EVALUATING AND IMPROVING THE QUALITY OF BEEF CARCASSES SLAUGHTERED AND DRESSED AT OLD-FASHIONED MANSOURA ABATTOIR

Elgazzar, M. M. M.*; Hassan, M. A. M. and Zakaria, A. I.***

*Department of Food Hygiene and Control, Faculty of Veterinary Medicine, Mansoura University.

**Department of Food Control, Faculty of Veterinary Medicine, Benha University.

ABSTRACT

Beef quality of a total 35 carcasses, slaughtered and dressed at old-fashioned Mansoura abattoir, was evaluated by making both general bacteriological analyses and pHu estimation of such careasses. Plates of aerobic plate count agar medium exhibited the occurrence of aerobic mesophilic bacteria in deep tissues of all samples (25 (100%) for each samples' type) excised from 25 unrested beef animals, slaughtered and dressed at abattoir without previous lairaging, with ranges (minimum-maximum) and means±standard errors of 10^2-$3.7x10^4$ and $3.4x10^3$±$1.5x10^3$ organisms/g of flexor carpi radialis muscle, 10^2-$2x10^5$ and $4.6x10^4$±10^4 organisms/g of prescapular lymph node, $4x10^2$-$4.5x10^5$ and $9.5x10^4$±$2.3x10^4$ organisms/g of mesenteric lymph node, alongside $3x10^2$-$2.9x10^5$ and $4.7x10^4$±$1.3x10^4$ organisms/g of liver; meanwhile lesser occurrence and intensities of Enterobacteriaceae organisms were recorded in the same aforementioned samples, as plates of violet red bile glucose medium emphasized the presence of such bacteria in 3 (12%) samples of flexor carpi radialis muscle by intensities of 0-47 and 4.68±1.23 organisms/g, in 1 (4%) samples of prescapular lymph node by populations of 0–100 and 4±1.31 organisms/g, in 5 (20%) samples of mesenteric lymph node by counts of 0-100 and 92±27.1 organisms/g, besides in 10 (40%) samples of liver by numbers of 0-100 and 93.2±23 organisms/g.

Similar bacteriological techniques were also applied on the same tissues' types excised from additional 10 beef carcasses, slaughtered and dressed at the same abattoir after lairaging their animals for 4 h, and revealed the presence of aerobic mesophiles in 7 (70%) samples of flexor carpi radialis muscle by populations of 0-$7.5x10^2$ and $2.6x10^2$±10^2 organisms/g, whilst this presence was detected in deep tissues of all the remaining samples (10 (100%) each) by intensities of 5x10-$4x10^2$ and $1.8x10^2$±$0.4x10^2$ organisms/g of prescapular lymph node, $1.5x10^2$-$1.7x10^3$ and $8.9x10^2$±$2.1x10^2$ organisms/g of mesenteric lymph node besides 5x10-$1.2x10^3$ and $5x10^2$±$1.3x10^2$ organisms/g of liver; whereas the Enterobacteriaceae organisms cannot be recovered from deep tissues of flexor carpi radialis muscle or prescapular lymph node (0% each), of surveyed carcasses of 4 h-rested animals but they were

only detected in 2 (20%) samples of mesenteric lymph node by counts of 0-75 and 12.5±3 organisms/g alongside in 1 (10%) samples of liver, excised from the same carcasses, by 0-200 and 20±6 organisms/g.

Additionally, an electronic temperature-modified pH meter (Model: pH-206, Lutron Electronic, Australia) estimated the ranges (minimum-maximum) and mean values±standard errors of pHu levels in diaphragm muscle samples, 24 h after slaughter, as 5.70-6.30 and 5.94±0.04 for those samples excised from the carcasses of unrested beef animals in additional to 5.48-6.18 and 5.80±0.07 for those beef samples taken from the carcasses of 4 h-rested animals.

Seeing the detailed pHu readings of both two carcasses' categories, (derived from unrested and rested animals) reveal that 16 (64%) and 8 (32%) of beef samples excised from the former carcasses' category besides 4 (40%) and 1 (10%) of beef samples taken from the latter carcasses' category possessed pHu levels of >5.8 and >6, respectively. Also, the inspection of detailed findings of both general bacteriological analyses and pHu readings, for each carcasses' category, exhibited slight and not constant relation between them.

Finally, the recommendations were also provided for solving the problem of impaired beef quality; the prevalent characteristic of all the surveyed beef carcasses.

INTRODUCTION

In the healthy and physiologically normal animal those organs which have no direct contact with the exterior may be regarded as virtually sterile, though the actual operation of slaughter and dressing may introduce bacteria to the blood, tissues and organs. These organisms are usually a mixed flora of a non-specific type but can include Salmonella and other food-poisoning organisms. On the other hand, the bacteria present may be of a specific and pathogenic type and the presence of these in organs or tissues such as the spleen, muscular tissue or lymph nodes can only be attributed to the fact that a generalized septic or bacteraemic infection existed in the animal at the time of slaughter. Where such organisms are of intestinal origin their entry into the systemic circulation is explained by a breakdown in the natural resistance of the animal and emigration of the organisms from the intestinal tract; haematogenous invasion may, however, occur from other naturally infected cavities of the body for the same reason. As systemic invasion is most likely to occur in animals that are ill or exhausted, there are certain affections of animals where a bacteriological examination of the flesh and organs may be of material assistance to an inspector charged with assessing the fitness or otherwise of a carcass for human food. In some countries such a bacteriological examination is optional and undertaken only when the inspector deems it necessary, but in other countries, as in Germany and Denmark, a bacteriological examination is obligatory when certain conditions are observed on postmortem examination; in Denmark this method of

examination has been recognized as an official one since 1932, while in Federal Germany the provisions in regard to bacteriological examinations were redrafted in 1961 and made considerably more severe. Microorganisms are spread in meat through the blood and lymph vessels and connective-tissue interspaces. Meat is an ideal culture medium for many organisms because it is high in moisture, rich in nitrogenous foods of various degree of complexity, and plentifully supplied with minerals and accessory growth factors. Also, it usually has some fermentable carbohydrate (glycogen) and is at a favorable pH for most microorganisms. True putrefaction is the anaerobic decomposition of protein with the production of foul-smelling compounds such as hydrogen sulphide, mercaptant, indole, skatol, ammonia, and amines. It usually is caused by species of Clostridium, but facultative bacteria may cause putrefaction or assist in its production, as evidenced by the long list of species with the specific names putrefaciens, putrefidum, putida, etc., chiefly in the genera Pseudomonas and Alkaligenes. Also, some species of Proteus are putrefactive. Changes in meat quality are mainly associated with levels of glycogen and lactic acid (pH). Stress in any form seriously affects these entities; glycogen levels are decreased with the formation of less lactic acid after slaughter, a higher pH and poorer keeping quality of the meat. Stress brought about by factors not associated with disease conditions is sometimes encountered on ante-mortem inspection. The stressors involved are many and include fear, excitement, sever pain, overcrowding, mixing of different social groups, high and low environmental temperatures, marked physical effort, strange noises and surroundings, estrous and low transport standards. Exhaustion and elevated temperature attend these situations and along with tissue hyperaemia make the stressed animal unsuitable for immediate slaughter. Slaughter in these cases should be delayed, adequate rest being given and antemortem inspection repeated at an appropriate time. The high pH of the flesh from exhausted or ill animals favours bacterial growth and prejudices carcass durability. During the act of stieking, baeteria can enter the jugular vein or anterior vena cava and travel in the blood to the musele, lung and bone marrow. With respect to the keeping quality of meat, it is well know that meat from fatigued animals spoils faster than that from rested animals, and that this is a direct consequence of final pH attained upon completion of rigor mortis. Upon the death of a well-rested meat animal, the usual 1% glycogen is converted into lactic acid, which directly causes a depression in pH values from about 7.4 to 5.6, depending upon the type of animal **(Gracey and Collins, 1992 and Frazier and Westhoff, 1995)**.

Therefore, the present work was intended for evaluating the bacteriological quality of beef, the most common Egyptian favorite native meat, derived from traditional slaughtered cattle in our abattoirs without any previous slaughter treatment, through fulfilling the following points: (1) Determination of both acrobic mesophilic bacteria (APC) and Enterobacteriaceae organisms in deep tissues of flexor carpi radialis muscle, prescapular lymph node, mesenteric lymph node, and livers of beef carcasses, slaughtered and dressed at old-fashioned Mansoura abattoir, and (2) Measurement of pHu levels in diaphragm

muscle of the same bacteriologically-tested carcasses, after being refrigerated at 8-10°C for 24 h.

MATERIALS AND METHODS

[A] Collection of samples:

A total of 35 beef carcasses at Mansoura old-fashioned abattoir categorized as 25 carcasses from unrested animals, slaughtered and dressed immediately when received at abattoir, plus 10 carcasses from rested animals, slaughtered and dressed after 4 h-resting period at waiting pen of the abattoir, were evaluated for their quality through both bacteriological examination of muscle, lymph nodes and liver besides estimation of meat pH.

Whole muscle of flexor carpi radialis **(Getty, 1975)** plus one prescapular lymph node (intact and embedded in fat) of one carcass side in addition to 3 mesenteric lymph nodes (intact and embedded in fat) and about 250 g of liver tissue (left lobe) were sampled from each of the all surveyed carcasses and subjected for bacteriological tests besides almost 100 g-portion of costal part of the fleshy rim of diaphragm **(Getty, 1975)** was sampled from the same carcass and directed for pH estimation.

Every sample was individually and aseptically packed into a polyethylene bag then marked and transferred -in icebox with a minimum of delay- to the laboratory of Food Hygiene and Control Department, Faculty of Veterinary Medicine, Mansoura University, wherein the bacteriological analyses and preparation for pH estimation were done.

[B] Preparation of samples (AOAC, 1990):

(1) Samples for bacteriological analyses (Gill and Penney, 1977; AOAC, 1990 and Gracey and Collins, 1992):

• **Muscle and liver samples:** Ten grams were ascptically excised from the substance (deep tissue) each of both muscle and liver samples after sterilizing their surfaces by searing them to a depth of 3 mm using a heated spatula (showing redness), to avoid contaminating the excised deep tissues with organisms from the surface, then homogenized with 90 ml of 0.1% sterile peptone water (Oxoid CM0009) for one minute in a laboratory blender (Type: Moulinex-made in France) for obtaining an original dilution of 1:10. One ml from each of the original dilution was transferred to sterile test tubes containing 9 ml of the same diluent to be diluted in a sequential manner preparing a tenfold serial dilutions up to 10^6, to cover the expected range of samples contamination.

• **Lymph node samples:** the same technique was carried out for preparing these samples as described for muscle and liver ones with the exception of sterilizing the node surface by flaming them after fat removal and immersing in methanol.

(2) Samples for pH estimation (Pearson, 1984):

Ten grams from every collected muscle of diaphragm-after being refrigerated at 8-10°C/ 24 h and freed of fat, tendons, fascia and blood vessels-were homogenized with 10 ml of distilled water for one minute in a well-rinsed flask of aforementioned laboratory blender. The resultant meat extract was direct for pH

measuring after standing for 15 minutes, by using an electric pH meter.

[C] Bacteriological analyses:

(1) Aerobic plate count (ICMSF, 1978):

A tenth ml from each prepared serial dilution was transferred and evenly spread over a dry surface of duplicated, previously prepared sterile plate count agar medium (Oxoid CM0325B). The surface of inoculated plates was allowed to dry for 15 minutes before being placed inverted with control plates in the incubator adjusted at 30°C for 2 days. The bacterial colonies in the countable plates (having 30-300 colonies) were enumerated and the aerobic plate count per each g of examined samples was calculated and recorded.

(2) Enterobacteriaceae count (ISO, 1993):

Duplicated sets of sterile Petri dishes were inoculated with 1-ml amounts of the chosen range of prepared dilutions. A quantity of about 15 ml of violet red bile glucose agar (Oxoid CM485B), melted and cooled to 45°C, was added to each inoculated Petri dish, then mixed well and allowed to set. Another 5 ml of the same agar/temperature was finally overlain every plate, which left to be solidified, then incubated "inverted" at 30°C for 24 h. Typical colonies of Enterobacteriaceae (red surrounded by precipitation of bile salts in the medium and having 0.5 mm or more in diameter) were enumerated in the countable plates (having 25-250 colonies) and the Enterobacteriaceae count per g of the examined sample was calculated and recorded.

[D] pH measurement:

The pH values of prepared meat extract were measured by using an electric pH meter (Model: pH-206, Lutron Electronic, Australia) according to its operation manual, as follows:

(1) Calibration of the pH meter: pH ELECTRODE was connected to the BNC socket then placed into buffer pH 7 solution (Arabian Medical & Scientific Lab. Sup. Co.); followed by sliding the FUNCTION SWITCH to the pH position; "pH 7 (CAL) ADJ. KNOB" then adjusted until the reading value exact same as 7; the "TEMP. COMPENSATION KNOB" was adjusted to the value of the temperature of the pH 4 buffer; the pH electrode rinsed in distilled water then placed into the pH 4 buffer followed by adjusting "pH 4 (SLOPE) ADJ. KNOB" until the reading value exact same as 4.

(2) pH measurement: After the instrument and pH electrode were calibrated, the latter was placed into the tested meat extract after being rinsed in distilled water for direct measuring of the meat pH. Also the temperature probe was dipped in the tested solution for automatic temperature compensation of the pH reading.

[E] Statistical analyses:

The data obtained in this study were statistically analyzed according to methods described by **Snedecor (1989)**.

RESULTS & DISCUSSION

Inspection of Table (1) shows the occurrence of the general bacterial contaminants, represented by aerobic mesophiles, in all tested deep tissues of unrested slaughtered beef animals where they can be detected in 25 (100%) each of flexor carpi radialis muscle, prescapular lymph node, mesenteric lymph

node, and liver. Lesser presence of Enterobacteriaceae organisms were found in the aforementioned samples as they can only be recovered from 3 (12%) muscle, 1 (4%) prescapular lymph node, 5 (20%) mesenteric lymph node, and 10 (40%) liver samples. On the other hand, an exclusive decrease of the occurrence of aerobic mesophiles in surveyed tissues of beef careasses of 4 h-rested animals was observed in muscle where these organisms were represented by 7 (70%) muscle samples, whilst such occurrence was estimated in all the remaining tissues of the same carcasses; 10 (100%) samples every of prescapular lymph node, mesenteric lymph node, and liver. Meanwhile Enterobacteriaceae organisms cannot be detected in any muscle or prescapular lymph node sample (0% each) whereas can be found in one liver sample (10%) plus two samples (20%) of mesenteric lymph node of 4 h-rested beef animals. The obtained results exhibited much higher prevalence of both aerobic mesophilic bacteria and Enterobacteriaceae organisms in deep tissues, particularly of liver and mesenteric lymph node, of beef carcasses slaughtered without resting than that found in similar tissues of beef carcasses slaughtered after 4 h-resting at abattoir pen. The widespread presence of bacterial contaminants in surveyed tissue samples coincided with the literature of **Lepevetsky et al. (1953)** who emphasized that there is adequate support for the hypothesis that few microorganisms may be present in certain of the living tissues in addition to the bacteria in the deep tissues reach the lymph nodes via the lymphatic capillaries. Also, **Lawrie (1966)** enumerated the major sources of bacterial contamination in deep carcass tissues as animal's own lymph nodes, the stick knife used for exsanguination, and intestinal tract. Similar incidence of aerobic mesophilic bacteria (100%) was obtained by **Hassan (1999)** in all surveyed deep tissue samples (flesh, liver, spleen, kidney) of both normally- and emergency-slaughtered beef careasses, whilst lesser occurrence of the same organisms (40%) in lymph nodes, 2 h after slaughter, was recorded by **Lepevetsky et al. (1953)** who could also recover the Enterobacteriaceae organisms in deep tissues of higher lymph node samples (65.22%) and lower muscle samples (8.7%) of beef carcasses. Also, **Hassan (1999)** could isolate these latter organisms from the tissues of 40% and 66.67% of hindquarter flesh besides of 60% and 93.33% of liver samples excised aseptically from both normally- and emergency-slaughtered beef carcasses, respectively; by higher prevalence than that obtained in the present work. Furthermore, the particular increase of Enterobacteriaceae occurrence in tested liver and mesenteric lymph node samples can be explained by the literature of **Gracey and Collins (1992)** who stated that the laboratory experience has shown that the liver frequently contains intestinal bacteria which have gained entry by way of the portal vein; as this invasion may occur after slaughter. A relatively high prevalence of bacterial contaminants, particularly of aerobic mesophiles, in 70%-100% of carcasses' tissues of 4 h-rested animals may be attributed to the inadequacy of the received lairaging period (4 h) as well as emphasized the recommendation reported by **Thornton (1969)** who mentioned that in long transport times, the beef animals will require several days to re-established their physiological normality. Although slight reduction in the presenee of bacterial contaminant, especially Enterobac-

teriaceae organisms, in carcasses' tissues of 4 h-rested animals were obtained in the present study (Table 1).

Concerning the baeterial populations of aerobic mesophiles in excised tissues, dried plates of plate count agar medium showed counts ranged from 102-$3.7x10^4$ with a mean of $3.4x10^3 \pm 1.5x10^3$ and 0-$7.5x10^2$ with a mean of $2.6x10^2 \pm 10^2$ organisms/g of muscle, 10^2-$2x10^5$ with a mean of $4.6x10^4 \pm 10^4$ and 5x10-$4x10^2$ with a mean of $1.8x10^2 \pm 0.4x10^2$ organisms/g of preseapular lymph node, $4x10^2$-$4.5x10^5$ with a mean of $9.5x10^4 \pm 2.3x10^4$ and $1.5x10^2$-$1.7x10^3$ with a mean of $8.9x10^2 \pm 2.1x10^2$ organisms/g of mesenteric lymph node, besides $3x10^2$-$2.9x10^5$ with a mean of $4.7x10^4 \pm 1.3x10^4$ and 5x10-$1.2x10^3$ with a mean of $5x10^2 \pm 1.3x10^2$ organisms/g of liver taken from the carcasses of unrested- and 4 h-rested beef animals, respeetively (Table 2). These findings reveal that the highest mean value of general bacterial contamination, in the carcasses' tissues of unrested beef animals, was detected in mesenteric lymph nodes ($9.5x10^4$ organisms/g), followed - almost equally- by those evaluated in livers ($4.7x10^4$ organisms/g) and prescapular lymph nodes ($4.6x10^4$ organisms/g), then the lowest contamination level that found in muscle tissues ($3.4x10^3$ organisms/g). Similarly, sequential descent was also observed in levels of aerobic mesophilie bacteria estimated in tissue samples excised from 4 h-rested beef animals, as the highest mean level ($8.9x10^2$ organisms/g) was recovered from mesenteric lymph nodes followed by that evaluated in liver ($5x10^2$ organisms/g) then almost equally those deteeted in muscles ($2.6x10^2$ organisms/g) and prescapular lymph nodes ($1.8x10^2$ organisms/g). The top counts of general bacterial contaminants in surveyed lymph nodes of beef carcasses taken from both unrested- and 4 h-rested animals may be attributed to there continuous multiplication in such tissues **(Lepevetsky et al., 1953)** besides the reticuloendothelial system ceases to scavenge, thus allowing mieroorganisms to grow unchecked **(Lawrie, 1966).** By comparison, huge declines in the tissues' levels of general bacterial contamination were obtained in beef carcasses after lairaging their animals for 4 h; the findings that agreed with the work of **Flores et al. (2008)** whieh assured the efficacy of 4 h-resting period to beef animals, prior to slaughter, for rising their meat quality, as it revealed that when the waiting time of beef animals prior to slaughter was redueed to <4 h, the frequency of DFD defect in their flesh was higher by 30.27%. Additionally, **Hassan (1999)** could estimate the aforementioned organisms by higher mean eounts of $4.81x10^4$ and $7.34x10^5$ organisms/g of hindquarter flesh as well as of $1.44x10^5$ and $3.6x10^6$ organisms/g of liver samples taken from both normally- and emergency-slaughtered beef carcasses, successivcly. These variations in extent of bacterial eontamination in deep tissues of beef animal carcasses may be traced to the speeific eharacteristics of each animal, its geographie origin as well as the season of year **(Paramithiotis et al., 2009)**.

Data arranged in Table (3) show the intensities of Enterobaeteriaceae organisms in eontaminated tissue samples as a range of 0-4.7x10 and zero with mean of 4.68±1.23 and zero organisms/g of muscle, 0-102 and zero with mean of 4±1.31 and zero organisms/g of

prescapular lymph node, 0-10^2 and 0-7.5x10 with mean of 9.2x10±2.71x10 and 1.25x10±0.3x10 organisms/g of mesenteric lymph node, besides 0-10^3 and 0-2x10^2 with mean of 9.32x10±2.3x10 and 2x10±0.6x10 organisms/g of liver taken from both unrested and 4 h-rested beef animals, consecutively. Viewing the obtained results exhibit the highest and almost equal intensities of these organisms were detected in both liver and mesenteric lymph node samples from carcasses of unrested animals (mean of 9.32x10 and 9.2x10 organisms/g, respectively), whilst the lowest and nearly equal intensities were harbored in both muscle and prescapular lymph node samples from the same carcasses (mean of 4.68 and 4 organisms/g, successively). On the other hand, these organisms were only detected in both liver and mesenteric lymph node samples, taken from carcasses of 4 h-rested beef animals, with mean of 20 and 12.5 organisms/g, consecutively, whilst cannot be recovered from any of muscle or prescapular lymph node samples from the same carcasses. **Hassan (1999)** estimated extremely higher intensities of these organisms in deep tissues of hindquarter flesh; by a mean count of 3.76x10^2 and 6.23x10^2 as well as in liver by a mean of 6.61x10^2 and 1.21x10^3 organisms/g of samples taken from both normally- and emergency-slaughtered beef carcasses, consecutively. Furthermore, it is evident that the lairaging of beef animals for 4 h, done in this study prior to slaughter, could prevent the invasion of Enterobacteriaceae organisms into muscles or their draining lymph nodes, only few ones could emigrate from the intestinal tract into its draining lymph nodes and liver through portal vein **(Gracey and Collins, 1992)**.

Interpretation of all findings concerned with aforementioned bacteriological analyses (occurrence and intensities of both aerobic mesophilic bacteria and Enterobacteriaceae organisms in deep tissues of flexor carpi radialis muscle, prescapular lymph node, mesenteric lymph node, and liver taken from beef carcasses of unrested and 4 h-rested animals) concluded that although all the contaminated samples, in the present work, contained bacterial intensities by less than 10^7 organisms/g; coincided with the limit recommended by ICMSF "International Commission on Microbiological Specification for Foods", the spread of such bacteria throughout the surveyed tissues greatly favours bacterial decomposition, particularly when due to clostridia which may develop anaerobically in the deeper muscular portions of the carcass, it is now known that the presence of Clostridium perfringens in meat may give rise to enterotoxic food poisoning. Condemnation of carcasses shown to contain non-specific (non-pathogenic) bacteria is therefore justifiable when the bacteriological results show an extensive infection. In Denmark, the demonstration of non-specific bacteria from more than one submitted sample (not including the liver) is considered evidence of extensive infection (high grade) and the carcass condemned. On the other hand, where growth of non-specific bacteria is reported from only one of the submitted samples the infection is classified as low grade and is considered insufficient to justify total condemnation (**Gracey and Collins, 1992**). Furthermore, both **Lepevetsky et al. (1953) and Ingram and Dainty (1971)** were also maximized the danger of the widespread and heavy bacterial infections in deep carcass' tissues, as the former authors emphasized that

almost 4.8% of these bacteria are heat-resistant spores; whereas the latter workers mentioned that when the internal temperatures of contaminated carcass meat are not reduced to the refrigerator range, the spoilage is likely to occur by bacteria of internal sources; chief among these are Clostridium perfringens and genera in the Enterobacteriaceae family.

Electronic temperature-modified pH meter measured the pHu levels in diaphragm muscles taken from beef carcasses of unrested animals, 24 h after slaughter, by a minimum of 5.7 and a maximum of 6.3 with a mean of 5.94 ±0.04, whilst these readings in identical muscle from beef carcasses of 4 h-rested animals, 24 h after slaughter, were 5.48 as a minimum, 6.18 as a maximum with a mean of 5.8±0.07. Also, the obtained pHu readings exhibited that 16 (64%) and 4 (40%) muscle samples of unrested and 4 h-rested animals exceeded a level of 5.8, whereas 8 (32%) plus 1 (10%) of the same samples possessed pHu values > 6, successively (Table 4). Many researchers set up a pHu level of 5.8 in beef as a limit demarcating between high keeping quality beef when possessing pHu readings below and at this limit, whilst poorer quality ones had pHu levels above such limit **(Page et al., 2001; Kerry et al., 2002; Warriss, 2003; Apple et al., 2005 and Ferreira et al., 2006)**. Although numerous workers also considered 6.0 as a demarcation line of beef pHu levels i.e. the impaired-quality beef possessed a pHu of ≥ 6 **(Viljoen et al., 2002; Pipek et al., 2003; Hernandez et al., 2006; Mounier et al., 2006 and Jelenikova et al., 2008)** whereas **Gracey and Collins (1992)** emphasized that in Denmark of pHu of beef readings > 6.5 are regarded as evidence of poor keeping quality and such meat may not be sold through ordinary market channels. Seeing the pHu readings obtained in this work, about two thirds and one third of them exceeded 5.8 and 6 in beef samples taken from unrested animals, whilst only 2 fifths plus a tenth of another beef samples taken from 4 h-rested animals had pHu levels more than such limits, consecutively. These findings revealed that the surveyed unrested beef animals were slaughtered at Mansoura abattoir and at all the Egyptian old-fashioned abattoirs as well, without lairaging or any pre-slaughter treatment besides exposure of these animals to multiple stressors prior to slaughter like as physical exhaustion, excessive fatigue, mixing with unfamiliar animal groups, fighting among animals, high animal density in waiting pens, new noisy environment of abattoir, long-distance transportation, hot climate, restraint and other forms rough handling of animals. Additionally, the pHu levels in beef samples of 4 h-rested animals indicated the inadequacy of the beef animal lairaging for only four hours; most of workers found that the ideal lairaging of these animals can be fulfilled when performed in individual boxes for an overnight **(Franc et al., 1990; Maria et al., 2003 and Villarroel et al., 2003)** although **Warriss et al. (1984) and Mounair et al. (2006)** recommended the housing time for beef animals, before slaughter, by >17-48 h for restoring their glycogen reserves (at lairage) and excluding the undesirable high pHu values of their beef.

Both bacteriological and pHu readings of all surveyed 35 beef carcasses, slaughtered and dressed at Mansoura abattoir that

represent the old-fashioned abattoirs exclusively found in Egypt, justify the construction of waiting individual pens in these abattoirs all over the country for enabling the overnight housing of beef animals at them, in addition to minimizing the amount of stress prior to slaughter otherwise the almost exclusively favorite and expensive meat would continue to be offered for the Egyptians in poor quality forms; undesirable for human consumption owing to its darkened color and reduced flavor, causes important industry economic losses, tough on chewing when eaten cooked, hazardous for human health and more suseeptible to bacterial spoilage (**Lepevetsky et al., 1953; Corstiansen et al., 1981; Purchas, 1990; Gracey and Collins, 1992; Honikel, 2000; Pipek et al., 2003; Apple et al., 2005 and Jelenikova et al., 2008**).

Table (1): Numbers and percentages of tissue samples contaminated with each of aerobic mesophilic bacteria and Enterobacteriaceae organisms (n*=25 for unrested carcasses and 10 for rested ones).

Types of contaminated samples / Conditions of beef carcasses	Aerobic mesophiles-contaminated samples				Enterobacteriaceae- contaminated samples			
	Flexor carpi radialis muscle	Prescapular lymph node	Mesenteric lymph node	Liver	Flexor carpi radialis muscle	Prescapular lymph node	Mesenteric lymph node	Liver
Carcasses of unrested animals	25 (100%)	25 (100%)	25 (100%)	25 (100%)	3 (12%)	1 (4%)	5 (20%)	10 (40%)
Carcasses of 4 h-rested animals	7 (70%)	10 (100%)	10 (100%)	10 (100%)	0 (0%)	0 (0%)	2 (20%)	1 (10%)

n*= number of examined samples.

Table (2): Aerobic plate counts per gram of tissue samples (n*=25 for unrested carcasses and 10 for rested ones).

Types of contaminated samples / Conditions of beef carcasses	Flexor carpi radialis muscle			Prescapular lymph node			Mesenteric lymph node			Liver		
	Min	Max	Mean ± SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE
Carcasses of unrested animals	10^2	3.7×10^4	3.4×10^3 $\pm1.5\times10^3$	10^2	2×10^5	4.6×10^4 $\pm10^4$	4×10^2	4.5×10^5	9.5×10^4 $\pm2.3\times10^4$	3×10^2	2.9×10^5	4.7×10^4 $\pm1.3\times10^4$
Carcasses of 4 h-rested animals	0	7.5×10^2	2.6×10^2 $\pm10^2$	5×10	4×10^2	1.8×10^2 $\pm0.4\times10^2$	1.5×10^2	1.7×10^3	8.9×10^2 $\pm2.1\times10^2$	5×10	1.2×10^3	5×10^2 $\pm1.3\times10^2$

n*= number of examined samples. Min= minimum. Max= maximum. SE= standard error.

Table (3): Enterobacteriaceae counts per gram of tissue samples (n*=25 for unrested carcasses and 10 for rested ones).

Types of contaminated samples / Conditions of beef carcasses	Flexor carpi radialis muscle			Prescapular lymph node			Mesenteric lymph node			Liver		
	Min	Max	Mean ± SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE	Min	Max	Mean ± SE
Carcasses of unrested animals	0	4.7×10	4.68 ±1.23	0	10^2	4.0 ±1.31	0	$.10^2$	9.2×10 ±2.71×10	0	10^3	9.32×10 ±2.3×10
Carcasses of 4 h-rested animals	0	0	0	0	0	0	0	7.5×10	1.25×10 ±0.3× 10	0	2×10^2	2×10 ±0.6×10

n*= number of examined samples. Min= minimum. Max= maximum. SE= standard error.

Table (4): pH levels in diaphragm muscle of beef carcasses, 24 h after slaughter (n*=25 for unrested carcasses and 10 for rested ones).

pH levels / Conditions of beef carcasses	Min	Max	Mean ± SE	Numbers and percentages of samples exceeded pHu of 5.8	Numbers and percentages of samples exceeded pHu of 6
Carcasses of unrested animals	5.70	6.30	5.94 ± 0.04	16 (64%)	8 (32%)
Carcasses of 4 h-rested animals	5.48	6.18	5.80 ± 0.07	4 (40%)	1 (10%)

n*= number of examined samples.

REFERENCES

Apple, J. K.; Kegley, E. B.; Galloway, D. L.; Wistuba, T. J. and Rakes, L. K. (2005) : Duration of restraint and isolation stress as a model to study the dark-cutting condition in cattle. J. Animal Sci. 83: 1202-1214

AOAC (Association of Official Analytical Chemists) (1990) : Official Methods of Analysis, 15th ed. Washington, DC.

Corstiaensen, G. P.; Van Logtestijn, J. G.; Romme, A. M.; Vincenten, C. J. and Westgeest, P. W. (1981) : Dark, firm dry meat in beef bulls. Appearance and significance (author's transl). Tijdschrift voor Diergeneeskunde. 106: 655-661.

Ferreira, G. B.; Andrade, C. L.; Costa, F.; Freitas, M. Q.; Silva, T. J. P. and Santos, I. F. (2006) : Effects of transport time and rest period on the quality of electrically stimulated male cattle carcasses. Meat Sci. 74: 459-466.

Flores, A. P. S.; Linares, C. P.; Saavedra, F. F.; Serrano, A. B. and Lopez, E. S. (2008) : Evaluation of changes in management practices on frequency of DFD meat in cattle. J. Animal and Veterinary Advances 7: 319-321.

Franc, C.; Bartos, L.; Bouska, J.; Burda, J. and Slanec, E. (1990) : Prevention of the DFD defect of beef by housing of cattle in single-animal boxes at the slaugh–terhouse (in Czech). Zivoc. Vyr. 35: 603-608.

Frazier, W. C. and Westhoff, D. C. (1995) : Food microbiology, 4th ed. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Getty, R. (1975) : Ruminant mycology. In: The Anatomy of the Domestic Animals, 5th ed. Getty R. (Ed.). W. B. saunder company, chapter 28, pp. 791-860.

Gill, C. O. and Penney, N. (1977) : Penetration of bacteria into meat. Appl. Environ. Microbiol. 33: 1284-1286.

Gracey, J. E. and Collins, D. S. (1992) : Meat Hygiene, 9th ed. Bailliere Tindall, London, UK, p. 234.

Hassan, M. A. (1999) : Influenee of emergeney slaughter on bacteriologieal and chemical criteria of meat and edible offal. Benha Vet. Med. J. 10: 90-102.

Hernandez, B.; Lizaso, G.; Horcada, A.; Beriain, J. and Purroy, A. (2006) : Meat colour of fighting bulls. Arch. Latinoam. Prod. Animal 14: 90-94.

Honikel, K. O. (2000) : Aktuelles aus der internationalen Fleischforsehung-Veränderungen im Fleisch naeh dem Schlachten-Farbe des Fleisehes. Fleischwirtschaft 80: 116-119.

ICMSF (International Commission on Microbiological Specifications for Foods) (1978) : Microorganisms in Foods. 1 Their Significance and Methods of Enumeration, 2nd ed., University of Toronto Press, London.

Ingram, M. and Dainty, R. H. (1971) : Changes caused by microbes in spoilage of meats. J. Appl. Bacteriol. 34: 21-39.

ISO (International Organization for Standardization) (1993) : Mierobiology-General guidance for the enumeration of Enterobacteriaceae without resuscitation-MPN technique and colony-count technique; Standard 7402.

Jelenikova, J.; Pipke, P. and Staruch, L. (2008) : The influence of ante-mortem treatment on relationship between pH and tenderness of beef. Meat Sci. 80: 870-874.

Kerry, J.; Kerry, J. and Ledward, D. (2002) : Meat Processing: Improving quality. Woodhead Publishing Limited Abington Hall, Abington, Cambridge, England, pp. 53, 199.

Lawrie, R. A. (1966) : Meat science, chapters 4, 10. New York: Pergamon Press. Oxford.

Lepevetsky, B. C., Weiser, H. H. and Deatherage, F. E. (1953) : A microbiological study of lymph nodes, bone marrow and muscle tissue obtained from slaughtered cattle. Appl. Microbiol. 1: 57-59.

Mach, N.; Bach, A.; Velarde, A. and Devant, M. (2006) : Association between animal, transportation, slaughtering practices, and meat pH in beef. Meat Sci. 78: 232-238.

Maria, G. A.; Villarroela, M.; San-doa, C.; Olletaa, J. L. and Gebresenbetb, G. (2003) : Effect of transport time and ageing on aspects of beef quality. Meat Sci. 63: 1335-1340.

Mounier, L.; Dubroeucq, H.; Andanson, S. and Veissier, I. (2006) : Variations in meat pH of beef bulls in relation to conditions of transfer to slaughter and previous history of the animals .J. Animal Sci. 84: 1567-1576.

Page, J. K.; Wulf, D. M. and Schwotzer, T. R. (2001) : A survey of beef muscle color and pH. J. Animal Sci. 79: 678-687.

Paramithiotis, S.; Skandamis, P. N. and Nychas, G. J. E. (2009) : Insights into Fresh Meat Spoilage. In : Safety of Meat and Processed Meat, Toldra F. (Ed.). Springer Science-Business Media, LLC, New York, NY, USA, p. 55.

Pearson, D. (1984) : Chemical Analysis of Food. 8th ed. Publishing Co. Churchill Livingstone, Edinburgh, London.

Pipke, P.; Haberl, A. and Jelenikova, J. (2003) : Influence of slaughterhouse handling on the quality of beef careasses. Czech J. Animal Sci. 48: 371-378.

Purchas, R. W. (1990) : An assessment of the role of pH differences in determining the relative tenderness of meat from bulls and steers. Meat Sci. 27: 129-140.

Snedecor, G. W. (1989) : Statistical Method, 8th ed. The Iowa State Univ. Press.

Thornton, H. (1969) : Animals de açougue. In: Compêndio de inspecao de carnes 5th ed., Londres: Bailliere Tindall and Cassel, pp. 19-44.

Viljoen, H. F.; de Koch, H. L. and Webb, E. C. (2002) : Consumer acceptability of dark, firm and (DFD) and normal pH beef steaks. Meat Sci. 61: 181-185.

Villarroel, M.; Maria, G. A.; San-do, C.; Olleta, J. L. and Gebresenbet, G. (2003) : Effect of transport time on sensorial aspects of beef meat quality. Meat Sci. 63: 353-357.

Warriss, P. D. (2003): Ciencia de la Carne.Ed. Acribia, Zaragoza, Espana.

Warriss, P. D.; Kestin, S. C.; Brown, S. N. and Wilkins, L. J. (1984) : The time required for recovery from mixing stress in young bulls and the prevention of dark cutting beef. Meat Sci. 10: 53-68.

الملخص العربى

تقييم وتحسين جودة الذبائح البقرية المجهزة بمجزر المنصورة القديم (التقليدي)

أ. د. محمد محمد محمد الجزار* أ. د. محمد أحمد محمد حسن**

ط. ب. أميرة إبراهيم زكريا إبراهيم*

قسم الرقابة الصحية على الأغذية - كلية الطب البيطرى - جامعة المنصورة*

قسم مراقبة الأغذية - كلية الطب البيطرى - جامعة بنها**

تناولت الدراسة تقييم جودة اللحوم البقرية في خمس وثلاثين ذبيحة - تم ذبحها وتجهيزها فى مجزر المنصورة التقليدى (القديم) - من خلال إجراء الفحوص الجرائيمية بالإضافة إلى تقدير مستويات الأس الهيدروجينى لها.

وقد أظهرت أطباق العد الجرثومى plate count agar تراجد الجراثيم الهوائية المحبة للحرارة المعتدلة aerobic mesophiles في جميع عينات الذبائح المختبرة [25(100%)] والمذبوحة بدون إراحة سابقة، بنطاقات (حد أدنى - حد أقصى) و متوسطات± أخطاء معيارية 10^{2}-10^{4}x3.7 و 10^{3}x3.4±10^{3}x1.5 جرثوم/جرام من العضلة الباسطة الزندية، 10^{2}-10^{5}x2 و 10^{4}x4.6+10^{4} جرثوم/جرام من العقدة الليمفية الكتفية، 10^{2}x4-10^{5}x4.5 و 10^{4}x9.5+10^{4}x2.3 جرثوم/جرام من العقدة الليمفية المساريقية بجانب 10^{2}x3-10^{5}x2.9 و 10^{4}x4.7+10^{4}x1.3 جرثوم/جرام من الكبد، فى حين وجدت الجراثيم المعوية Enterobacteriaceae بنسب و أعداد أقل فى تلك العينات حيث أظهر مستنبت الآجار الخاص بتلك الجراثيم (جلوكوز- مرارة - الأحمر البنفسجى) violet red bile glucose agar تراجد تلك الجراثيم فى (12%) 3 من عينات العضلة الباسطة الزندية flexor carpi radialis muscle بأعداد 0-47 و4.68±1.23 جرثوم/جرام، فى 1 (4%) من عينات العقدة الليمفية الكتفية prescapular lymph node بأعداد 0-100 و 4±1.31 جرثوم/جرام، فى 5 (20%) من عينات العقدة الليمفية المساريقية mesenteric lymph node بأعداد 0-100 و 92±27.1 جرثوم/جرام، و كذلك فى 10 (40%) من عينات الكبد بأعداد 0-1000 و 93.2±23 جرثوم/جرام.

ومن ناحية أخرى فقد أجريت فحوص جرائيمية مماثلة على أنسجة مشابهة - أخذت من عشر ذبائح لحيوانات تمت إراحتها قبل ذبحها أربع ساعات - أظهرت تراجد الجراثيم الهوائية المحبة للحرارة المعتدلة aerobic mesophiles في 7 (70%) من عينات العضلة الباسطة الزندية flexor carpi radialis muscle بأعداد 0-10^{2}x7.5 و 10^{2}x2.6±10^{2}10 جرثوم/جرام، بينما كان هذا التواجد فى أنسجة كل من العينات المتبقية [10(100%)] بأعداد 5 x10-10^{2}x4 و 10^{2}x1.8±10^{2}x0.4 جرثوم/جرام من العقدة الليمفية الكتفية، 1.5 x10^{2}-10^{3}x1.7 و 10^{2}x8.9±10^{2}x2.1 جرثوم/جرام من العقدة الليمفية المساريقية بجانب 5x10-10^{3}x1.2 و 10^{2}5x10^{2}±10^{2}x1.3 جرثوم/جرام من الكبد ;فى حين لم يعثر على الجراثيم المعوية فى

أعـــاق أنســجة كـــل من العضـــلة الباســـطة الزنـــديـــة flexor carpi radialis muscle أو العقـــدة الليمفـية الكتفية prescapular lymph node (0%) للذبائح المختبرة، بينما تواجدت تلك الجراثيم فى 2 (20%) من عينات العقدة الليمفية المساريقية بأعداد 0-75 و 3±12.5 جرثوم/جرام، و أيضا في 1 (10%) من عينات الكبد لنفس الذبائح بأعداد 0-200 و 6±20 جرثوم/جرام.

وقد تم تقدير مستويات الأس الهيدروجيني باستخدام جهاز قياس الأس الهيدروجيني (pH meter) فى عضلة الحجاب الحاجز لكل الذبائح المختبرة بعد مرور أربع و عشرون ساعة من ذبحها حيث كانت 6.30-5.70 و 0.04±5.94 لذبائح الأبقار التي ذبحت دون إراحة حيواناتها، بالإضافة إلى 6.18-5.48 و 0.07±5.80 لعينات ذبائح الأبقار بعد إراحة حيواناتها لمدة أربع ساعات. و بالنظر إلى القيم التفصيلية للأس الهيدروجيني في كلتا المجموعتين تبين أن 16(64%) و 8 (32%) من عينات ذبائح المجموعة الأولى (التي ذبحت بدون إراحة سابقة) بالإضافة إلى 4 (40%) و 1 (10%) من عينات ذبائح المجموعة الثانية (التى ذبحت بعد توفير فترة راحة قدرها أربع ساعات) قد تجاوزت 5.8 و 6 على التوالى. وبالنظر إلى نتائج كل من الفحص الجرثومى و مستويات الأس الهيدروجينى لكل مجموعة من الذبائح المختبرة اتضح أنه توجد علاقة طفيفة وغير ثابتة بينهما.

هـذا وقـد تمت مناقشـة الأهمـية الصحية و الاقتصادية لتلك النتائج و كذلك النصائح الهادفة لحل مشكلة جردة الذبائح البقرية بمجازرنا فى ربـوع مصـر.