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MICROBIAL LOAD OF DIFFERENT CARCASS SURFACES

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ABSTRACT

A total of 160 random samples from 160 carcass surfaces of sheep, cattle, buffalo and goat (40 each) were collected as carcass surface swabs from El-Behera and Alexandria governorates for microbiological evaluation at the end of slaughtering. The microbiological examination revealed that, the highest different bacterial counts were found in sheep and decrease successively in cattle, buffalo and goat. Also, the highest mould and yeast count was found in sheep and decrease successively in cattle, buffalo and goat. The highest incidence of Salmonella was found in sheep and decrease successively in cattle, buffalo, while it could not be detected in goat at all. The public health significance of such microbial counts and isolated microorganisms as well as suggestive measures were discussed.

INTRODUCTION

The consumable tissues of healthy stock are sterile **(Bell et al., 1994)**, with the exception of the tongue and gastrointestinal tract, which carry natural microflora **(Nottingham, 1982)**. However, during slaughter and dressing of meat animals, contamination of the carcass is unavoidable **(Newton et al., 1978** and **Bell et al., 1994)**. The hide/fleece and viscera are reservoirs for human pathogens and spoilage microorganisms **(Newton et al., 1978)** although contamination from the viscera is only significant if rupture or leakage occur during removal and is, therefore, considered to be a less important source than the hide/fleece **(Gerrand, 1975)**. Also, dust, water, rodents, flies, hands, clothes of workers as well as in edible material derived in abattoirs are important source of contamination.

During the act of slaughtering, dressing and evisceration, the surrounding environment becomes grossly contaminated with large numbers of microorganisms which are originally present on the skin, hoofs and body cavities of the slaughtered animals. These organisms being settled on the surface of carcasses leading to contamination of meat **(Nottingham, 1982;** and **Small et al., 2006)**. These particularly occur in temperate counties, since meat is sold fresh and sometimes without the application of any cooling devices, and where favourable condition supporting the growth and multiplication of contaminating organisms exist **(El-Nawawi et al., 1976)**.

The determination of bacterial counts on carcass surfaces has been surveyed by various authors as well

as by the European Commission (EC-documents VI/5938/87 and PVET/2140). The initial contamination of meat occurs during slaughtering and at this stage hygienic deficiencies can lead to considerable contamination of meat. Highly contaminated raw meat is the main source for macrobial contamination and cross-contamination in meat processing plants. Hence carcass contamination during slaughtering entails hygiene deficiencies which cannot be compensated for, even by the most vigorous hygienic measures during later stages of processing. This underlines the major significance of slaughter hygiene. As with other foodstuffs, microbiological hygiene measures in meat production and processing aim to protect the consumer from pathogenic agents and to prevent rapid spoilage of meat. These measures, therefore, serve the purposes of health protection as well as those of quality assurance in general.

External contamination of raw meat is a constant possibility from the moment of bleeding until consumption. In order to improve the keeping quality of meat as well as to protect the consumer from pathogenic micro-organisms, the microbial load present on the surface of carcasses must be investigated.

MATERIALS AND METHODS

A total of 160 random samples from 160 carcass surfaces of sheep, cattle, buffalo and goat (40 each) were collected as carcass surface swabs from El-Behera and Alexandria governorate slaughterhouses at the end of slaughtering process. This study was carried out within three years. The wet-dry double swab technique was used. Each area of 10 cm^2 was sampled first with a cotton wool swab moisten with sterile peptone water 0.1% and then with a dry swab. Both swabs were put together into a tube containing 10 ml of sterile bacteriological peptone. Two sampling sites per each carcass were investigated. All samples were transferred to icebox then transferred to the laboratory as soon as possible for microbiological investigation as follow: (1) total aerobic bacterial count **(FAO, 1992)**, (2) total Enterobacteriaceae count **(ICMSF, 1978)**, total staphylococci count **(ICMSF, 1978)**, (5) total mould and yeast count **(FAO, 1992)**, and (5) detection of Salmonella **(APHA, 1992; Cruickshank et al., 1975; Thatcher and Clark, 1978)** and serologically according to **Edwards and Ewing (1972; ICMSF, 1978)**.

RESULTS

Table (1): Statistical analytical results of total aerobic bacterial count (TABC, cfu/cm^2) of examined carcass surfaces

Species	Minimum	Maximum	Mean ± SEM
Cattle	2.21×10^4	9.64×10^6	$3.31 \times 10^6 \pm 3.11 \times 10^4$
Buffalo	4.11×10^3	4.17×10^6	$3.14 \times 10^5 \pm 2.41 \times 10^3$
Sheep	4.31×10^4	7.42×10^7	$7.16 \times 10^6 \pm 4.15 \times 10^4$
Goat	3.23×10^3	3.11×10^5	$4.11 \times 10^4 \pm 1.65 \times 10^3$

N = 40 per species; SEM = Standard error of mean

Table (2): Statistical analytical results of total Enterobacteriaceae count (cfu/cm^2) of examined carcass surfaces

Species	Minimum	Maximum	Mean ± SEM
Cattle	3.11×10^2	3.43×10^4	$1.57 \times 10^3 \pm 2.80 \times 10^2$
Buffalo	2.33×10^2	3.11×10^3	$8.13 \times 10^2 \pm 1.41 \times 10^2$
Sheep	4.12×10^2	7.35×10^4	$4.64 \times 10^3 \pm 3.90 \times 10^2$
Goat	1.11×10^2	2.45×10^3	$1.14 \times 10^2 \pm 1.14 \times 10^2$

N = 40 per species; SEM = Standard error of mean

Table (3): Statistical analytical results of total staphylococci count (cfu/cm^2) of examined carcass surfaces

Species	Minimum	Maximum	Mean ± SEM
Cattle	1.13×10^2	8.14×10^3	$6.91 \times 10^2 \pm 2.95 \times 10^2$
Buffalo	1.12×10^2	7.95×10^3	$6.95 \times 10^2 \pm 2.11 \times 10^2$
Sheep	1.15×10^2	9.15×10^3	$8.11 \times 10^2 \pm 2.14 \times 10^2$
Goat	1.13×10^2	6.97×10^3	$6.81 \times 10^2 \pm 1.12 \times 10^2$

N = 40 per species; SEM = Standard error of mean

Table (4): Statistical analytical results of total mould and yeast count /cm^2 of examined carcass surfaces

Species	Minimum	Maximum	Mean ± SEM
Cattle	2.85×10^2	3.21×10^4	$5.13 \times 10^3 \pm 2.13 \times 10^2$
Buffalo	2.24×10	5.23×10^3	$6.41 \times 10^2 \pm 3.14 \times 10^2$
Sheep	3.34×10^2	9.15×10^4	$6.65 \times 10^4 \pm 2.41 \times 10^2$
Goat	2.11×10	3.12×10^3	$2.35 \times 10^2 \pm 2.11 \times 10^2$

N = 40 per species; SEM = Standard error of mean

Table (5): Incidence of Salmonella in examined carcass surfaces

Species	No. of examined samples	Positive samples	
		No.	%
Cattle	40	2	5
Buffalo	40	1	2.5
Sheep	40	3	7.5
Goat	40	0	0
Total	160	6	3.75

DISCUSSION

The contamination of carcass surfaces has been reported to have a significant effect on the shelf-life of meat. Moreover, the initial contamination can be directly correlated with keeping quality of meat, so food hygienists have been attempting to detect and quantify microorganisms on carcass surfaces. Concerning the total aerobic bacterial count (TABC), The highest count was found in sheep and decrease successively in cattle followed by buffalo and goat, respectively (Table 1). This may be due to the fleece of sheep is highly contaminated **(Gerrand, 1975)** which may come in contact with carcass surface during dressing by the "in-rolling" of the fleece in the shoulder region during skinning or indirect to the carcass surface via contact with slaughtermen, their tools and equipment **(Hess and Lott, 1970)**. In addition to the large tail in sheep which is more contaminated by faecal matter which is a big source of contamination. In cows, such high count may be attributed to that, the thigh and both sides of the abdomen of alive animals may be heavily soiled with wet faecal matter which come in contact with the carcass surface either directly or indirectly during processing. A wet soiling faecal matter may increase contamination by 5 – 10 folds than dry one **(Newton et al., 1978** and **Patterson and Gibbs, 1978)**. While, TBAC was relatively low in buffaloes since buffaloes like swimming in water and spend much of time in water which may remove the faecal matter on their bodies. In addition, the skin of buffaloes is not covered with heavy hair as in cows. The heavy hair skin increases the chance of sticking of faecal matter with such skin, so the skin of buffaloes is less soiled with faecal matter than cows. The low contamination in goat carcass surfaces may be due to that goats have no such large tail as in sheep and also have not soiled with faecal matter as in cows, also its small size so they need no much work for processing. These may decrease the chance of carcass surface contamination. So, these results show that, the condition of the live animal significantly affects the microbial load of the dressed carcass surface. Nearly similar results were obtained by **Mira (1989)** in beef. Slightly lower results were obtained by **Wanas (1995)** for cattle and buffalo, much lower results were obtained by **Sofos et al. (1999)** and **Stopforth et al. (2006)** in beef. But, higher results have been obtained by **Al-**

Ackshar (2003) in cattle and buffaloes. Such high TABC may be in addition to previously mentioned causes may be attributed to different sources of contamination especially hides of animals **(Ojala, 1964)**, pollution of the abattoirs from atmosphere **(Malder and Kroll, 1976)**, hands of workers, rodents, fleece, equipment, and washing water **(Heuvelink et al., 2001** and **Gill et al., 2001)**.

Concerning the Enterobacteriaceae count (EC) of carcass surfaces, the highest count was found on sheep carcasses followed by cattle, buffalo and goat, respectively. (table 2). This may be attributed to the previously mentioned causes under TABC, also the animals have been slaughtered, dressed and handled under poor sanitary conditions or bad hygienic measures, in addition to the acts of slaughtering and dressing were done where the animal lies on the floor of the slaughterhall which is more contaminated with faecal matter from previously slaughtered animals.

From data presented in Table (3), it is clear that, the staphylococci count (SC)/cm^2 were nearly similar in all examined carcass surfaces in all animals. This may be attributed to the common sources of staphylococci are the same for different animal carcasses as nasal passage, boils and infected wounds of man **(Frazier and Westhoff, 1983)**. Slightly higher results were obtained by **Wanas (1995)** and **Al-Ackshar (2003)**.

From data presented in Table (4), it is clear that the highest mould and yeast count/cm^2 was found on sheep and decreased successively in cattle, buffalo and goat carcass surfaces, respectively. This may be due to the previously mentioned caused mentioned under TABC. Slightly lower results were obtained by **Wanas (1995)**, while much higher results were recorded by **Al-Ackshar (2003)**. The mould count is used as an index of the proper sanitation and quality of the product. Moulds can assist in the putrefactive process and in other cases they may impart a mouldy odour and taste of foodstuffs. Also, moulds can grow over an extremely wide range of temperature. Therefore, one can find mould on particularly all foods as almost any temperature under which foods are held. Besides, mould can assist in the putrefactive process and may produce toxic substrates namely mycotoxins which are harmful to man and animals **(Frazier and Westhoff, 1983)**. In addition to that the harmful effect of some pathogenic yeasts, spoilage yeasts can cause undesirable changes in physical appearance of food **(Walker, 1976)**.

Data presented in Table (5) it is clear that the highest incidence of Salmonella was found in sheep and decreased successively in cattle and buffaloes, (7.5, 5 and 2.5%, respectively), while it could not be detected in goat carcass surfaces. **Stopforth et al. (2006)** could isolate it at an incidence of 2.2% from raw beef cuts, while **Phillips et al. (2006)** could not isolate it from beef carcasses but they could isolate Salmonella only from one sample out of 1082 boneless

products. **Small et al. (2006)** found Salmonella in 9.6% of 240 lamb carcasses, 12.7% of 330 beef carcasses, 20% of 80 calf carcasses younger than 14 days of age and none of 330 cull cow and bull carcasses. Salmonellas are now established as one of the most important causes of foodborne illness worldwide since the major source of human illness is contaminated carcasses. Salmonellas are responsible for a number of different clinical syndromes, grouped here as enteritis and septicemic disease as typhoid and entric fever . In comparison, such high levels of microbial contamination reflect the poor hygienic quality of meat of such carcasses, possibly due to uncontrolled processing and handling during slaughtering process. So it is of great hygienic importance to prevent or reduce these microbiological contamination by improving the control measures on the farm as well as in the slaughterhouses by application of the HACCP as well as ISO principles.

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