

## Quality Assessment of Nutritional Value and Safety of Different Meat

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Received date: January 04, 2018; Accepted date: February 18, 2018; Published date: February 23, 2018

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### Abstract

**Objective:** Study aimed to evaluate the chemical composition and the microbiological quality of mutton, beef and camel meat.

**Methods:** A total of 30 musculus Biceps femoris muscles (breed: Egyptian sheep, cattle; camel: male, one-day postmortem, muscle pH: 5.75-5.95, 250 g weight) were purchased from Ismailia city abattoir. The mean moisture, fat, protein and ash content for mutton were 73.4, 3.2, 22.3 and 1.1 respectively, for beef meat were 68.5, 12.2, 18.1 and 1.3 respectively and for camel meat were 75.8, 1.7, 21.3 and 1.2.

**Results:** Meat chemical compositions of mutton and camel were significantly higher ( $P < 0.05$ ) than recorded for beef meat. The mean values of aerobic plate count for of mutton, beef and camel meat were 6.0, 5.6 and 4.5 Log CFU/g respectively. The mean values of total proteolytic counts for of mutton, beef and camel meat were 4.5, 3.5 and 3.2 Log CFU/g respectively. The mean values of total lipolytic counts for of mutton, beef and camel meat were 4.4, 4.0 and 2.2 Log CFU/g. respectively. The total yeast and mold counts were significantly higher ( $P < 0.05$ ) in mutton followed by beef then camel meat.

**Conclusion and recommendation:** The results of this study recommend that more stringent inspection and regular supervision and/or monitoring of hygiene practices in the abattoir to ensure production of good quality meat of high nutritive values.

**Keywords:** Mutton; Beef; Camel meat; Proteolytic counts; Lipolytic counts; protein content; ash

### Introduction

Fresh meat considering one of the most perishable food due to its composition which, rich in protein, omega-3 polyunsaturated fats, vitamin and minerals, in addition to wide range of endogenous antioxidants and other bioactive substances including carnitine, taurine, carnosine, ubiquinone and creatine [1-4]. These chemical components of meat varies according to the difference such as; animal species, age, breed, sex, feed and body weight. Consequently, quality of the meat is dependent upon changes in its chemical components; protein, moisture, fat and ash [5-7].

The abattoir is an important step in the production of meat as it presents some of the preferable opportunities for contamination. Biological, physical and chemical hazards may be encountered at an abattoir [8]. The most important microbial contamination sources arise from endogenous sources as the microbial load of meat mainly due to its high water activity, high protein content and approximately neutral pH [9-11]. Exogenous sources of meat were occurred during or after slaughtering, processing, abuse storage conditions including; and/or during the meat transportation [3,12-14].

The meat microbiological quality is very important concerning public health. There are more than a few reports on outbreaks of food poisoning because of meat consumption [10,15-17]. Carcass contamination resulting in meat spoilage, reduced meat shelf-life and

may cause a consumers health hazards either due to the presence of spoilage bacteria responsible for harsh changes or pathogenic bacteria leading to risky effects for consumers as food infection or intoxication [18,19].

Inspection of meat aimed to assessment of the quality control of slaughter animals and meat, which provide wholesome and safe meat for human consumption and achieved by abattoir meat inspectors (veterinarians) who is representing the authorities of public health [8,20].

Quality monitoring is important not only for protecting the consumer health but also for authority concern. Chemical and microbial quality of freshly meat and edible offal have been getting attention all over the global scales, from researchers, meat industry, governments and other health organizations due to its effect on the nutritive value of meat and susceptibility to food-borne illness affecting consumers. In addition, few studies discussed the chemical and microbial quality of mutton and camel meat. Therefore, this study aimed to evaluate the chemical and microbiological quality of different fresh meat, which slaughtered at Ismailia abattoir level, Egypt.

### Materials and Methods

#### Samples collection

A total of 30 musculus Biceps femoris muscles (Breed: Egyptian sheep, cattle; camel: male, one day postmortem, muscle pH: 5.75-5.95, 250 g weight) were purchased from Ismailia city abattoir. All samples

were immediately transported to the Food Hygiene Laboratory, Faculty of Veterinary Medicine, Suez Canal University. Meat was kept at cool chamber of refrigerator (3°C ±) until they were used for the experiments.

### Preparation of the beef samples

The external fat was trimmed then samples were divided into two portions, one for chemical evaluation and the other for microbiological analysis.

### Chemical analysis of the samples

**Determination of moisture content:** Performed using the AOAC [21] Official Method 950.46 moisture removal process. 2.0 g of meat samples was weighed out into aluminum tins and allowed to dry for 24 h at 100°C in an air-oven. After cooling, the loss in weight was calculated.

**Determination fat content:** Determined using the AOAC [22] A clean Soxhelt's flask was placed in a hot air oven at 105°C for 30 min, and then it was placed in desiccator and weighed just after cooling. The flask was fitted with a Soxhelt's extractor and secured in a stand on the bench. Mould a filter paper on a large test-tube and the homogenate meat sample was transferred into the paper and then plug the top of the paper with de-fattened cotton wool and push it into the lower part of the extractor. Then, light petroleum ether was added through the top of the extractor. A suitable condenser was attached and heating was applied to the flask in the apparatus on special water bath. The extraction was begun and continued for about 16 h. Then replaced the ordinary extractor with one that is suitable for removing solvent and placed it on the apparatus and tap of the condensed solvent. The flask was placed in a hot air oven at 105°C for 3-5 h. Hence, the flask was removed from time to time during the heating and blow air onto the fat by using a hand bellows. Finally, the flask was transferred to desiccator, cooled and weighed to determine the weight of fat by difference. The fat percentage of the original sample was calculated.

**Determination of protein content:** Protein was determined using the AOAC [23] Official Method 992.15 as follow: Digestion: One gram of the homogenate meat sample was placed in Kjeldahl's flask with 8 g catalyst mixture (96% anhydrous Sodium Sulfate, 3.5% Copper Sulfate and 0.5% Selenium Dioxide). Then, 20 ml of conc. H<sub>2</sub>SO<sub>4</sub> were poured on the sample and vigorous shaking was applied. Vigorous boiling was carried out till the mixture become clear and transparent then allowed to cool. This is called "digestion mixture". Distillation: The digested mixture was transferred into another Kjeldahl's flask then 400 ml of distilled water and 75 ml of 50% NaOH were added. The flask was connected with condenser then, heating was applied and receiving of the liberated ammonia in a conical flask contains 50 ml of 2% boric acid with indicator (20 g boric acid with 200 ml Alcohol plus 700 ml distilled water plus 10 ml mixed indicator) was carried out. Approximately, 300-330 ml of the distillate was gained. Titration: The

boric acid containing ammonia was titrated against N/10 H<sub>2</sub>SO<sub>4</sub> and determines the Number of ml of H<sub>2</sub>SO<sub>4</sub>. Calculation: Each ml of H<sub>2</sub>SO<sub>4</sub> N/10 was equivalent to 0.0014 g nitrogen. The total nitrogen in the sample was estimate by the macro-Kjeldahl's technique by the following equation:

**Percentage of nitrogen**=Number of ml of N/10 H<sub>2</sub>SO<sub>4</sub> × 0.0014 × 100.

**Determination of ash content:** Determined using AOAC [23] Official Method 920.153. Approximately 1.0 g of meat sample was placed into a dry, pre-weighed crucible. The samples were then placed into a Thermolyne box furnace at 600°C for 24 h. Samples were allowed to cool and weighed. Ash was calculated by loss in weight as percent was calculated.

### Microbiological analysis of the samples

**Enumeration of aerobic plate count:** Ten grams from each sample was aseptically cut and transferred into a sterile polythene stomacher bag and blended with 90 ml sterile normal saline in a stomacher homogenizer (Stomacher 400, Seaward medicals, UK.) at 230 rpm for 60 s. Then, one ml of the homogenate was aseptically transferred into 9 ml normal saline in test tube. Similarly, further dilutions required for inoculation was prepared by this decimal serial dilution process. The plating was done by adding a loopful from each dilution on Plate Count Agar medium using pour plate method. The colonies that formed after incubation at 35°C for 2 days under aerobic conditions were counted.

**Determination of total proteolytic count:** Carried out as recommended by APHA, [24] as follows: One ml of the previous decimal serial dilutions was inoculated in Skim Milk Agar medium aseptically then inoculated at 37°C for 48 h and examined for clear zone around the growth.

**Enumeration of total lipolytic count :** One ml of each dilution mixed with tributyrin nutrient agar media and incubated at 37°C/48 h, lipolytic activity was determined by measuring clear zone.

### Statistical analysis

Means and standard error were calculated among samples and the t-test was done for significant differences between meat samples using the Microsoft Office Excel 2007 and Graph Pad Instat 3 for Windows software. When P value > 0.05 → the observed difference is "not significant" When P value ≤ 0.05 → the observed difference is "significant".

### Results

Food safety is of principal importance to the meat industry. Chemical and microbial contamination of meat is a critical global problem [25].

Content	mutton			beef			camel Meat		
	Min.	Max.	Mean ±	Min.	Max.	Mean ±	Min.	Max.	Mean ±
Moisture	69.6	76.5	73.4 ± 1.25	65.2	71.4	68.3 ± 3.46	71.2	76	75.8 ± 2.70
Fat	1.8	7.5	3.2 ± 1.32	18.1	25.3	12.2 ± 2.4	1.2	2.3	1.7 ± 0.32

<b>Protein</b>	18.2	23.1	22.3 ± 1.65	17.4	22.6	18.1 ± 3.41	18.3	23.1	21.3 ± 1.43
<b>Ash</b>	0.7	2.3	1.1 ± 0.19	0.7	1.8	1.3 ± 0.20	0.8	1.5	1.2 ± 0.30

**Table 1:** Chemical Composition Estimates for meat of Slaughtered Animals at Ismailia Abattoir

**Chemical composition:** The mean moisture, fat, protein and ash values for the meat of slaughtered animals at Ismailia abattoir revealed in the table 1. The mean moisture content of mutton, beef, and camel meat were 73.4, 68.5, and 75.8 respectively. The mean fat content mutton, beef, and camel meat were 3.2, 12.3, and 1.7 respectively. The mean protein content of mutton, beef, and camel meat were 22.3, 18.1, and 21.3 respectively. The mean ash content of mutton, beef and camel meat were 1.1, 1.3, and 1.5 respectively.

**Bacteriological quality:** Aerobic plate count is a commonly recommended microbiological method for estimating the shelf-life of

meat. Bacteriological content for mutton, beef and camel meat at Ismailia abattoir were revealed in the table 2. The mean values of aerobic plate count for mutton, beef and camel meat were 6.0, 5.6, and 4.5 Log CFU/g respectively. Aerobic plate count is generally is an indicator of microbial contamination of carcasses and abattoir hygienic conditions. Meat is nutrient-rich food, but also they are highly perishable due to they provide the nutrients needed for multiplication and growth of a lot of microorganisms [26].

content	mutton			beef			camel Meat		
	Min.	Max.	Mean ±	Min.	Max.	Mean ±	Min.	Max.	Mean ±
*APC	4.5	5.3	6.0a ± 2.31	4.5	5.9	5.6b ± 4.06	3.4	4.9	4.5c ± 2.11
Proteolytic Counts	2.4	5.1	4.5a ± 2.30	3.4	3.9	3.5b ± 2.20	2.2	3.8	3.2c ± 1.02
Lipolytic Counts	2.3	5.6	4.4a ± 1.20	3.2	4.8	4.0b ± 1.01	1.1	2.9	2.2c ± 0.83

**Table 2:** Bacteriological Quality (Log cfu/g) for meat of Slaughtered Animals at Ismailia Abattoir \*APC means Aerobic Plate Counts. Mean values in the same line have different letter are significantly difference (P<0.05).

The mean values of total proteolytic counts for mutton, beef and camel meat were 4.5, 3.5, and 3.4 Log CFU/g respectively. The mean values of total lipolytic counts for mutton, beef and camel meat were 4.4, 4.3, and 2.2 Log CFU/g respectively.

**Mycological quality:** Mycological qualities for the meat of slaughtered animals at Ismailia abattoir in were presented in table 3.

The mean values of total yeast count for mutton, beef and camel meat were 4.01, 3.62, and 2.51 Log CFU/g respectively. The mean values of mold counts for mutton, beef and camel meat were 5.71, 5.00, and 3.12 respectively. The total yeast and mold counts were significantly higher (P<0.05) in mutton followed by beef then camel meat.

Content	mutton			beef			camel Meat		
	Min.	Max.	Mean ±	Min.	Max.	Mean ±	Min.	Max.	Mean ±
<b>T. Yeast Counts</b>	2.81	6.2	4.01 <sup>a</sup> ± 1.21	2.62	5.2	3.62 <sup>b</sup> ± 2.70	1.22	3.98	2.51 <sup>c</sup> ± 1.01
<b>T. Mold Counts</b>	3.64	7.52	5.71 <sup>a</sup> ± 3.60	3.68	6.66	5.00 <sup>b</sup> ± 1.50	1.67	4.69	3.12 <sup>c</sup> ± 1.72

**Table 3:** Mycological Quality (Log cfu/g) for meat of Slaughtered Animals at Ismailia Abattoir. Mean values in the same line have different letter are significantly difference (P<0.05).

## Discussion

The mean moisture, fat, protein and ash values for the meat of slaughtered animals at Ismailia abattoir. The mean moisture content for mutton, beef and camel meat were 73.4, 68.5, and 75.8 respectively. The mean fat content mutton, beef and camel meat were 3.2, 12.3, and 1.7 respectively. The mean protein content of mutton, beef and camel meat were 22.3, 18.1, and 21.3 respectively. The mean ash content of mutton, beef and camel meat were 1.1, 1.3, and 1.5 respectively. The results of meat chemical compositions of mutton and camel meat were significantly higher (p<0.05) than recorded for beef meat. FAO, [27] recorded the moisture content for beef and mutton meat are 74.7 and

76.4 respectively. Protein, fat and ash content for beef should be 16.5, 28.0, and 0.8 respectively.

The obtained results are nearly similar to those obtained by Williams [2], Tariq et al. [7] and Madruga et al. [28-35]. On the other hand, the results obtained for beef and mutton fat are lower than obtained by Maiti and Ahlawat [34]. The obtained results are higher than those obtained by [36,37].

Chemical composition of meat is affected by many factors as age, species, and feeds [7,28,33,38-40]. Fat content are higher in the animal groups that fed on the pastoral feeds [41]. Cattle grazed on grass had more muscle than those that received concentrate and oat hay [42].

The fat content of camel meat has a great effect on their moisture, cooking loss, drip loss and water holding capacity [27,43].

The mean values of aerobic plate count for mutton, beef and camel meat were 6.0, 5.6, and 4.5 Log CFU/g respectively. Aerobic plate count is generally an indicator of microbial contamination of carcasses and abattoir hygienic conditions [44]. Meat is nutrient-rich food, but also they are highly perishable due to they provide the nutrients needed for multiplication and growth of many microorganisms [26].

Aerobic microorganisms can cause negative changes in flavor, appearance, odour, and consistency of the meat by their metabolic activity and may also include some pathogenic microorganisms which affects public health hazards and leading to economic losses by causing meat spoilage and/or food poisoning [45,46]. In this study, on-floor slaughtering technique was applied during slaughtering the sheep, cattle, and camel, where various microorganisms might have contaminated the carcasses and may be responsible for increasing the initial microbial loads [47]. Carcass contamination by soil, abattoir discharged and wastewater considers the main sources of meat microbial load inside the abattoir.

The mean values of total proteolytic counts for mutton, beef, and camel meat were 4.5, 3.5, and 3.4 Log CFU/g respectively. The mean values of total lipolytic counts for mutton, beef and camel meat were 4.4, 4.3, and 2.2 Log CFU/g respectively. The aerobic plate count, proteolytic and lipolytic counts were significantly higher ( $P < 0.05$ ) in mutton followed by beef then camel meat. Proteolytic and lipolytic microorganisms grow well in meat leading to loss of meat quality and reduction its shelf-life due to protein and fat hydrolysis which leads to deterioration in color, flavor, and texture of displayed meat [48].

The obtained results were nearly similar to those reported by Immonen et al. [49], Feizullah and Daskalov [50] and Hemmat et al. [3]. While, higher results were obtained by Rabah et al. [51], El-Shamy [52], Hejazi [53] and Bogere and Baluka [54]. However, lower results were obtained by Shimaa [55].

The Egyptian organization for standardization and quality control [56] is set a permissible limit for the aerobic plate in meat which not exceed  $10^6$  CFU/g. According to this limit, all examined meat samples were found within the permissible limit and fit for human consumption.

The mean values of total yeast counts for mutton, beef and camel meat were 4.01, 3.62, and 2.51 Log CFU/g respectively. The mean values of mold counts for mutton, beef and camel meat were 5.71, 5.00, and 3.12 respectively. The total yeast and mold counts were significantly higher ( $P < 0.05$ ) in mutton followed by beef then camel meat. Nearly similar results in red meat were obtained by EL-Shamy [52], Hejazi [53] and Hemmat et al. [3]. Higher results were recorded by Rasha [57].

Yeast slower grows than most bacteria and their growth limited by metabolic substances produced by bacteria. Yeast plays a mild role in spoilage because they constitute only a small portion of the initial population. Food spoilage by yeasts leading to undesirable changes in physical appearance of food. Some species of yeast resulting in a public health hazard such as some species of candida which cause gastrointestinal disturbances, pulmonary infection, endocarditis and occasionally fatal systemic disease [3]. Most of the fungal isolates were soil-inhabiting microorganisms [58].

Mould also used as an index of proper sanitation and high-quality products. Abattoir is a good environment for the mold growth because

of their high moisture content [52]. Mould produces in its putrefactive processes a mycotoxin which is toxic substances leading to hemorrhages with hepatotoxic, carcinogenic or immunosuppressive effects [59].

The results of this study recommend that more stringent inspection and regular supervision and/or monitoring of hygiene practices in the abattoir to ensure production of good quality meat of high nutritive values. Further research should be done to assess, the meat safety and hygiene knowledge levels of meat handlers, the bacterial load on meat cutting equipment including knives, blades, and machetes at the abattoir and butchery levels.

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