Comparing the Microbial Load on Hide and Beef Carcasses at Minna Abattoir

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Abstract

The hide, viscera and faeces of cattle entering the slaughter facility all serve as sources of contamination to the carcass. In this study, animal carcasses at the Minna abattoir, Nigeria, were sampled at the hock, brisket, bung, cranial back and inside round sites. Samples were analyzed for microbiological qualities and numbers between the three cattle cleanliness categories (2) clean, (3) dirty, and (5) very dirty, hence total viable counts (TVC) were taken. The hock harbored aerobic heterotrophic bacteria (2.1×10^5 - 7.0×10^6 cfu/ml), bung (2.5×10^5 - 1.1×10^7 cfu/ml) and the inside round (3.1×10^5 - 1.9×10^7 cfu/ml). The TVC at the brisket were significantly higher on category 5 (2.0×10^5 cfu/ml) than on category 2 (1.6×10^5 cfu/ml) carcasses. There were no significant differences between TVC of categories 3 and 5 at the cranial back. Analysis of TVC for each category averaged over the five sites showed that TVC on category 5 carcasses were significantly higher than category 2 carcasses with less significant difference between TVC of categories 3 and 5. Based on the result of this study, it is recommended that there be establishment of standard slaughtering facilities.

Keywords: *Viscera, faeces, beef carcasses, aerobic heterotrophic bacteria, total viable counts.*

1. Introduction

During beef carcass dressing, transfer of contamination from the hide surface to the carcass is unavoidable due to the nature of the hide removal process. Contamination can occur by direct contact between the hide and the carcass, or by indirect transfer, i.e. from workers' hands, clothes, tools or factory equipment, which had previous contact with the hide. During the life of the animal, the hide becomes contaminated with large number of microorganisms derived from a wide range of sources, such as faeces, soil, water and vegetation, including pathogens such as *E. coli* O157:H7 and *Salmonella*.

Many of these organisms are present on the hide of animals presented for slaughter (McEvoy *et al*. 2001).

The deep muscle tissues of healthy, slaughtered livestock contain few, if any, microorganisms. However, their exterior surfaces (hide, hair, skin, feathers) are naturally contaminated with a variety of microorganisms as are their gastro-intestinal tracts. From the moment of slaughter, each processing step subjects the carcass to opportunities for contamination with microorganisms from the exterior surfaces, utensils and equipment and, most importantly, from the gastro-intestinal tract. Cutting of carcasses also involves the use of utensils and equipment and transfers micro-organisms to the cut surfaces. Theoretically, removal of the skin should expose the sterile surface of the muscle but in practice the extra handling seems to contribute significantly to the bacterial load on the surfaces. This happens with meat production where the skin is removed early in the slaughtering process (e.g. beef, mutton, lamb, ostrich, and goat) or where the skin is removed later on (e.g. some pork cuts, skinned chicken portions). According to McEvoy *et al*. (2000), there is ample opportunity to contaminate the exposed tissues of the carcass with microorganisms from the

exterior surface of the animal, contents of the gastro-intestinal tract, equipment and utensils, workers' garments and hands, the abattoir itself (e.g. air, floor drains, water drip from ceiling), water (and ice, if used), and food additives (e.g. spices for value added products). Therefore, there is a need to control said opportunity for contamination by using properly cleaned equipment, ensuring that the abattoir is properly cleaned/sanitized, using hygienic methods of dressing that control contamination, and applying a high standard of personal hygiene (Doherty 1999).

A study was conducted which performed the following tasks: (1) comparison of the microbial load on hide and beef carcasses presented for slaughter at the Minna abattoir, Nigeria; and (2) characterization and identification of microorganisms isolated from carcasses of sampled cattle.

2. Materials and Methods

2.1 Description of Study Site

The study site was the Minna Municipal abattoir located at Agwanbiri, Bosso, Niger State, Nigeria, and managed by the Chanchaga Local Government Council. The abattoir has two slaughter halls that lack functional animal slaughtering facilities. It has a non-functional cold room, rough slaughter slabs and floor.

Animals are slaughtered here using a decapitation technique on the bare floor. Evisceration and dressing are done on the floor in the slaughter halls.

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2.2 Collection and Analysis of Samples

The selection procedure for cattle cleanliness and categorization were in line with the methods as described by McEvoy *et al*. (2001). Cattle carcasses from categories 2 (clean), 3 (dirty) and 5 (very dirty) of selected animals were sampled using the swab technique at the hock, brisket, cranial back, bung and the inside round sites. The hock was sampled at first legging, after loosening of the hide from the hind legs. The brisket, cranial back and bung were sampled immediately after hide removal before any other processing operation.

The inside round was sampled after carcass splitting and trimming but before carcass washing.

Samples were collected by swabbing using the swab technique. Each set of swabs was suspended in nutrient broth and potatoes broth, maintained at about 5°C with the aid of an ice pack cooler and transported to the laboratory within four hours prior to analysis.

2.3 Microbiological Analysis

Total viable counts were obtained by spread plating 0.1 ml of each sample on nutrient agar (NA), and sabouraud dextrose agar (SDA), both using the spread plate technique for the enumeration of total aerobic bacteria and fungi, respectively.

The nutrient agar plates were incubated at 37°C for 24 hours while the SDA plates were incubated at room temperature (28 ± 2°C) for 72 hours.

3. Results

3.1 Microbial Counts

TVCs of aerobic heterotrophic bacteria from day 1 samples are shown in Table 1. TVCs of fungal isolates from day 1 samples are shown in Table 2.

The total viable counts (TVCs for categories 2, 3 and 5) can be seen in Table 3.

Samples from category five cattle had the highest microbial load ranging from 1.6×10^6 cfu/ml to 6.4×10^7 cfu/ml. The least microbial load was recorded at category 2 ranging from 9.2×10^5 cfu/ml to 4.2×10^7 cfu/ml, while samples from category three cattle carcasses had microbial load ranging from 1.8×10^6 cfu/ml to 6.0×10^7 cfu/ml.

Table 4 shows the results of bacterial count averaged at the hock, bung and inside round sites with the hock ranging from 2.1×10^5 to 7.0×10^6 cfu/ml. The inside round had the highest bacterial load (3.1×10^6 to 1.9×10^7 cfu/ml).

Table 1. TVCs of aerobic heterotrophic bacteria from day 1 samples.

Carcass site	TVCs ($\times 10^5$ cfu/ml) for different cattle cleanliness categories		
	Cat. 2	Cat. 3	Cat. 5
Hock	1.4	2.4	2.6
Brisket	1.6	2.2	2.0
Cranial back	2.0	2.5	2.5
Bung	1.9	TNTC	TNTC
Inside round	1.9	TNTC	TNTC

Note: TNTC - Too Numerous To Count.

Table 2. TVCs of fungal isolates from day 1 samples.

Carcass site	TVCs ($\times 10^5$ cfu/ml) for different cattle cleanliness categories		
	Cat. 2	Cat. 3	Cat. 5
Hock	1.2	4.0	2.8
Brisket	1.6	3.6	4.8
Cranial back	1.2	3.2	4.4
Bung	2.0	3.6	3.2
Inside round	1.2	2.0	4.8

Table 3. TVCs averaged for categories 2, 3 and 5 carcasses on separate sample collection dates.

Sample date	TVCs (cfu/ml) for different cattle cleanliness categories		
	Cat. 2	Cat. 3	Cat. 5
05/07/2012	9.2×10^5	1.8×10^6	1.6×10^6
12/07/2012	5.2×10^6	8.6×10^6	8.9×10^6
19/07/2012	4.2×10^7	6.0×10^7	6.4×10^7

Table 4. TVCs of bacteria isolates averaged for the hock, bung and inside round sites.

Carcass site	TVCs (cfu/ml) for different sample dates		
	05/07/12	12/07/12	19/07/12
Hock	2.1×10^5	1.0×10^6	7.0×10^6
Bung	2.5×10^5	1.3×10^6	1.1×10^7
Inside round	3.1×10^5	1.7×10^6	1.9×10^7

4. Discussion

In general, the total bacterial and fungal counts for cattle sampled at the Minna abattoir were high. This study identified the bung and inside round sites as the most contaminated sites which is at variance with the findings of McEvoy *et al*. (2000) who identified the hock and brisket as the most contaminated sites after hide removal. Contamination at these sites is influenced by the skill of the operative and manual skinning during hide removal (McEvoy *et al*. 2001). There was little significant difference in TVCs between carcasses of category 3 (dirty) and category 5 (very dirty) cattle, and a huge difference in total viable counts between clean (category 2) and very dirty (category 5) cattle at the cranial back. This was also observed at the bung and inside round which is also at variance with the findings of Doherty (1999). This was probably due to the fact that these sites (bung and inside round) were contacted by the outer surface of the hide and contaminated during manual skinning.

TVCs of category two carcasses were observed to be less significant when compared to TVCs obtained from carcasses of category 3 and 5 cattle. *Escherichia coli* were the most predominant bacteria. Bridges *et al*. (2001) reported that total bacterial counts higher than 10^2 cfu/ml indicate a dangerous contaminant. The predominance of *E. coli* suggests that the sampled carcasses may have come in contact with faecal contaminants which could be as a result of a poor dressing technique.

Bacillus subtilis were the least predominant bacteria isolated. The organism is known to be a spore former and produces toxins. Alonge (2005) indicated that *B. subtilis* is an etiological agent of food poisoning that may be characterized by either diarrhea and abdominal pain or by nausea and vomiting after ingestion of contaminated beef or food. The presence of *B. subtilis* in animal carcasses suggests that the carcasses may have been contaminated by dust or soil carrying the resistant form of the organism.

For fungal species, *Aspergillus niger* being ubiquitous in nature (i.e. found wherever organic debris occurs) was the most predominant fungus isolated from sampled animal carcasses at the Minna abattoir. *A. niger* is known to be the causative agent of aspergillosis (Alonge 1988). *Mucor* spp. was observed to be the least predominant fungus isolated from animal carcasses at the Minna abattoir. This may be as a result of unfavorable environment for its growth.

This study demonstrated the effect of improved hygiene practices in reducing carcass contamination.

5. Acknowledgements

The authors acknowledge with gratitude the entire Department of Microbiology, Federal University of Technology, Minna, Niger State, Nigeria.

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