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*Original article*

# Microbiological Evaluation of Retail Veal Meat in the City of Al Bayda, libya

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**Abstract**

*By examining veal carcasses sold in Al Bayda and surrounding areas this study assessed the microbiological status in 2020. Eighty pieces of veal one for each of the shoulder, head, ribs, and thigh regions were randomly selected from several places selling the meat. Locations Aerobic plate count (APC) and enterobateriaceae were measured. In addition to isolating and identifying Salmonella and E. coli bacteria the presence of which indicates contamination they were found in samples taken from meat markets. The results showed the presence of APC in all different cuts of veal samples that were examined and evaluated during the study. We found the highest number of APC in thigh samples (1.3×106) and the lowest number found in rib meat samples (9.5×105). Regarding food poisoning bacteria six (30%) seven (35%) six (30%) and four (20%) of the twenty subjects had positive tests for Salmonella in the shoulder, ribs, and thighs. However, of the veal samples tested 18 (90%) 16 (80%) 15 (75%) and 19 (95%) contained E. coli. The results showed that a wide range of microorganisms from different sources may be present in fresh cuts of veal. This highlights the need to follow strict health precautions when handling cooking and slaughtering animals. It also highlights the need for regulatory authorities to take all necessary measures especially in light of the absence of inspection, sealing and cleanliness procedures for carcasses.*

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## INTRODUCTION

Controlling primary microbial contamination is important in ensuring bacteriological integrity as part of the overall guarantee of meat quality, especially veal meat, due to the multiple sources of contamination [1]. The consumption of veal meat is average compared to the consumption of poultry and sheep meat, especially in North African countries [2]. Calves are usually raised in small pens, but in recent periods, they have gained great importance as a source of protein and have their markets, especially with the rise in sheep meat prices [3].

Consumption of veal meat is considered very beneficial for the health of the consumer because it contains low levels of fat compared to sheep meat and a low cholesterol content [4]. Slaughtering, skinning, and eviscerating are three sequential steps involved in the process of preparing an animal for consumption. This handling causes a rise in the number of microbes, especially those of digestive origin if proper procedures are not followed [5]. The degree of

contamination of the carcass depends on the cleanliness of the calves themselves, as well as the slaughterhouse, the equipment used, the design of the slaughter facilities, and the method of slaughter. As in automated slaughter, there is less contamination than manual slaughter, the disinfectants used, and the sewage system in the slaughterhouse [3]. The presence of contaminated organisms in calf carcasses shows the effectiveness and effectiveness of the health measures and procedures followed during slaughter. Therefore, the purpose of this investigation was to assess the microbiome of calf carcasses by plate count (APC) and intestinal bacteria, in addition to the isolation of *Escherichia coli* and *Salmonella* [6].

## METHODS

### *Samples collection*

All of the samples were gathered from the meat markets in the city of Al-Bayda and were delivered to the microbiology lab at Omar Al-Mukhtar University by following the instructions in the box that was intended for that purpose. For additional microbiological analysis, 80 arbitrary samples of veal cuts (20 samples from each) from the shoulder, head, ribs, and thigh regions were gathered.

### *Microbiological analyses*

After leaving the samples to thaw and under complete sterilization inside the laboratory, the necessary serial dilutions were made. The dilution represents (10-1) according to previous studies (4, 5). About 25 grams were homogenized and transferred to a sterile mixture in a homogenizer flask containing 250 ml of 1% peptone water. The homogenization process involved subjecting the mixture to 2500 rpm for a duration of 2 minutes using standard plate number agar media. In the APC (Aerobic Plate Count) test, 1 ml of each dilution was then transferred and evenly spread onto separate petri dishes that contained agar growth medium. The plated dishes were subsequently placed in an incubator set at a temperature of 35C° ± 1C° for a period of 48 ± 2 hours. Following the specified incubation time, the plates were carefully examined to determine the presence of aerobic bacteria [9].Isolation and identification of *Escherichia coli* bacteria was done using MacConkey broth and eosin methylene blue (EMB) agar accoding to the standard methods [10]. The original suspension (1-10) was incubated for 24 hours at 37°C to prepare it for pre-enrichment with Salmonella. Then, for 24 h at 41°C, isolation and identification of Salmonella was done using Rappaport Vassilidis broth and Xylose Lysine Deoxycholate (XLD) agar [11].

## RESULTS

Table 1 displayed the findings of the study, indicating the presence of aerobic plate counts (APC) in various cuts of veal meat samples. The thigh samples exhibited the highest APC count (1.3 x 10^6), while the lowest count was observed in rib meat samples (9.5 x 10^5).

***Table 1. The aerobic plate counts (APC) at a temperature of 37 °C in different fresh cuts of veal meat obtained from the examined calf carcasses. The table displays the microbial counts in colony-forming units per gram (CFU/g).***

| Veal samples | (+) Samples | | Minimum of Samples | Maximum of Samples | Mean of Samples | Standard error the Mean |
|---|---|---|---|---|---|---|
| | Number | Percentage | | | | |
| Shoulder | 20 | 100 | $4.4x10^5$ | $1.8\ x10^6$ | $1.1x10^{6\ A}$ | **$1.1x10^5$** |
| Ribs | 20 | 100 | $4.5\ x10^5$ | $1.7\ x10^6$ | $9.5\ x10^{5A}$ | **$9.0\ x10^4$** |
| Head | 20 | 100 | $4.2\ x10^5$ | $1.8\ x10^6$ | $1.0\ x10^{6A}$ | **$1.2\ x10^5$** |
| Thigh | 20 | 100 | $5.8\ x10^5$ | $2.4\ x10^6$ | $1.3\ x10^{6A}$ | **$1.4x10^5$** |

*Significant differences ($p<0.05$)were observed among the means within the same column، indicated by different superscript letters.).*

According to Table 2, the thigh meat samples exhibited the highest count of intestinal bacteria, with a recorded value of 6.2 x 10^4. On the other hand, the shoulder meat samples displayed the lowest count, with a recorded value of 4.6 x 10^4. The analysis of calf carcasses revealed the presence of pathogens, as indicated by the data presented in Table 3. Specifically, when examining Enterobacteriaceae, the thigh meat samples exhibited the highest count, with a recorded value of 6.2 × 10^4. Conversely, the shoulder meat samples displayed the lowest count, with a recorded value of 4.6 × 10^4. This information is summarized in Table 2. Regarding the presence of pathogens isolated from the calf carcasses that were examined, the data in the table showed the presence of *Escherichia coli* and *Salmonella* in all samples. The highest percentage of presence of *Escherichia coli* was in (Thigh) samples and was estimated at 95%, and the highest percentage of presence of *Salmonella* was in( Ribs) samples and was estimated at 35%.

***Table 2. Counts of intestinal bacteria in various cuts of veal obtained from the examined calf carcasses. The bacterial counts are expressed in colony-forming units per gram (CFU/g).***

| Veal samples | (+) Samples | | Minimum of Samples | Maximum of Samples | Mean of Samples | Standard error the Mean |
|---|---|---|---|---|---|---|
| | Number | Percentage | | | | |
| Shoulder | 20 | 100 | $5.0 \times 10^3$ | $9.2 \times 10^4$ | $4.6 \times 10^{4\ A}$ | **$7.1 \times 10^3$** |
| Ribs | 20 | 100 | $1.3 \times 10^4$ | $9.0 \times 10^4$ | $5.7 \times 10^{4A}$ | **5.9 x103** |
| Head | 18 | 90 | $1.1 \times 10^4$ | $9.5 \times 10^4$ | $5.1 \times 10^{4A}$ | **6.5 x103** |
| Thigh | 20 | 100 | $3.0 \times 10^3$ | $1.3 \times 10^5$ | $6.2 \times 10^{4A}$ | **$9.2 \times 10^3$** |

*Means within the same column with different superscript letters are significantly different ($p < 0.05$).*

***Table 3. The occurrences of Salmonella and Escherichia coli isolated from different cuts of veal obtained from the examined calf carcasses. The bacterial counts are expressed in colony-forming units per gram (CFU/g).***

| Cuts of Veal | *Salmonella* (Number =20) | | *Escherichia coli* (Number =20) | |
|---|---|---|---|---|
| | Number | Percentage | Number | **Percentage** |
| Sample of Shoulder | 6 | 29 | 18 | **88** |
| Sample of Ribs | 7 | 33 | 16 | **79** |
| Sample of Head | 6 | 29 | 15 | **73** |
| Sample of Thigh | 4 | 18 | 19 | **93** |

# DISCUSSION

Microbial contamination poses a risk to the safety and duration of quality preservation for meat products. The slaughter process can lead to significant contamination of muscle tissue, involving a diverse array of microorganisms. The examination of different veal meat samples revealed varying levels of epiphyte populations. The results, presented inTable 1, indicated that the average APC (Aerobic Plate Count) values ranged from 9.6×10^5 to 1.2×10^6 CFU/g [5], Similar findings to those in Sudan were obtained, with average APC values of 1.7 x 10^6, 1.3 x 10^6, 1.2 x10^5, and 5.8x 10^6 CFU/g observed in the sample of shoulder, ribs, head, and thigh regions, respectively. Conversely, higher APC values of 2.8 x 10^6 and4.3 x 10^6 CFU/g were reported in the anterior and posterior quadrants, respectively, in studies conducted in Britain [6], and 3.8 x 106 in India [7]. Furthermore, In a previous study, the microbial quality of veal meat from three slaughterhouses was assessed, revealing that the majority of slaughterhouse walls exhibited an aerobic plate count (APC) lower than 10^5 CFU/g [9]. Similarly, a previous study indicated that the average aerobic plate count (APC) value in veal samples was below 10^5 CFU/g [10]. In a previous study, lower results were observed, with the average count of aerobic mesophilic microorganisms measuring 0.14 x 10^3 CFU/g in the thigh samples of calf carcasses [11].

Regarding the permissible limits, all 20 veal meat samples analyzed from the shoulder, ribs, head, and thigh regions surpassed the permissible limits as per the standards set by the World Food Organization [12]. The elevated levels of aerobic plate counts (APC) observed in the study, reaching 10^5 CFU/g of meat in sheep, could potentially be attributed to inadequate hygiene practices observed throughout the slaughter, processing, and handling of carcasses during marketing and sale. According to previous study [12], Microbial contamination of meat can arise from various sources such as water, floors, equipment, tools, and workers. When calf carcasses are slaughtered under specific hygienic conditions, they tend to have low microbial counts initially. However, the number of microorganisms increases during subsequent handling and processing. The findings of the study suggest that carcasses of calves slaughtered in private slaughterhouses exhibit higher bacterial counts compared to those slaughtered in government slaughterhouses due to a lack of sufficient control measures in place [1].

The primary cause of the overall bacterial population increase in calf carcasses is unsanitary handling during slaughter, evisceration, storage, and marketing at points of sale. The presence of intestinal bacteria in the meat indicates that contamination originates from feces and inadequate hygiene practices during carcass handling. In a previous study, the average quantities of intestinal bacteria in the shoulder, rib, head, and thigh regions of the examined calf carcasses were 4.7 ×10^4,5.7 × 10^4, 5.1 × 10^4, and 6.0× 10^4 CFU/g , respectively. NO statistically significant difference ($p > 0.05$) was observed among these regions. [12]. Similarly, in another study, the presence of enteric bacteria was detected in raw veal samples, with a count of 7.2 x 10^4 CFU/g [13]. Additionally, in Sudan, high numbers of intestinal bacteria were observed, with average values of 3.6 x 10^6 and 9.54 x 10^6 in the anterior and posterior

quadrants, respectively [14]. On the other hand, lower counts of Enterobacteriaceae were observed, measuring 9.2×10^2, 0.30×10^2, and 0.23×10^2 CFU/g for butcher shops, locally slaughtered carcasses, and frozen calf carcasses sold, respectively [15]. Furthermore, the average count of intestinal bacteria in the examined veal meat samples was found to be below 10^3 colony-forming units per gram [1].

*Escherichia coli* is a cause of food poisoning and is currently recognized as a human pathogen. Isolating *E. coli* from food samples is critical to consumer health since consumption of contaminated food can cause diarrhea in children and intestinal infections in adults [6].

In the present study, varying levels of E. coli were detected in different cuts of the previously examined veal meat samples. The presence of any positive E. coli cases in the samples violates the guidelines established by the World Food Organization standards [18]. According to the standards set by the World Food Organization, veal meat should be devoid of E. coli. However, similar findings were reported in which E. coli was detected in different proportions among sampled calves, with prevalence rates of 44% in the shoulder region, 60% in the rib region, 32% in the head region, and 40% in the thigh region [19]. Conversely, other studies reported lower rates of E. coli contamination [17,20]. In contrast, one study did not detect any presence of E. coli in the examined calf carcasses [7]. Salmonella species continue to be a significant contributor to foodborne illnesses globally, particularly in Africa. As per the guidelines established by the World Food Organization [22], the presence of *Salmonella* species in veal meat is strictly forbidden. This study explicitly prohibits its occurrence; *Salmonella* was identified in the analyzed veal cuts, with a prevalence ranging from 20% to 35%. These findings align with previous research [23], which also reported the detection of Salmonella spp. in calf carcasses, with an incidence of 27.4% in the front quarters and 20% in the rear quarters. In contrast, lower rates of Salmonella spp were observed, with 12% and 55% (*salmonella typhimurium*) detected in the carcasses of retail calves from Sudan [8]. Additionally, in a previous study, the presence of Salmonella spp was detected in veal meat samples, ranging from 0.5% to 11.9% [9]. Conversely, in a different study, no presence of Salmonella was observed in any of the examined calf carcasses [26]. Similarly, Salmonella was not isolated from the surfaces of the slaughtered carcasses, but varying proportions of Salmonella spp (ranging from 27% to 35%) were found in samples taken from the slaughterhouse environment such as walls and floors [27,28]. Furthermore, our findings align with previous data [10], which reported the isolation of Salmonella from slaughtered animals and detected rates of 4.3% and 6.5% among slaughterhouse personnel. The contamination of the calf carcasses with Salmonella bacteria was attributed to inadequate personal hygiene practices among slaughterhouse workers, failure to use appropriate cleaning disinfectants, and the absence of health requirements.

## CONCLUSION

The total number of microbes was increased during the handling of the carcass during slaughter, evisceration, and marketing, as well as appropriate storage and even transportation by non-designated vehicles. There is a need for more periodic studies on applying strict procedures while dealing with carcasses, raising awareness and educating slaughterhouse workers about the dangers of these microbes, and using appropriate disinfectants inside the slaughterhouse to reduce pathogens transmitted through food, especially meat, given its rapid contamination and spoilage

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# التقييم الميكروبيولوجي للحوم العجول بالتجزئة في مدينة البيضاء، ليبيا

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**المستخلص**

في هذه الدراسة تم فحص ذبائح العجول المُباعة في مدينة البيضاء والمناطق المحيطة بها وكان ذلك في عام 2020. تم اختيار ثمانين قطعة من لحم العجل لكلا من مناطق الكتف والرأس والضلوع والفخذ بشكل عشوائي من عدة أماكن لبيع اللحوم. تم قياس أطباق العد الهوائية والبكتيريا المعوية. بالإضافة إلى عزل وتحديد بكتيريا السالمونيلا والإشريكية القولونية التي يُشير وجودها إلى تلوث تم العثور عليه في عينات مأخوذة من أسواق اللحوم. أظهرت النتائج وجود عدد أطباق العد الهوائية في جميع القطع المختلفة لعينات لحم العجل التي تم فحصها وتقييمها أثناء الدراسة. وجدنا أكبر عدد من أطباق العد الهوائية في عينات الفخذ ($1.3 \times 106$) وأقل عدد موجود في عينات لحوم الأضلاع ($9.5 \times 105$). فيما يتعلق ببكتيريا التسمم الغذائي، كان لدينا ستة (30٪) سبعة (35٪) ستة (30٪) وأربعة (20٪) من العينات العشرين اختبارات إيجابية للسالمونيلا في الكتف والضلوع والفخذين. ومع ذلك، من بين عينات لحم العجل اختبرت 18 (90٪) 16 (80٪) 15 (75٪) و19 (95٪) تحتوي على الإشريكية القولونية. أظهرت النتائج أن مجموعة واسعة من الكائنات الحية الدقيقة من مصادر مختلفة قد تكون موجودة في قطع جديدة من لحم العجل. يُسلط هذا الضوء على الحاجة إلى اتباع الاحتياطات الصحية الصارمة عند التعامل مع الطهي وذبح الحيوانات. كما نرى ضرورة أن تتخذ السلطات الرقابية جميع التدابير اللازمة خاصة في ظل عدم وجود إجراءات تفتيش وختم ونظافة الذبائح.

**الكلمات الدالة**. اللحوم، البكتيريا المعوية، لحم العجل، البيضاء