

**QUALITY PROFILE OF THE SEMI-DRY EGYPTIAN SALTED MEAT (BASTERMA) AVAILABLE IN MARKETS OF ASSIUT CITY**

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**ABSTRACT**

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A total of 50 samples of semi-dry Egyptian salted meat (basterma) were randomly collected from different retail outlets in Assiut city, Egypt. The samples were examined sensorially for color, odor, taste, tenderness, juiciness, palatability and overall acceptability; chemically for pH and sodium chloride (NaCl) content; and microbiologically for the count of total aerobes, halophiles, *Staphylococcus aureus*, lactobacilli, and mould and yeast. As well, most probable number (MPN) count was performed for coliforms, fecal coliforms, *E. coli* and *Clostridium perfringens*. The obtained results revealed that examined samples were of medium quality from the sensory point of view. The mean values of pH and NaCl content for the examined samples were 4.78 and 7.30, respectively. For total aerobes, halophiles, *Staph. aureus*, lactobacilli, and mould and yeast counts the mean values were 7.81, 7.18, 6.62, 7.61 and 2.32 log cfu/g sample, respectively. The MPN count of coliforms varied greatly in positive samples from 3 to > 1100 MPN/g sample. The MPN count for fecal coliforms, *E. coli* and *C. perfringens* in positive samples ranged from 3 to 120; 3 to 21; and from 3.6 to 93 MPN/g, respectively. According to the Egyptian standards, most of the examined samples (98%) had pH values complied with the standards limits. However, all the examined samples (100%) had total aerobic and *Staph. aureus* counts above the standards limits. As for total mould and yeast, and *C. perfringens* counts, 38 and 24% of the examined samples were not complied with the standards. The results declared that the hygienic quality of basterma available in Assiut retail markets is not satisfactory and not comply with the standards.

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**Key words:** *Semi-dry Egyptian salted meat, Basterma, Assessment, Sensory, Chemical, Microbiological.*

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**INTRODUCTION**

Meat and meat products are important for human diet because they provide a great part of nutrients (Simonsen *et al.*, 1988). The determination of the sanitary condition and the prevalence of different food-borne pathogens in foods will indicate the potential health risks to consumers (CDC, 1983).

The microbiological quality and safety of commercially processed meat and poultry products are major areas of concern for producers, consumers and public health officials worldwide (Okolocha and Ellerbroek, 2005). Products excessively contaminated with microorganisms are undesirable from the standpoint of public health, storage, quality and general aesthetics (Cunningham, 1982; Mead, 1989). The quality of meat product depends on the quality of the used meat, additives, sanitary condition of the

equipments and the processing procedures (Chesnut *et al.*, 1977; Teufel *et al.*, 1982).

Meat cured with sodium chloride and drying is an ancient preservation method that ensures availability of product today in many countries (Wilson *et al.*, 1981). Contamination of cured meat products with pathogens may occur through improper handling, processing and storage. The factory utensils, workers and the surrounding atmosphere are considered the most important sources of contamination with pathogens (Bryan *et al.*, 1968). The study of the microbial quality of preserved cured meat products is important from the public health point of view. Most of these food products are ready-to-eat without any need for further cooking (Bryan *et al.*, 1968). To ensure the safety of these foods, periodic surveillance to determine the microbiological quality (spoilage and pathogenic agents) is necessary.

Basterma "Pastirma", a traditional Turkish meat product, is a popular cured and dried meat product in many Islamic countries including Egypt. It is recognized as an intermediate moisture food; its name comes from bastirma, meaning being pressed for the beef is squeezed between stones to lose its water content (Leistner, 1988; Demirezen and Uruc, 2006). Basterma was produced from whole muscle obtained from certain parts of cattle, buffalo and camel carcasses. It requires simple equipment and little energy for preparation. Three steps are involved in the manufacture of Egyptian basterma: curing, drying and covering. Muscles are cleaned of tendon and fat and then cured (common salt and potassium nitrate), dried (at room temperature), pressed (about one ton of pressure applied for 12 hrs) and coated with paste of 35% garlic, 20% fenugreek (*Trigonellum foenum graecum*), 5-6% red paprika and cumin and 38-40% water; and again dried. The production process of basterma takes approximately a month (El-Khateib et al. 1987; Demirezen and Uruc, 2006). Nowadays, basterma is prepared from the imported boneless frozen beef. Despite of its high nutritive value, basterma may constitute public health hazards due to high salt content, residues of nitrite, presence of nitrosamines, spoilage and pathogenic microorganisms, which may affect the quality of the product leading to economic losses and public health hazards (El-Banna, 1974).

So, the aim of the present study is to through the light on the hygienic (sensory, chemical and microbiological) quality of basterma sold in the retail markets in Assiut city, Assiut province, Egypt and declares how much it complies with the standards.

## **MATERIALS and METHODS**

### **Sample collection:**

A total of 50 semi-dry Egyptian salted meat (basterma) samples were randomly collected from different, supermarkets and mini-markets in Assiut city, Assiut province, Egypt. The samples were directly dispatched to the laboratory and subjected to the required investigations (sensory, chemical and microbiological examination) with a minimum of delay. The basterma samples were in slice form and were kept at 4°C till all tests were performed.

### **Sample preparation:**

Using sterile instruments, the outer-coating of the samples was removed. Each sample was divided into two parts, one part used for sensory assessment and the other part was cut into small pieces and thoroughly mixed in sterile mortar as it prepared for microbiological and chemical examination.

### **Sensory evaluation:**

The sensory parameters were evaluated by members of the department of food hygiene (meat hygiene) faculty of veterinary medicine, Assiut University,

Assiut, Egypt. Three consumer-based sensory panel was conducted to evaluate the color, odor, taste, tenderness, juiciness, palatability and overall acceptability of the basterma samples using a 9-point hedonic scale (Meilgaard *et al.*, 2007), where 9 = like extremely; .....5 = neither like, nor dislike; and .....1 = dislike extremely.

### **Chemical examination:**

Ten grams of each sample was used to determine the pH value using EC-pH Scan 2 (EUTECH INSTRUMENTS 59000-20) at room temperature according to Lyhs *et al.* (1998). The salt content of the samples was determined according to the method described by AOAC (1995).

### **Microbiological assessment:**

In sterile plastic bag 10 grams of the prepared sample were stomached with 90 ml sterile 0.1% peptone water for 2 minutes using laboratory blender stomacher (Seward 400). Ten folds serial dilutions (up to 10<sup>6</sup>) were prepared and the appropriate dilutions were surface plated for all counts expect for mould and yeast, they were pour plated. Microbiological analyses were carried out to determine: total microbial flora on plate count agar (Oxoid), total halophilic flora on plate count agar supplemented with 7% (w/v) NaCl, *Staphylococcus aureus* count on mannitol salt agar" (Himedia), mould and yeast count on acidified malt extract agar (Oxoid, 1982). All were carried out according to APHA (1984). Lactobacilli were determined on deMan, Rogosa and Sharpe "MRS" (Biolume) agar (deMan *et al.*, 1960). All media were incubated aerobically at 35 ± 1°C for 48 hours, except for lactobacilli, it was incubated in CO<sub>2</sub> (5%) incubator at 37°C for 72 hours; and for mould and yeast, it was incubated at 25°C for up to 7 days. Coliforms, fecal coliforms and *E. coli* most probable number "MPN" counts were done following the procedures described in AOAC (1995). For *Clostridium perfringens* MPN count; lactose sulphite broth (Biolume) was used and it was incubated at 46 ± 0.5°C for 48 hours (Beerens *et al.*, 1982).

## **RESULTS**

The data presented in Table 1, declared that the examined basterma samples were generally of medium quality from the sensory point of view. The color of the samples varied between light to dark red (48%), red brown (38%) and greenish red (14%). The odors were spicy (58%), weak (24), sour (10%), sweet (4%), or moldy (4%). Samples taste was very salty (8%), slight salty to salty (74%), plain (10%), or bitter (8%). As for tenderness, the Samples were either tender (10%), slight to moderate tender (68%), or slight to moderate tough (22%). Concerning juiciness, 28% of samples were juicy, 44% were slight to medium juicy and 28% were slight dry. Regarding palatability, 22% of the samples were palatable, 60% were slight to moderate palatable and 18% were not

palatable. The overall acceptability of the samples varied between like very much (8%), moderately like (28%), slight like (26%), neither like nor dislike (6%), slight dislike (18%), and moderate dislike (14%) (data not shown).

The pH values of the examined samples ranged from 3.30 to 6.10 with a mean value of 4.78, while NaCl contents varied from 4.36 to 12.34% with a mean value of 7.30% (Table 2). Out of the 50 examined samples 49 (98%) had pH values in complies with the Egyptian standards specifications (E.S.S., 2005) for basterma "pH 6" (Table 5). Only 1 sample was above the standards and had pH value of 6.1.

The minimum, maximum, and mean values for total aerobes, halophiles, *Staph. aureus*, lactobacilli, and mould and yeast counts in the positive examined samples were declared in Table 3. All the examined samples were positive for total aerobes, halophiles, *Staph. aureus* and lactobacilli counts. Only 35 (70%) out of the 50 examined samples showed mould and yeast counts  $\geq 1$  log cfu/g (Table 3). The Egyptian

standards (E.S.S., 2005) for total aerobes, *Staph. aureus*, and mould and yeast counts in basterma are 4, zero, and 2 log cfu/g, respectively. All the examined (100%) samples showed a count above the standards limits for total aerobes and *Staph. aureus*. Out of the 50 examined samples 19 (38%) had yeast and mould counts above the Egyptian standards limits (Table 5).

As recorded in Table 4, out of the 50 examined samples 34 (68%), 9 (18%), 4 (8%), and 12 (24%) were positive for coliforms, fecal coliforms, *E.coli* and *C. perfringens* MPN counts, respectively. The MPN counts for the previously mentioned microorganisms in the positive examined samples were ranged from 3 to >1100, 3 to 120, 3 to 21, and from 3.6 to 93 MPN/g; with a median values of 15, 20, 3.6 and 3.6 MPN/g sample, respectively. It was found that 24% of the examined samples had *C. perfringens* counts above the Egyptian standards "sample should be free" (Table 5).

**Table 1:** Sensory assessment of the examined basterma samples (Mean and SE)

Character	Color	Odor	Taste	Tenderness	Juiciness	Palatability	Overall acceptability	
Score	mean	5.51	5.66	6.21	6.00	5.66	6.12	5.75
	S.E.	0.14	0.16	0.14	0.18	0.15	0.15	0.16

**Table 2:** Statistical values of pH and NaCl content of the examined basterma samples (n\*=50)

Item	Minimum	Maximum	Mean	S.E.
pH	3.30	6.10	4.78	0.10
NaCl	4.36	12.34	7.30	0.26

\*n= number of samples

**Table 3:** Statistical values of total aerobes, halophiles, *Staph. aureus*, lactobacilli, and yeast and moulds counts (log cfu/g) of the examined basterma samples (n\*=50)

Microorganism	Positive samples		Minimum	Maximum	Mean	SE
	No.	%				
Total aerobes	50	100	5.52	8.85	7.81	0.10
Halophiles	50	100	5.20	8.88	7.18	0.13
<i>Staphylococcus aureus</i>	49**	100	3.00	8.57	6.62	0.19
<i>Lactobacilli</i>	49**	100	5.53	8.90	7.61	0.10
Total mould and Yeast	35	70	1	5.72	2.32	0.22

\*n= number of samples

\*\* one sample was not counted

**Table 4:** Statistical values of coliforms, fecal coliforms, *E. coli* and *Clostridium perfringens* (MPN/g) of the examined basterma samples (n\*=50)

Microorganism	Positive samples		Minimum	Maximum	Median
	No.	%			
Coliforms	34	68	3.00	>1100	15.0
Fecal Coliforms	9	18	3.00	120.00	20.0
<i>E.coli</i>	4	8	3.00	21.00	3.6
<i>Clostridium perfringens</i>	12	24	3.60	93.00	3.6

\*n= number of samples

**Table 5:** Egyptian standards limits for basterma (E.S.S., 2005).

Item	The standard limit	Samples within the standard limit		Samples above the standard limit		Total number
		No.	%	No.	%	
pH	6	49	98	1	2	50
Total aerobes	10 <sup>4</sup>	0	0	50	100	50
<i>Staphylococcus aureus</i>	free	0	0	49	100	49
Mould and yeast	10 <sup>2</sup>	31	62	19	38	50
<i>Clostridium perfringens</i>	free	38	76	12	24	50

## DISCUSSION

Meat is a good source of animal protein and minerals especially iron (Hammed, 2001). Shelf-stable meat products, such as the dry-cured salt-coated beef produced in Egypt (basterma), are technically considered to be ready-to-eat meat products (El-Khateib, 1997). The curing of meat inhibits the growth of microorganisms and improves the sensory characteristics of final products (El-Sayed, 2006).

Organoleptic and sensory properties of a particular product (primary quality) are the first contact between the consumer and that particular product (Abd El-Gafar, 1999). Sensory assessment of the examined basterma samples in the present study revealed that most (54%) of them had general acceptability of slight to medium. Only 8% of the samples were very acceptable, while 6% were border line. The remaining samples (32%) were unacceptable from the sensory point of view. They may have bitter taste, undesirable odor and/or color (data not shown). The obtained results seem to be in partial agreement with those of Saad (1976), Hassan (1997) and Abd El-Gafar (1999). Saad (1976) found that 56.67% of examined basterma samples had dark red color for meat, while 20% were

purplish red, 13.33% were dark brown and 10% were grayish brown. He reported that most of the samples smell spicy or after garlic while putrid, moldy and rancid odors were found in 16.67, 6.67 and 3.33% of the samples, respectively. He also mentioned that taste were normal specific taste in 73.33%, while unpleasant and rancid taste was in 16.67 and 10% of the samples, respectively. He found that the consistency was firm in 63.33% of samples, while the tender and soft consistency was present in 20 and 15.67% of samples, respectively. On the same trend, Hassan (1997) reported that, 50% of the examined whole basterma block samples showed normal meat surface cure color, while 26.7% showed fading color. He observed over cure color (dark red) in 23.3% of the examined samples and found that the meat surface was firm in 66.7% of the samples, while 33.3% had soft texture which may be due to either under pressing or microbial spoilage. He detected normal cure odor of meat, sour, and putrid odor in 80, 16.7 and 3.3% of the examined samples, respectively. Furthermore, he mentioned that 26.7% of the slices of cured meat showed a normal cured pink coloration, while 66.7% showed an over cured cut section indicating high nitrite residue. Abd El-Gafar (1999) mentioned that, of examined basterma samples 55% were had normal

cure color while fading and over cure were detected in 10 and 35% of the samples, respectively. He reported that 60% of the examined samples were found to be firm, while 40% had soft texture; which may be due to under pressing or microbial spoilage. He detected normal cure odor of meat in 70% of the samples, while the rest of samples suffered from sour odor. As well, he detected normal cured pink color in 55% of the slices of cured meat, while over cure color and fading were detected in 35 and 10% of the examined samples, respectively.

The pH of some Foods changes as a result of microbial activity; consequently, pH determinations have been applied to determine the degree of quality deterioration. However, changes in pH because of microbial activity vary with conditions such as nature of the food, the type of microbial flora, and packaging conditions "gaseous atmosphere" (National Academy of Sciences, 1985). In the current study, most of the examined samples (98%) had pH values comply with the standards of Egypt for basterma. The obtained values of pH (3.30 – 6.10) seem to be lower than those detected by Saad (1976), El Khateib *et al.* (1987) and Aiedia (1995). As well, the mean pH value in the present study ( $4.78 \pm 0.10$ ) was lower than those detected by El Khateib (1997) in 50 examined basterma samples ( $5.70 \pm 0.19$ ), and by Abd El-Gafar (1999) in 20 examined basterma samples ( $5.32 \pm 0.070$ ).

Salt is introduced into food in processing at two levels either for flavoring at about 2 percent, or for long term preservation at about 18 – 20 percent (Ranken, 1986). The obtained NaCl content mean value ( $7.30 \pm 0.26$ ) in the current study seems to be nearly similar to those detected by Mousa *et al.* (1993b), Aiedia (1995) and Abd El-Gafar (1999). However, El-Khateib *et al.* (1987) recorded a lower mean value for NaCl (6.5%). Higher values were reported by Saad (1976), Mahmoud (1987), El-Khateib (1997) and Hassan (1997), which are  $10.52 \pm 0.34$ , 17%,  $8.30 \pm 1.75$ , and 8.1%, respectively.

It is well known that the microflora of any foodstuff is qualitatively and quantitatively affected by so many factors. Important among them are the physical and chemical properties of food, its ingredients, presence of inhibitors or stimulators, the microbial load of raw materials, sanitary conditions of production, the extent of the thermal treatment, ...etc (Tawfeek *et al.*, 1989). The study of the microbial quality of preserved cured meat products is important from the public health point of view. Most of these food products are ready-to-eat without any need for further cooking. Thus contamination of these products with pathogens is considered a serious problem (Bryan *et al.*, 1968).

The aerobic plate count may have no overt public health significance, but it may indicate that the finished product has been mishandled. Further more it may be indicative of neglected sanitary measures in

curing, processing, handling, as well as the use of low quality ingredients (Yassien, 1988). In the present study the total aerobes count was high and it exceeded the recommended standards of Egypt in all the examined samples which is in harmony with that recorded by Abd-El-Shahid and Ibrahim (2010). Nearly similar counts to the current finding were recorded by Saad (1976), Abd El-Aziz (1987), El-Khateib *et al.* (1987) and Abd El-Gafar (1999). On the other hand, Hemeida *et al.* (1986), Yassien (1988), Mousa *et al.* (1993a), Tolba (1994), Aiedia (1995), El-Khateib (1997), and Abd-El-Shahid and Ibrahim (2010) examined a variety of basterma samples and recorded total aerobes mean values of  $2.3 \times 10^5$ ,  $2 \times 10^5 \pm 8 \times 10^4$ ,  $4.7 \times 10^6$ ,  $5.5 \times 10^2 \pm 10^2$ ,  $1.7 \times 10^6$ ,  $1.4 \times 10^5$ , and  $3.0 \times 10^6$  cfu/g sample, respectively, which are lower than the present finding ( $7.81 \pm 0.10$ ). Increase in the count of aerobic bacteria in the samples may be attributed to spices that are used for the manufacturing of basterma. Christensen *et al.* (1967) reported that some spices harbor numerous microorganisms, including spore-forming bacteria and spoilage organisms. Unless spices are chemically or thermally treated or irradiated they may contaminate menu items and cause spoilage and may even introduce harmful organisms (Strong *et al.* 1963). The high count may also be due to neglected sanitary measures or the use of low quality ingredients. The use of imported frozen beef for basterma manufacturing in Egypt, nowadays, might be related to this high count. The aerobic plate count may have no overt public health significance, but it may contribute to some degree toward spoilage of a product containing spices (Julseth and Deibel, 1974).

Although salt prevents growth of spoilage bacteria, other microorganisms may not be affected by its presence. The microbial types associated with a particular salted food depend on the concentration and type of salt and the type of food. Microorganisms have been conveniently divided into four groups based on their sensitivity to salt: halotolerant, slight halophiles, moderate halophiles and extreme halophiles. Most halotolerant microorganisms are isolated when foods are tested for slight or moderate halophiles. Some halotolerant microorganisms are involved in the spoilage of salted foods, whereas others, such as *Staph. aureus* are human pathogens (APHA, 1984; Baross and Lenovich, 1992). In the present study, the mean, minimum and maximum values of halophilic bacteria count were high which are indicative of neglected sanitary measures or the use of low quality salt in the process. Mahmoud (1987) found a mean halophilic bacterial count in market basterma samples of  $8.73 \times 10^7$ , which is nearly similar to the current finding.

*Staphylococcus aureus* is a salt-tolerant microorganism that can grow at water activity levels as low as 0.83 to 0.84, depending on the product. Enterotoxins causing intoxication could be produced

during growth of *Staph. aureus* at water activity values of  $\geq 0.86$ . The release of enterotoxin by *Staph. aureus* can occur if population exceeds ca  $10^7$  cfu/g (Tatini, 1973, Tatini *et al.*, 1973 and Boylan *et al.*, 1976). In the present study *Staph. aureus* count was high and 40.82% of the samples showed count  $>10^7$  cfu/g (data not shown). The count exceeded the recommended standards of Egypt in all the examined samples which are in agreement with the results of Abd-El-Shahid and Ibrahim (2010). Lower percentages were reported by Refai (1984) and Abd El-Gafar (1999) who found that *staph. aureus* count exceeded the recommended standards of Egypt in 46.7 and 80% of examined basterma samples, respectively. Lower mean values of *Staph. aureus* count were detected by Refai (1984), Abd El-Aziz (1987), Mousa *et al.* (1993a), Hassan (1997), Abd El-Gafar (1999), Abd-El-Shahid and Ibrahim (2010) and Saleh *et al.* (2010). Higher value ( $1.7 \times 10^7$ ) was detected by Rageh (1980), and nearly similar value ( $4.4 \times 10^6$ ) was detected by Tolba (1986). The presence of high densities of organisms shows typical characteristics of *Staph. aureus* in processed cured meat products might pose a potential health hazard and it indicates non-hygienic production control (Tawfeek *et al.*, 1989).

In products with low water activity such as heavily cured meat products, a salt-resistant microflora develops in the initial phase, before the water activity drops below 0.90-0.85; this flora is composed of lactobacilli (Simonsen *et al.*, 1988). Lactic acid-producing bacteria are able to grow under a variety of conditions that prevent the growth of gram-negative aerobes (Egan, 1983). The counts of lactobacilli recorded in the present study were higher than those recorded by El-Khateib (1997) in 50 examined basterma samples. He detected counts ranged from  $1 \times 10^4$  to  $1 \times 10^7$  with a geometric mean of  $3.9 \times 10^6$  cfu/g. Tawfeek *et al.* (1989) detected a mean count of  $6.9 \times 10^3$  for acid producing bacteria in basterma samples collected from Jeddah markets, Jeddah, Saudi Arabia.

Moulds and other osmophilic microorganisms are involved in the spoilage of foods with low water activity values including salted foods (APHA, 1984). For basterma, the effects of processing and the ingredients in the coating layer showed that garlic (35%) in the paste protects it from mould for at least 12 days even under unfavorable conditions "i.e., high inoculum of mould, storage at 25°C with 90% relative humidity". When the relative humidity is lower than 90%, the use of 35% garlic in basterma paste is likely to protect it from mould for several months (El-Khateib *et al.*, 1987). The total mould and yeast count in the current investigation exceeded the Egyptian standards in 38% of the examined samples. Lower percentage was reported by El-Khateib *et al.* (1987), while higher ones were found by Abd El-Gafar (1999), and Abd-El-Shahid and Ibrahim (2010). The

high incidence of mould and yeast count might be attributed to use of lower garlic percentage ( $<35\%$ ) in basterma paste beside to neglected sanitary measures in curing, processing and handling. The current mean value of mould and yeast was lower than those detected by Hemeida *et al.* (1986), Edris and Salem (1990), Hassan (1997), Abd El-Gafar (1999), and Abd-El-Shahid and Ibrahim (2010) however, it was higher than that recorded by El-Khateib *et al.* (1987). Nearly similar count was reported by Ouf *et al.* (2010). Contamination of foods by moulds can result in substantial economic losses to producer, processor, and consumer. Moulds can cause various degrees of deterioration and decomposition of foods. Abnormal flavors and odors may also be produced. Several food-borne moulds may also be hazardous to human health because of their ability to produce toxic metabolites known as mycotoxins (FDA, 1992).

From hygienic point of view, it is of great importance to determine the possibility of fecal contamination of preserved cured meat products. Such study is highly important since most of these products are eaten without any further thermal treatment. Thus the presence of enteric pathogens in these foodstuffs will be a serious problem. The presence of coliforms in cured meat indicates non-sanitary conditions of production (Tawfeek *et al.*, 1989). The present coliforms, fecal coliforms, and *E. coli* MPN counts were  $>3$  in 68, 18, and 8% of the examined samples, respectively. Higher incidences were detected by Yassa (1985); Abd El-Gafar (1999); and Abd-El-Shahid and Ibrahim (2010) for coliforms, which were 82, 70 and 100%, respectively. As well, Abd El-Gafar (1999) reported higher incidence for fecal coliforms (30%). *Escherichia coli* were detected at lower rates by Hemeida *et al.* (1986), Tolba (1986), Tolba (1994), and Abd El-Gafar (1999); and at higher rates by Saad (1976), El-Safey and Abdul-Raouf (2003). Nearly similar rates for *E. coli* were recorded by Zaki (1990), Aiedia (1995) and Saleh *et al.* (2010). As for coliforms count nearly similar values were detected by Saad (1976), Yassa (1985), Yassien (1988), and Abd-El-Shahid and Ibrahim (2010). Higher counts were recorded by Abd El-Aziz (1987) and Mousa *et al.* (1993a), while Al-Cherif (1983) and Tolba (1994) recorded lower counts. Concerning fecal coliforms; lower count was detected by Al-Cherif (1983) and Yassien (1988), while nearly similar count was recorded by Abd El-Gafar (1999). Lower *E. coli* count ( $8 \pm 5.80$ ) was recorded by Al-Cherif (1983).

Food illness caused by *Clostridium perfringens* is among the common illnesses resulting from the consumption of contaminated food, the vehicles of infection are typically meat and poultry products. *C. perfringens* is more widely spread than other pathogenic bacteria; its principal habitats are in the soil and the intestinal contents of man and animals (Hayes, 1992). The microorganism contaminates meat via containers, handlers, water, and dust (Jay, 1992).

In the present investigation 24% of the examined samples showed *C. perfringens* count >3 MPN/g. El-Lawendy (1996), Khater (2004), and Atwa and Abou El-Roos (2011) recorded lower incidences of *C. perfringens* in basterma, which were 16, 20 and 16%, respectively. Higher counts of anaerobic bacteria were detected in basterma by Yassa (1985), Mahmoud (1987), Tawfeek *et al.* (1989), Aiedia (1995), Hassan (1997) and Abd El-Gafar (1999). *Clostridium perfringens* has a great effect on the human health causing food poisoning, however millions of viable *C. perfringens* are required to induce the illness ( $10^6$  microorganisms/g food); also it causes a number of human diseases ranging from necrotic enteritis to wound infection and life threatening gas gangrene (Atwa and Abou El-Roos, 2011).

In conclusion, the hygienic quality of Egyptian basterma sold in Assiut city is not satisfactory and should be improved. The high counts of total aerobes, halophiles and *Staph. aureus* and the presence of coliforms and fecal coliforms indicate that the product be produced under unsanitary hygienic conditions of processing, storage or handling; and/or low quality ingredients may be used for its production. The presence of *C. perfringens*, *E. coli* and high counts of *Staph. aureus* indicate that the product might pose potential health hazard to consumers. So, careful inspection of raw materials, production lines and storing conditions should be intensified to eliminate serious contamination of this product with spoilage microorganisms and human pathogens. As well new regulations are required for Egyptian basterma to establish precise and practical microbiological standards limits for coliforms, fecal coliforms, *C. perfringens*, halophiles and *Staph. aureus* contaminations.

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### صورة جودة اللحوم المصرية شبه الجافة المملحة (البسطرمة) المتداولة في أسواق مدينة أسيوط

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تم جمع عدد خمسين عينة من اللحوم المصرية شبه الجافة المملحة (البسطرمة) من مختلف محلات بيع الأغذية في مدينة أسيوط بطريقة عشوائية. تم فحص العينات معمليا من الناحية الحسية، والكيميائية، والميكروبيولوجية. تم فحص العينات حسيا من حيث اللون، الرائحة، الطعم، الطراوة، العصيرية؛ الاستساغة، والقبول العام. شمل الفحص الكيميائي قياس تركيز أيون الهيدروجين ونسبة ملح الطعام في العينات. أما الفحص الميكروبيولوجي للعينات فقد شمل العد الكلي للبكتريا الهوائية، والبكتريا أليفة الملوحة، والمكرو العنقودي الذهبي، وعصيات الحليب، والخمائر والفطريات. كما أجري العد الاحتمالي لبكتريا القولون، وبكتريا القولون البرازية، وبكتريا الاشيريشيا كولاي، وبكتريا الكلوستريديم بيرفرينجز. أظهرت النتائج أن عينات البسطرمة كانت في العموم ذات جودة متوسطة من الناحية الحسية. كانت متوسطات تركيز أيون الهيدروجين ونسبة ملح الطعام في العينات هي 4.78 و 7.30، على التوالي. بالنسبة للعد الكلي للبكتريا الهوائية، أليفة الملوحة، المكرو العنقودي الذهبي، عصيات الحليب، والفطريات والخمائر فقد كانت متوسطاتها 7.18، 7.62، 6.62، و 7.61، و 2.32. لوخلية/جم عينة، على التوالي. اختلف العد الاحتمالي لبكتريا القولون بدرجة كبيرة حيث تراوح في العينات الموجبة من 3 إلى <math>1100</math> عدد احتمالي/جم عينة. بينما تراوح العد الاحتمالي لبكتريا القولون البرازية، بكتريا الاشيريشيا كولاي، وبكتريا الكلوستريديم بيرفرينجز في العينات الموجبة من 3 إلى 21، و من 3.6 إلى 93 عدد احتمالي/جم عينة، على التوالي. طبقا للمواصفات القياسية المصرية، كان تركيز أيون الهيدروجين لمعظم العينات (98%) مطابقا للمواصفات، بينما كان العد الكلي للبكتريا الهوائية، والمكرو العنقودي الذهبي في كل العينات التي تم فحصها أعلى من الحدود المسموح بها. بالنسبة لعد الفطريات والخمائر، وبكتريا الكلوستريديم بيرفرينجز فقد كان 38، و 24% من العينات التي تم فحصها غير مطابق للمواصفات، على التوالي. أظهرت النتائج أن جودة اللحوم المصرية شبه الجافة المملحة (البسطرمة) الموجودة في أسواق مدينة أسيوط غير مقبولة وغير مطابقة للمواصفات.

**الكلمات الكاشفة:** اللحوم المصرية شبه الجافة المملحة، البسطرمة، التقييم الحسي، الكيميائي، الميكروبيولوجي.