



## Evaluation of nitrite and sodium chloride in some locally manufactured meat products

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### ABSTRACT

This study is for detection of some food additives used on manufacturing of some meat products as nitrite and sodium chloride. A total of 150 random samples of locally manufactured meat products represented by beef burger, Kofta, frankfurter, sausage and luncheon (30 of each) were collected from different markets, Egypt. The collected samples of beef burger, kofta, frankfurter and sausage were frozen and the weight of each unit was 340 g. while, the luncheon samples were collected as slices (250g). Each sample was kept in a separate plastic bag and preserved in an ice box then transferred to the laboratory without delay. The collected samples were examined to determine nitrite and sodium chloride contents. The mean values of nitrite in beef burger, kofta, frankfurter, sausage and luncheon were  $46.75 \pm 2.33$ ,  $52.18 \pm 2.64$ ,  $59.29 \pm 3.10$ ,  $67.73 \pm 3.48$  and  $79.40 \pm 3.52$ , respectively. Moreover the the mean values of Sodium chloride (%) in beef burger, kofta, frankfurter, sausage and luncheon were  $1.91 \pm 0.28$ ,  $2.89 \pm 0.41$ ,  $2.75 \pm 0.32$ ,  $3.07 \pm 0.37$  and  $3.30 \pm 0.39$ , respectively. The current study revealed the acceptable and non-acceptable meat products exposed to illegal amounts of nitrite and Sodium chloride according to ES (2005).

**Keywords:** Nitrite, sodium chloride, beef burger, kofta, sausage.

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## 1. INTRODUCTION

Food additive means any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food.

Nitrates and nitrites are short names for "Sodium nitrate" and "Sodium nitrite" which are forms of salt. Common salt (Sodium chloride) has been used for thousands of years to preserve meat well before the discovery of refrigeration. Several centuries ago, nitrate and nitrite salts were recorded in salt by accident and it was soon realized these closely related

ingredients helped to extend the shelf life (aka. preserve) of meat by preventing rancidity and by also controlling the growth of bacteria (Sindelar,2012).

Nitrite has several adverse effects on human health, for example, in vivo reaction between nitrite and secondary or tertiary amines producers N-nitrosamines, which are potential carcinogens, mutagens and/or teratogens (Bories and Bories, 1995)

Sodium chloride was dissolved in water to form brine solution which retard microbial

growth, it aids in solubility of the myosin-type protein of comminuted muscle for emulsifying in emulsion and contributes to basic taste characteristics

The excess of Sodium chloride intake above nutritional recommendation many involve harmful consequences to health such as hypertension and some cardiovascular diseases (Taormina, 2010 and Ripolles et al., 2011)

Therefore, the current study was planned out to determine the contents of Sodium nitrite and Sodium chloride in some locally manufactured meat products (Beef burger, Kofta, Frankfurter, Sausage and Luncheon) and their acceptability for human consumption with the legal limits of ES 2005.

## 2. Materials and methods

A total of 150 random samples of locally manufactured meat products represented by beef burger, kofta, frankfurter, sausage and luncheon (30 of each) were collected from different markets, Egypt. The collected samples of beef burger, kofta, frankfurter and sausage were frozen and the weight of each unit was 340 g., while, the luncheon samples were collected as slices (250 g).

Each sample was kept in a separate plastic bag and preserved in an ice box then transferred to the laboratory without undue delay. The collected samples were subjected to the chemical examination for evaluation of nitrite and Sodium chloride.

### 2.1. Determination of nitrite (AOAC, 2016):

Accurately, 5 g of prepared sample were weighed in 50 ml beaker, then 40 ml H<sub>2</sub>O heated to 80°C were added to the sample. The mixture was mixed thoroughly with glass rod and transferred to 500 mL volumetric flask.

The beaker and rod were thoroughly washed with successive portions of the hot water. Further, enough hot water was added to bring volume to 300 ml, and then stand in steam bath for 2 hours with shaking. The contents were

cooled to room temperature, diluted to 500ml with distilled water, remixed and then filtered. If turbidity remains after filtration, centrifuging will till be cleared of the solution. Moreover, 2.5 ml sulfanilamide reagent was added to 10ml of the filtrate, and mixed. After 5 min, 2.5 ml NED (*N*-(1-naphthyl) ethylenediamine) reagent was added, diluted to 50ml and mixed. Accordingly, the developed color within 15 minutes was determined at 540 nm against blank of 45 ml water, 2.5 ml sulfanilamide reagent and 2.5 mL NED reagent using spectrophotometer.

Nitrite present was determined by comparison with standard curve prepared as follows: 10, 20, 30, and 40 ml nitrite working standard solutions were separately added to 50 ml volumetric flasks and 2.5 ml sulfanilamide reagent were added, mixed, and proceeded as first step. Standard curve is straight line to 1µg/ml NaNO<sub>2</sub> in final solution.

### 2.2. Determination of Sodium chloride % (AOAC, 2016):

To 1 gram of the sample, 40 ml of Silver nitrate solution N/10 were added to precipitate all the chloride as Silver chloride, then 5 ml nitric acid was added. The contents were then gently boiled on hot plate until all solids except Silver chloride were dissolved (about 15 minutes). After cooling, 50 ml of distilled water and 2 ml of saturated solution of ferric Ammonium sulphate were added. The excess of silver nitrate was titrated against N/10 Ammonium thiocyanate solution using ferric indicator. The amount of standard Ammonium thiocyanate exhausted in the titration (R) was recorded.

The same technique was repeated using 0.5 ml of the brine solution. The Sodium chloride % was calculated according to the following formula.

$$\text{Sodium chloride \%} = (R - 10 \times 0.00585 \times 10)$$

Where,

R= ml of exhausted 0.1N silver nitrate.

### 3. RESULTS

The results recorded in the table (1) revealed that the mean values of nitrite in beef burger, kofta, frankfurter, sausage and luncheon were  $46.75 \pm 2.33$ ,  $52.18 \pm 2.64$ ,  $59.29 \pm 3.10$ ,  $67.73 \pm 3.48$  and  $79.40 \pm 3.52$  respectively .with minimum values of 5.4,12.1, 16.6, 21.3 and 24.5 and maximum values of 100.9, 103.5, 112.4, 119.7 and 136.8 respectively for the above mentioned meat products.

The results recorded in the table (2) revealed the highest acceptable samples was the beef burger (96.67%) while the lowest acceptable was luncheon (73.33%) according to the ( ES 2005).

The results recorded in the table (2) revealed that the mean values of Sodium chloride (%) in beef burger, kofta, frankfurter, sausage and luncheon were  $1.91 \pm 0.28$ ,  $2.89 \pm 0.41$ ,  $2.75 \pm 0.32$ ,  $3.07 \pm 0.37$  and  $3.30 \pm 0.39$  respectively, with minimum values of 1.0, 2.3, 2.0, 2.5 and 2.4 and maximum one of 2.7, 3.5, 3.3, 3.6 and 3.9 respectively for the above mentioned meat products.

The results recorded in the table (4) revealed the highest acceptable samples was the frankfurter (90%) and the sausage was (90%) also, while the lowest acceptable samples were the luncheon samples (80%) according to the (ES 2005)

Table 1: Statistical analysis of nitrite contents (ppm) in the examined samples of locally manufactured meat products (n=30).

Meat products	+ve samples				
	No	%	Min	Max	Mean $\pm$ S.E*
Beef burger	19	63.3	5.4	100.9	$46.75 \pm 2.33$
Kofta	22	73.3	12.1	103.5	$52.18 \pm 2.64$
Frankfurter	26	86.7	16.6	112.4	$59.29 \pm 3.10$
Sausage	27	90	21.3	119.7	$67.73 \pm 3.48$
Luncheon	30	100	24.5	136.8	$79.40 \pm 3.52$

Table 2: Acceptability of the examined locally manufactured meat products according to their contents of nitrite (n=30).

Meat Products	Nitrite (ppm)	Accepted samples		Unaccepted samples	
		No.	%	No.	%
Beef burger	< 100	29	96.67	1	3.33
Kofta	< 100	28	93.33	2	6.67
Frankfurter	< 100	26	86.67	4	13.33
Sausage	< 100	23	76.67	7	23.33
Luncheon	< 100	22	73.33	8	26.67

Table 3: Statistical analysis of sodium chloride (%) in the examined samples of locally manufactured meat products (n=30).

Meat products	Min	Max	Mean ± S.E*
Beef burger	1.0	2.7	1.91 ± 0.28
Kofta	2.3	3.5	2.89 ± 0.41
Frankfurter	2.0	3.3	2.75 ± 0.32
Sausage	2.5	3.6	3.07 ± 0.37
Luncheon	2.4	3.9	3.30 ± 0.39

Table 4: Acceptability of the examined locally manufactured meat products according to their contents of sodium chloride (n=30).

Meat Products	NaCl (%)	Accepted samples		Unaccepted samples	
		No.	%	No.	%
Beef burger	< 2%	26	86.67	4	13.33
Kofta	< 3%	25	83.33	5	16.67
Frankfurter	< 3%	27	90	3	10
Sausage	< 3%	27	90	3	10
Luncheon	< 3%	24	80	6	20

S.E\* = standard error of mean

\*Egyptian Organization for Standardization "EOS" (2005).

No 1688-2005 for beef burger

No 1973-2005 for kofta

No 3492-2005 for frankfurter

No 1972-2005 for sausage

No 1114-2005 for luncheon

#### 4. DISCUSSION

The function of nitrite and nitrate in meat is providing three desirable properties to meat to which it is added. First, it fixes the red to pink color, commonly associated with nitrite cured meat, it accomplishes this by combining with haem protein and myoglobin which after heat

denaturation becomes relatively stable. Secondary nitrite enhances flavor, i.e. retards its degradation through inhibition by oxidation. The third function is to inhibit toxin production by *Clostridium botulinum*. So for this functions meat processors insist to use nitrite so far no alternative is available (Gray et al., 1981).

In this respect Nayel (2013) recorded that mean values of nitrite was 94.75 for beef burger, 79 for kofta, 127 for sausage and 98.65 for luncheon, Vuida-Martos, et al., (2009) who recorded  $45.5 \pm 4.3$  for luncheon and EL-Khawas, (1996) said that  $97.255 \pm 12.66$  for luncheon (canned meat). These results were more or less in accordance with that in the present research. Higher results for luncheon were obtained by EL-Kewaiey and Al-Teddawy, (2012), Tolba, et al., (1994) and Aiedia-Hoda, (1995) as they recorded  $137.7 \pm 8.05$ , 118.9 and  $134.7 \pm 2.4$  ppm. Moreover Ahmad, (2004) recorded higher results for sausage and luncheon where the mean values of nitrite were  $120.40 \pm 7.03$  for sausage and  $159.96 \pm 6.73$  for luncheon. Lower results were obtained by Farag and Abd-El-fatah, (2011) as they could detect nitrite with 24.31 ppm as minimum and 36.71 as maximum for meat products. Slightly lower results obtained by Zahran and Kassem, (2011) for the examined samples of luncheon and sausage.

Sodium chloride reported that sodium chloride has three functions in meat products, first providing and enhancing flavors, second solubilizing protein to create desired texture and third controlling microbial growth to prolong shelf and inhibit pathogens (Terrel, 1983).

Regarding to the obtained data for beef burger, nearly similar results was obtained by Tolba et al. (1994) while higher results were obtained by Mousa et al. (1993), El-Zahaby-Dina (2013) and Nayel (2013) the obtained data for sausage and luncheon were nearly similar to the results obtained by Aiedia-Hoda (1995), Abu-zid Souzan (1998), Nayel (2013) and El-Zahaby-Dina (2013), while high results obtained by Ahmed (2004).

Although salt added to meat products serve for many functions, but excess use of NaCl has undesirable effects on the flavor, color and

appearance of meat (Pearson and Gillett, 1999) in addition to excessive intake of NaCl has been linked to serious cardiovascular diseases (Stollewerk et al., 2012).

## 5. Conclusion

The obtained results concluded that some of the meat products included in this study contain residual nitrite and Sodium chloride more than the permissible limits which lead to adverse effect on human public health. So more observation, examination and strict hygienic measure as well as good manufacturing practices (GMP) should be applied for meat products especially when food additives are needed.

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