - spiced, 10⁷/g - processed, 10⁷/g - second day before heating and 10⁵/g - second day after heating. Generally, the result showed that *Klebsiella* sp. had the highest count of 6.7 x 10⁶/g in raw beef suya samples. *Klebsiella* sp. is ubiquitous in surface water and reservoirs. It is also present in the gut and epithelial lining of cattle. Improper handling of cattle during slaughtering can result in contamination of the carcass which is bought for suya production. Unfortunately, suya vendors have little concern and knowledge about the quality of water to use. This calls to question the hygiene and sanitation practices of these locations where suya is produced as well as the quality of the water used. Thus, the issue of cross-contamination of the product is quite certain. For instance, bare hands...
used in handling meat, utensils and money at the same time could be greatly implicated.

The reduction of microbial count in processed suya was due to heating during roasting. *E. coli* counts were reduced from $3.3 \times 10^6/g$ in the raw suya to $3.3 \times 10^4/g$ in the processed suya. This value still exceeds the tolerance level ($10^5/g$ total count) reported in literature (Pace, 1975; Solberg et al., 1975). Similar results were obtained for *Klebsiella* sp. in beef and chicken suya ($3.3 \times 10^5/g$ and $3.3 \times 10^3/g$ in beef and $3.3 \times 10^4/g$ in chicken suya). Heating the second day before sales was done in a way to minimize shrinkage of the suya and thus, the insufficient heating would not destroy the micro organisms which had contaminated the suya overnight.

**Conclusion**

It was observed that the microbial counts of chicken and beef suya were at levels that pose health implications for consumers. The results also buttressed the need to educate suya vendors on personal hygiene and environmental sanitation practices during handling products to prevent cross contamination, thereby making available to consumers quality snacks.

**REFERENCES**


