QUALITY OF BEEF AND EDIBLE OFFAL AT ABATTOIR LEVEL

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ABSTRACT

A total of 120 random samples of cattle shoulder meat, liver, kidneys and lungs (30 of each) were collected from two traditional abattoirs of Elbehira province. All collected samples were subjected to organoleptic, chemical and microbiological examinations to determine their quality. The results showed that the sensory characters (color, odor and consistency) and chemical parameters (pH with the mean of 5.70 ± 0.04, 6.45 ± 0.02, 6.49 ± 0.01, 6.48 ± 0.02, TVN with the mean of 12.68 ± 0.02, 13.06 ± 0.04, 12.76 ± 0.03, 12.98 ± 0.04 and TBA with the mean of 0.24 ± 0.01, 0.16 ± 0.01, 0.25 ± 0.01, 0.24 ± 0.01) for shoulder meat, liver, kidneys and lungs respectively were normal and accepted. On the other hand the results of microbiological examination in examined samples of shoulder meat, liver, kidneys and lungs revealed that the mean of total APC were 2.36×10⁵ ± 48×10³ , 20.1×10⁴ ± 37×10³, 3.43×10⁵ ±1.97×10⁵ ,18.9×10⁴ ±3.8×10⁴, respectively. While the mean of Enterobacteriaceae count were 10.8×10⁴ ± 2.6×10⁴ , 84×10³ ± 18×10³ , 69×10³ ± 17×10³ , 84×10³ ± 21×10³, respectively, coliform count with the mean of 44×10³±12×10³, 34×10³±7×10³, 22×10³±5×10³, 32×10³±8×10³ respectively, total Staphylococci count with the mean of 28×10³±5×10³, 23×10³±4×10³, 23×10³±5×10³, 20×10³±4×10³ respectively, total mould with the mean of 1.24×10²±0.64×10², 0.46×10²±0.9×10², 0.49×10²±0.1×10², 0.87×10²±0.22 ×10², respectively and total yeast count with the mean of 2.59×10²±1.41×10², 0.85×10²±0.36×10², 0.23×10²±0.07×10², 1.62×10² ± 0.8×10², respectively, were higher than the permissible limits and the examined samples failed to be accepted.

KEY WORDS: Shoulder meat, liver, kidneys, lungs, organoleptic examination, chemical examination, microbiological examination, abattoirs.

1- INTRODUCTION

Fresh meat is highly perishable due to its biological composition. The slaughter of animals yields many edible products other than carcass meat (such as red offal), which are fit for human consumption. They are used either as prepared items (e.g. slices of liver) or used as ingredients in meat products. The market for ‘edible by-products’ differs with country (even region) and culture (Devatkl et al., 2004). The intact tissues of healthy slaughtered animals are mostly sterile but the meat may be contaminated during slaughtering, handling, processing and storage from hands, workers, clothes, knives, hide, gut, fecal material on feet or from the environment. Microbial contamination of the carcass results in spoilage of meat, reduced shelf-life of meat and public health hazards (Phillips et al., 2006) either due to presence of spoilage bacteria responsible for unfavorable changes or pathogenic bacteria leading to harmful effects as food infection or intoxication among consumers (Eley, 1992). Organoleptic, chemical and microbiological quality of fresh meat and edible offal have been receiving attention, all over the world, from researchers, food industry, health organization and governments due to the occurrence of significant outbreaks of food borne illness affecting consumers. Quality maintenance is important not only for consumer health.
Quality of beef and edible offal at abattoir level

This page is a continuation of the previous one, discussing the evaluation of organoleptic, chemical, and microbiological quality of cattle meat and edible offal at abattoir level. The objectives of the study were to assess the quality of these products at different stages of production and to improve the overall quality.

2. MATERIAL AND METHODS:

2.1. Collection of samples:
A grand total of 120 cut samples of cattle shoulder meat and internal edible offal (liver, kidneys, and lungs) (30 of each) were equally collected from 30 different cattle carcasses slaughtered in two different traditional abattoirs in El Behera governorate (15 carcasses from each abattoir). The samples were collected after complete stamping of slaughtered animals, and transferred to the laboratory in an insulated ice box under complete aseptic conditions, without undue delay for organoleptic, chemical, and microbiological examinations.

2.2. Organoleptic Examination:

2.3. Chemical Examination:
- Determination of pH, TVN (FAO, 1980) and TBA (Kirk and Sawyers, 1991).

2.4. Microbiological Examination:
- Determination of APC, Enterobacteriaceae, coliform and total Staphylococcus counts (ICMSF, 1982).
- Determination of total mould and yeast count (Cruickshank et al., 1975).
- Isolation and identification of mould and yeast (Refai, 1987).
- Isolation and identification of Staphylococcus aureus (ICMSF, 1996).

2.5. Statistical analysis:
Data were analyzed by one way ANOVA. Means with different alphabetical superscripts in the same columns are significantly different at $P \leq 0.05$.

3. RESULTS:

From the results reported in table (1), it is obvious that 40%, 36.6% and 23.4% of the examined meat samples, 53.4%, 30% and 16.6% of the examined liver samples, 70%, 30% and zero% of the examined kidney samples and 43.4%, 26.6% and 30% of the examined lung samples took excellent, very good and good grades, respectively according to the quality system [1].

Regarding the results recorded in table (2), pH mean values $5.70 \pm 0.04$ in the examined meat samples, $6.45 \pm 0.02$ in the examined liver samples, $6.49 \pm 0.01$ in the examined kidneys samples and finally $6.48 \pm 0.02$ in the examined lung samples. It is evident from the results recorded in table (2) that TVN mean values (mg/100gm) $12.68 \pm 0.02$ in the examined meat samples, $13.06 \pm 0.04$ in the examined liver samples, $12.76 \pm 0.03$ in the examined kidney samples and finally $12.98 \pm 0.02$ in the examined lung samples. Results achieved in table (2) revealed that TBA mean values (mg malonaldehyde/kg of sample) $0.24 \pm 0.01$ in the examined meat samples, $0.16 \pm 0.01$ in the examined liver samples, $0.25 \pm 0.01$ in the examined kidney samples and finally $0.24 \pm 0.01$ in the examined lung samples. Moreover, table (2) revealed that there were high significant differences in pH, TVN and TBA values ($p < 0.05$) between the examined samples of meat and edible offal.

It is evident from the results recorded in table (3) that APC mean values (cfu/gm) in the examined samples $2.23 \times 10^5 \pm 48 \times 10^3$ for shoulder meat, $20.1 \times 10^4 \pm 37 \times 10^3$ for liver, $3.43 \times 10^5 \pm 1.97 \times 10^5$ for kidneys and $18.9 \times 10^4 \pm 3.8 \times 10^4$ for lungs. Table (3) indicated that the mean values of Enterobacteriaceae count (cfu/gm) in the examined samples $10.8 \times 10^4 \pm 2.6 \times 10^4$, $84 \times 103 \pm 18 \times 10^3$, $69 \times 10^3 \pm 17 \times 10^3$ and $84 \times 10^3 \pm 21 \times 10^3$ for shoulder meat, liver, kidneys and lungs respectively. From the obtained results recorded in table (3), it was clear that the mean values of coliform count (cfu/gm) in
the examined samples $44 \times 10^3 \pm 12 \times 10^3$ for shoulder meat, $34 \times 10^3 \pm 7 \times 10^3$ for liver, $22 \times 10^3 \pm 5 \times 10^3$ for kidneys and $32 \times 10^3 \pm 8 \times 10^3$ for lungs. The data recorded in table (3) revealed that the mean values of total Staphylococci count (cfu/gm) in the examined samples were $28 \times 10^3 \pm 5 \times 10^3$ for shoulder meat, $23 \times 10^3 \pm 4 \times 10^3$ for liver, $23 \times 10^3 \pm 5 \times 10^3$ for kidneys and $20 \times 10^3 \pm 4 \times 10^3$ for lungs. In other words, there were no significant differences in APC, Enterobacteriaceae, coliform and total Staphylococci counts ($P < 0.05$) between the examined samples of meat and edible offal. Table (4) declared that 40%, 20%, 13.3% and 30% of the examined meat, liver, kidney and lung samples, respectively, were contaminated with S. aureus. It is evident from table (3) that the mean values of total mould count (cfu/gm) of the examined samples $1.24 \times 10^2 \pm 0.64 \times 10^2$ for shoulder meat, $0.46 \times 10^2 \pm 0.09 \times 10^2$ for liver, $0.49 \times 10^2 \pm 0.1 \times 10^2$ for kidneys and $0.87 \times 10^2 \pm 0.22 \times 10^2$ for lungs. Means within examined samples of meat and edible offal showed no significant differences ($P < 0.05$). Identification of mould species isolated from the examined samples of meat and edible offal was shown in table (5). In shoulder meat were Aspergillus spp. 66.6%, Penicillium spp. 23.3%, Geotrichum spp. 43.3%, Cladosporium spp. 16.6%, Fusarium spp. 6.6%, Alternaria spp. 20% and Mucor spp. 36.6% but Rhizopus spp. failed to be detected, in liver were Aspergillus spp. 60%, Penicillium spp. 23.3%, Geotrichum spp. 13.3%, Cladosporium spp. 16.6%, Fusarium spp. 10%, Alternaria spp. 6.6%, Rhizopus spp. 10% and Mucor spp. 11%, in kidneys were Aspergillus spp. 56.6%, Penicillium spp. 13.3%, Geotrichum spp. 16.6%, Fusarium spp. 10%, Alternaria spp. 13.3%, Rhizopus spp. 6.6% and Mucor spp. 36.6%, but Cladosporium spp. failed to be detected, in lungs were Aspergillus spp. 63.3%, Penicillium spp. 20%, Geotrichum spp. 10%, Cladosporium spp. 23.3%, Fusarium spp. 20%, Alternaria spp. 16.6% and Mucor spp. 13.3% but Rhizopus spp. failed to be detected. It is evident from table (3) that the mean values of total yeast count (cfu/gm) of examined samples $2.59 \times 10^2 \pm 1.41 \times 10^2$ for shoulder meat, $0.85 \times 10^2 \pm 0.36 \times 10^2$ for liver, $0.23 \times 10^2 \pm 0.07 \times 10^2$ for kidneys and $1.62 \times 10^2 \pm 0.8 \times 10^2$ for lungs. Means within examined samples of meat and edible offal showed no significant differences ($P < 0.05$). Table (6) showed the incidence of species of yeast isolated from the examined samples of meat and edible offal. Rhodotorulla was detected in 50%, 56.6%, 33.3% and 53.3% of the examined meat, liver, kidney and lung samples, respectively. While, Candida kiusci was detected in 36.6%, 13.3%, 26.6% and 23.3% of the examined meat, liver, kidney and lung samples, respectively.

4. DISCUSSION:

Meat and edible offal have long been considered as highly desirable, nutritious and protein-rich food, but at the same time, unfortunately, they are also highly perishable because they provide the nutrients needed to support the growth of many types of microorganisms. Due to their unique biological and chemical nature, their quality attributes deteriorate from the time of slaughter until consumption (Kalalou et al., 2004). Due to lipid oxidation and bacterial growth which are the main factors that determine food quality loss and shelf life reduction. Lipid oxidation leads to the degradation of lipids and proteins which, in turn, contribute to the reduction in nutritional quality as well as deterioration in flavor, color and texture of displayed meat (Aguirrezábal et al., 2000). Bacterial contamination can precipitate major public health hazards and economic losses in terms of food poisoning and meat spoilage (Fernández – López et al., 2005). From the results reported in table (1), it is obvious that according to the quality system recommended by Devatkl et al. (2004). Accordingly, all the examined samples were accepted organoleptically. It could be concluded that the examined kidney...
Quality of beef and edible offal at abattoir level

Table (1): Organoleptic evaluation of examined cattle meat and offal samples at abattoir level (n= 30)

<table>
<thead>
<tr>
<th>Samples</th>
<th>Meat</th>
<th>Liver</th>
<th>Kidneys</th>
<th>Lungs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>Point No.</td>
<td>% No.</td>
<td>% No.</td>
<td>% No.</td>
</tr>
<tr>
<td>Excellent</td>
<td>10</td>
<td>12</td>
<td>40</td>
<td>16</td>
</tr>
<tr>
<td>Very good</td>
<td>9</td>
<td>11</td>
<td>36.6</td>
<td>9</td>
</tr>
<tr>
<td>Good</td>
<td>8</td>
<td>7</td>
<td>23.4</td>
<td>5</td>
</tr>
</tbody>
</table>

Table (2): Statistical analyses of chemical results of examined samples of cattle meat and edible offal at abattoir level (n=30)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Meat</th>
<th>Liver</th>
<th>Kidneys</th>
<th>Lungs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>5.70 ± 0.04b</td>
<td>6.45 ± 0.02a</td>
<td>6.49 ± 0.01a</td>
<td>6.48 ± 0.02a</td>
</tr>
<tr>
<td>TVN</td>
<td>12.68 ± 0.02b</td>
<td>13.06 ± 0.04a</td>
<td>12.76 ± 0.03b</td>
<td>12.98 ± 0.04a</td>
</tr>
<tr>
<td>TBA</td>
<td>0.24 ± 0.01a</td>
<td>0.16 ± 0.01b</td>
<td>0.25 ± 0.01a</td>
<td>0.24 ± 0.01a</td>
</tr>
</tbody>
</table>

There were high significant differences (P < 0.05) in pH, TVN and TBA values of the examined samples.

Table (3): Statistical analyses of microbiological results of examined samples of cattle meat and edible offal at abattoir level (n=30)

<table>
<thead>
<tr>
<th>Count CFU/g</th>
<th>Meat</th>
<th>Liver</th>
<th>Kidney</th>
<th>Lung</th>
</tr>
</thead>
<tbody>
<tr>
<td>APC</td>
<td>2.36×10^5±48×10^3a</td>
<td>2.10±10^4±37×10^3a</td>
<td>3.43×10^5±1.97×10^5a</td>
<td>18.9×10^4±3.8×10^4a</td>
</tr>
<tr>
<td>EC</td>
<td>10.8×10^4±2.6×10^4a</td>
<td>8.10±10^3±18×10^3a</td>
<td>6.9×10^3±17×10^3a</td>
<td>8.4±10^3±21×10^3a</td>
</tr>
<tr>
<td>CC</td>
<td>44.10^3±12×10^3a a</td>
<td>3.4×10^3±7×10^3a a</td>
<td>2.2×10^3±5×10^3a a</td>
<td>3×10^3±8×10^3a a</td>
</tr>
<tr>
<td>TSC</td>
<td>2.8×10^3±5×10^3a a</td>
<td>2.3×10^3±4×10^3a a</td>
<td>2.3×10^3±5×10^3a a</td>
<td>2×10^3±4×10^3a a</td>
</tr>
<tr>
<td>TMC</td>
<td>1.24×10^2±0.64×10^2 a</td>
<td>0.46×10^2±0.09×10^2 a</td>
<td>0.49×10^2±0.1×10^2 a</td>
<td>0.87±10^2±0.22×10^2 a</td>
</tr>
<tr>
<td>TYC</td>
<td>2.59×10^2±1.41×10^2 a</td>
<td>0.23×10^2±0.07×10^2 a</td>
<td>0.85×10^2±0.36×10^2 a</td>
<td>1.62×10^2±0.8×10^2 a</td>
</tr>
</tbody>
</table>

There were no significant differences (P < 0.05) in APC, TEC, TCC, TSC, TMC and TYC of the examined samples.

-APC: Aerobic Plate Count.  -EC: Enterobactriaceae Count.
-CC: Coliform Count.            - TSC: Total Staphylococcal Count
-TMC: Total Mould Count.       - TYC: Total Yeast Count

Table (4): Incidence of Staphylococcus aureus isolated from the examined samples of cattle meat and edible offal at abattoir level (n=30)

<table>
<thead>
<tr>
<th>Samples</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Liver</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Kidney</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Lung</td>
<td>9</td>
<td>30</td>
</tr>
</tbody>
</table>
samples showed superior organoleptic quality than the examined lung samples. Such findings may be attributed to the fact that kidneys are embedded in body fat and remain hanged in the body cavity not handled except by the veterinarian’s knife. However, lungs undergo numerous faulty manipulations and handling from butchers. Regarding the results recorded in table (2), pH mean values in the examined samples and according to the safe permissible limit stipulated by EOS (2005) for pH in red meat (5.6 - 6.2) and edible offal (6 - 6.8), it was indicated that all the examined samples of meat and edible offal were in accordance with this limit. The obtained results were nearly similar to those reported by Immonen et al. (2000). While, higher results were obtained by El-Shamy (2011) in the examined liver samples (6.96 ± 0.09). However, lower results were reported El-Shamy (2011) in the examined lung samples (6.08 ± 0.07). pH value plays an important role for the microbiological growth quality affecting the shelf life of meat (Hathout-Amal and Aly-Soher, 2010). It is evident from the results recorded in table (2) that TVN mean values showed that all the examined samples of meat and edible offal were accepted according to the safe permissible limit recommended by EOS (2005) for TVN in red meat (should not exceed 20 mg/100 gm) and edible offal (should not exceed 30 mg/100 gm). TVN value was more useful for assessing the degree of meat deterioration than for evaluating the changes occurring during the first storage stages (El Marrakchi et al., 1990).
Results achieved in table (2) revealed that TBA mean values (mg malonaldehyde/kg of sample) in the examined meat and edible offal were accepted based on their TBA content according to EOS (2005) which stated that the maximum permissible limit for TBA in meat and edible offal should not exceed 0.9 mg malonaldehyde/kg of sample. TBA is a good indicator of the quality of meat. TBA value is a widely used indicator for the assessment of degree of lipid oxidation (Raharjo and Sofos, 1993). It is evident from the results recorded in table (3) that the mean values of APC (cfu/gm) in the examined samples of meat and edible offal and according to the safe permissible limit stipulated by EOS (2005) for APC in red meat (not exceed $10^6$ cfu/gm) and edible offal (not exceed $10^5$ cfu/gm), it was indicated that all the examined samples of red meat were in accordance with this limit. While, all the examined samples of edible offal were not in accordance with this limit. Concerning red meat cuts, nearly similar results were obtained by Feizullah and Daskalov (2010). However, lower results were obtained by Shimaa (2012). While, higher results were obtained by Hejazi (2013). Regarding to edible offal, lower results were obtained by Ammar (2012), but higher results were obtained by Rasha (2013). Aerobic plate count is generally accepted as a criterion for microbial contamination of carcasses and a useful indicator of hygienic conditions of abattoir (Cohen et al., 2007).

Table (3) indicated that the mean values of total Enterobacteriaceae count (cfu/gm) in the examined samples of meat and edible offal were accepted based on their Enterobacteriaceae count according to EC (2007) which stated that the maximum permissible limit for Enterobacteriaceae count in meat and edible offal should not exceed $3.17 \times 10^2$ cfu/gm. Regarding to red meat, nearly similar results were obtained by Hejazi (2013). However, higher results were obtained by Ali (1992) and lower results were obtained by Feizullah and Daskalov (2010), Sabik (2011), and Shimaa (2012). Concerning edible offal, higher results were obtained by El-Shamy (2011). While, lower results were obtained by Ammar (2012).

Enterobacteriaceae have an epidemiological importance as some of their members are pathogenic and may cause serious infections and food poisoning outbreaks to human being. The presence of Enterobacteriaceae in large numbers in food indicates improper hygienic measures, inadequate processing or recontamination due to cross contamination by raw materials, dirty equipment or unhygienic handling (Gill and Landers, 2004).

From the obtained results recorded in table (3), it was clear that the mean values of coliform count (cfu/gm) in the examined meat and edible offal and according to the safe permissible limit stipulated by FAM [33] for total coliform count in red meat (not exceed $10^3$ cfu/gm) and edible offal (not exceed $10^2$ cfu/gm), it was indicated that all the examined samples of red meat were unaccepted with this limit. The current results of red meat were nearly similar with those obtained by Hejazi (2013). While, higher results were obtained by Yadav et al. (2006) and lower results were obtained by Sabik (2011) and Shimaa (2012) $4.36 \times 10^2$ (cfu/gm). On the other hand, nearly similar results of edible offal were obtained by Ammar (2012). While, higher results were obtained by El-Shamy (2011). Furthermore, the high coliform count of edible offal may be attributed to the unsanitary conditions of offal collection after evisceration; putting offal on floor contaminated with fecal matters and delayed transportation of offal to special hygienic place. Total coliform count is used as general indicator of water pollution or sanitary conditions in the food processing environment (Feng et al., 2002).

The data recorded in table (3) revealed that the mean values of total Staphylococci count (cfu/gm) in the examined samples of meat and edible offal nearly similar with results in red meat which obtained by Sabik (2011). However, lower results were
obtained by El-Shamy (2008). Higher results were obtained by Hejazi (2013). While, nearly similar results in edible offal were obtained by El-Shamy (2011). Meanwhile, lower results were obtained by Ammar (2012). Higher results were obtained by Rasha (2013). *Staphylococci* are commonly found in the skin and upper respiratory tract of man and animals and can easily contaminate the carcass. The presence of *Staphylococci* on carcass surface may be due to contamination during dressing and evisceration in slaughter house, contaminated equipment, butcher’s hand with abrasions and wounds, slaughter of animal beside dressed one in the same area in the slaughter hall and contamination of air from crowness of workers and their aerosols (Lasts *et al.*, 1992). The obtained results of red meat were nearly similar with those reported El-Shamy (2011). While, lower results were obtained by Sabik (2011) who mentioned the ratio was 4%. Concerning edible offal, lower results were obtained by Rasha (2013) who found coagulase positive *S. aureus* in 4% and 4% of the examined samples of beef liver and kidney, respectively. Higher results were obtained by Ammar (2012) who found coagulase positive *S. aureus* in 42% and 28% of the examined samples of beef liver and kidney, respectively.

*Staphylococcus aureus* enterotoxins are the predominant cause of gastrointestinal symptoms observed during intoxications. *Staphylococcus aureus* is considered the third most important cause of disease in the world amongst the reported food-borne illnesses (Tamarapu *et al.*, 2001).

It is evident from table (3) that the mean values of total yeast count (cfu/gm) of the examined samples of meat and edible offal showed no significant differences (P < 0.05). Nearly similar results were obtained by El-Shamy (2011). Yeasts normally play a small role in spoilage because they constitute only a small portion of the initial population. They grow slowly in comparison with most bacteria and their growth may be limited by metabolic substances produced by bacteria. Spoilage yeasts find their way into food resulting in undesirable changes in physical appearance of food. Some species of yeast constitute a public health hazard as some species of *Candida* may cause gastrointestinal disturbances, vulvovaginitis, endocarditis, pulmonary infection, and occasionally fatal systemic disease (Jesenska and Hardinovva, 1981).
5. REFERENCES


Quality of beef and edible offal at abattoir level
