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# QUALITY CHARACTERISTICS OF SOME EMULSION-TYPE MEAT PRODUCTS

By

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## ABSTRACT

A total of 140 beef frankfurter and Egyptian luncheon sausage samples were investigated to evaluate its quality. Proximate chemical analysis revealed significant differences (P<0.05) between the different processing plants with mean values of 61.39, 15.74, 7.66 and 3.50% in frankfurter in comparison with 57.24, 7.35, 8.68 and 4.09% for moisture, protein, fat and ash in luncheon sausage respectively. The mean values for pH, TBARS and TVBN showed significant differences between the different processing plants in both products with mean values of 5.83, 0.81 and 13.47 for beef frankfurter and 6.15, 0.91 and 7.50 for luncheon respectively. Shear force and instrumental color evaluation also showed slight significant differences in both products.Moreover, bacteriological analysis revealed slight and significant differences in aerobic mesophilic, anaerobic and aerobic spore formers count.

**Keywords:**

Frankfurter, Luncheon, quality

## INTRODUCTION

The increase of human population and the great progress of various aspects of life and high cost of meat, forced the consumers to use meat products in different forms for its ease in preparation and lower cost. Moreover, the technological development in meat processing provided consumers with a much greater choice over the foods they can buy **(Vernam and Sutherland, 1995).** Emulsion-type meat products includes a wide variety of products e.g. bologna, frankfurter as well as different types of sausages which can provide the consumer with products different texture and acceptable flavors which meet its requirement about nutrition and taste **(Dingman *et al.*, 2002)**. Emulsion-type sausages of high quality are produced with a very low concentration of non-meat ingredients. When non-meat binders are not used, the natural proteins are relied upon to impart a suitable texture of the product; however, consideration must be given to the amount of lean meat to provide the protein when the formulation contains a large amount of variety meats and other low bind materials for

maximum extraction of skeletal lean meat. For production of good quality emulsion-type sausages, using high quality skeletal muscles with good hygienic conditions during processing is necessary which ultimately increase the cost of final product, which forced most meat processing plants in Egypt to replace meat with low coast ingredients. Addition of large percentage of non-muscular tissues impairs many technological defects to the final product **(Viuda - Matros *et al.*, 2012).** Therefore, the aim of the present study is to determine the quality, and safety of some Egyptian Traditional Emulsion type meat products.

## MATERIALS AND METHODS

A total of 140 beef frankfurter and traditional Egyptian luncheon sausage samples produced by 5 and 9 different processing plants respectively (10 samples from each processing plant) were collected from Cairo and Giza markets. Each sample was represented by three packages from the same production date. Samples were immediately transferred to the laboratory of food hygiene Department, Faculty of Veterinary Medicine, Cairo University, and kept at 4ºC till investigation

**Proximate composition analysis:**

Moisture, protein, fat and ash percentages of each frankfurter and luncheon sausage were determined for each replicate according to the method of **AOAC (2000)**. For determination of moisture 3 gm of sample were dried at100 ºC until constant weight was obtained. Protein content was determined according to the Kjeldahl method of analysis. For conversion of protein into crude protein, a factor 6.25 was used. Fat % was determined by 6 - cycle extraction with petroleum ether in a soxhlet apparatus and calculating the weight loss. Ash was determined by ignition at 500 ºC for five hours.

**Physicochemical criteria:**

**Determination of pH.**

Five grams from each sample were homogenized with 20 ml distilled water for 10 -15 seconds, and the pH of the slurry was measured using digital pH meter (Lovibond Senso Direct) with a probe type electrode (Senso Direct Type 330) where three reading for each sample were obtained and the average was calculated. The meter was calibrated every two samples using two buffers 7.0 and 4.0**.**

**Determination of thiobarbituric acid reactive substances (TBARS):**

Five grams from each sample were homogenized with 15 ml deionized distilled water using a stomacher (Lab blender 400) for 10 seconds at the highest speed. One milliliter from the

homogenate was mixed with 50µl butylated hydroxyanisole (7.2%) and one ml each of 15mM 2-thiobarbituric acid and 15% trichloroacetic acid. The mixture was vortexed, incubated in a boiling water bath for 15 minutes to develop color, then cooled under running water for 10 minutes, vortexed again, and centrifuged for 15 min at 2500 rpm. The absorbance of the resulting supernatant was measured at 531 nm using Unico 1200 (USA) series spectrophotometer against a blank containing 1 ml of deionized water and 2 ml of 2-thiobarbituric acid-trichloroacetic acid solution. The reading was multiplied by 7.8 to obtain the value of thiobarbituric acid reactive substances expressed as milligrams of malonaldehyde per kilogram of sample **(Du and Ahn, 2002)**.

**Determination of total volatile base nitrogen (TVBN):**

Ten grams' muscle sample were macerated with 100 ml tap water and washed into a distilling flask with 200 ml tap water, and then 2 grams' magnesium oxide was added. A macro-Kjeldahl distillation apparatus was connected to the distillation flask containing 25 ml of 2% boric acid solution and few drops of methyl-red indicator (0.016 g methyl red, 0.083 g bromocresol green per 100 ethanol) with the receiving tube was dipped below the liquid, with distillation continued till collection of 200ml. The condenser was then washed with distilled water and the distillate was titrated with 0.05 M (0.1N) Sulphoric acid. The Total Volatile Base Nitrogen (mg/100 gram sample) was calculated as the titration multiply by 14 **(Kearsley *et al.*, 1983)**.

**Shear force:**

Steaks of 2x2x2 cm were prepared from each sample and six core samples of 1.3 cm diameter were removed parallel with the sliced surface using hand-held coring device. Each core was sheared once with a Warner-Bratzler shear force (WBSF) device attached to an Instron Universial Testing Machine (Model 2519 105; Intron Corp., Canton, MA, USA) with a 55-kg tension/compression load cell and a crosshead speed of 200 mm/min. An average shear force value was calculated and recorded for each sample **(Shackelford *et al.*, 2004)**.

**Color evaluation:**

Color of sausage samples were measured using Croma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer. The L* (lightness), a* (redness), and b* (yellowness) values were obtained using CIE standard illuminant D65 light source. Color was expressed using the Commission International de l'Eclairage (CIE) L*,a*,and b* color system. The bloom time was 30 min and the observation

angle was 10°. Three measurements were taken from each sample surface at each time. The average score of triplicate experiments was recorded, and expressed as CIE lightness (L*), redness (a*), and yellowness (b*) **(Shin *et al*., 2008).**

**Bacteriological examination:**

Sample homogenate was prepared by homogenizing ten gm from each sample with 90ml of sterile 1/4 strength Ringer's solution (Oxoid BR 52) for 2 minutes in a stomacher bag under aseptic conditions using stomacher (Lab blender 400, Sweard lab. Model No. AB 6021). Ten-fold decimal dilutions were prepared using the same diluent **(APHA, 1992)**. A 0.1 ml portion from each dilution was spread in duplicates onto plate Count Agar (Merck) and incubated at 35ºC for 48 hours for enumeration of Total aerobic mesophilic bacteria **(Swanson *et al.,* 1992)**. Mesophilic anaerobic bacterial count was performed using Reinforced Clostridial Medium "RCM" (**Oxoid, CM 149**). Inoculated plates were over lodged with an additional layer of about 10 ml of melted RCM (50-55ºC) then incubated anaerobically using anaerobic jar and kit at 35ºC for 72 hours **(Lake *et al.,* 1992)**. Enumeration of Aerobic spore former count was implemented according to (**Collins and Lyne,1984**), The previously prepared decimal dilutions were heated in a thermostatically controlled water bath at 80ºC for 10 minutes and suddenly cooled by ice. From each dilution 0.1 ml. was seeded evenly onto duplicate plates of Dextrose Tryptone Agar medium (**Oxoid manual, 2010**).Inoculated plates were incubated at32oC for 72 hours. All bacterial counts were expressed as $\log_{10}$ cfu/gm colony forming units per gm of sample.

**Statistical analysis:**

Each analysis was run in three replicates, and collected data were analyzed using SPSS statistics 17.0 for windows. Results were recorded as mean ± SE. Analysis of variance was performed by ANOVA procedure to compare results among the different processing plants by the least significant (LSD) and significance was defined at $P<0.05$.

## RESULTS

**Table (1):** Proximate chemical composition (g %) of Egyptian beef frankfurter and Luncheon sausage produced by different processing plants.

| | Processing plant | Moisture | Protein | Fat | Ash |
|---|---|---|---|---|---|
| Beef Frankfurter | 1 | 61.29$^{a}$±0.87 | 17.39$^{a}$±0.56 | 8.82$^{a}$±0.46 | 2.87$^{a}$±0.08 |
| | 2 | 64.48$^{b}$±0.70 | 18.95$^{b}$±0.54 | 6.07$^{bd}$±0.24 | 2.83$^{a}$±0.16 |
| | 3 | 56.18$^{c}$±1.36 | 14.73$^{c}$±0.42 | 11.60$^{c}$±0.72 | 3.78$^{a}$±0.26 |
| | 4 | 61.77$^{a}$±0.67 | 14.47$^{cd}$±0.53 | 5.07$^{b}$±0.23 | 2.86$^{a}$±0.25 |
| | 5 | 63.25$^{ab}$±0.38 | 13.16$^{cd}$±0.45 | 6.75$^{bd}$±0.46 | 5.14$^{b}$±0.63 |
| | Mean | 61.39±0.96 | 15.74±0.50 | 7.66±0.33 | 3.50±0.21 |
| Luncheon | 1 | 57.14$^{a}$±0.64 | 4.77$^{a}$±0.12 | 8.68$^{a}$±0.48 | 3.65$^{a}$±0.15 |
| | 2 | 53.45$^{b}$±1.06 | 5.43$^{a}$±0.13 | 6.07$^{a}$±0.26 | 4.47$^{b}$±0.14 |
| | 3 | 52.67$^{b}$±0.96 | 6.46$^{c}$±0.15 | 5.81$^{a}$±0.35 | 4.13$^{b}$±0.12 |
| | 4 | 57.48$^{a}$±0.86 | 8.06$^{d}$±0.28 | 7.06$^{a}$±0.27 | 4.32$^{b}$±0.22 |
| | 5 | 61.04$^{bc}$±0.79 | 10.18$^{b}$±0.48 | 9.35$^{c}$±0.20 | 5.04$^{c}$±0.16 |
| | 6 | 55.92$^{a}$±0.85 | 10.22$^{be}$±0.28 | 10.54$^{c}$±0.41 | 5.11$^{c}$±0.15 |
| | 7 | 56.88$^{a}$±0.85 | 10.90$^{be}$±0.16 | 9.15$^{ad}$±0.12 | 3.57$^{ad}$±0.09 |
| | 8 | 60.52$^{bc}$±0.14 | 5.09$^{a}$±0.22 | 9.63$^{ad}$±0.07 | 3.28$^{ad}$±0.05 |
| | 9 | 60.04$^{bc}$±0.51 | 5.05$^{a}$±0.10 | 11.82$^{d}$±0.42 | 3.21$^{d}$±0.19 |
| | Mean | 57.24±0.80 | 7.35±0.15 | 8.68±0.60 | 4.09±0.22 |

$^{*}$**a-d Means with different superscripts differ significantly at p<0.05.**

**Table (2):** Physicochemical criteria of Egyptian beef frankfurter and Luncheon sausage produced by different processing plants.

| | Processing plant | pH | TBARS | TVBN | Shear force | Color | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | L* | a* | b* |
| Beef Frankfurter | 1 | 5.28$^{a}$±0.31 | 0.83$^{a}$±0.45 | 9.70$^{a}$±2.92 | 0.85$^{a}$±0.14 | 46.33$^{a}$±0.62 | 22.50$^{a}$±1.34 | 9.21$^{a}$±0.68 |
| | 2 | 5.56$^{a}$±0.27 | 0.43$^{a}$±0.10 | 14.05$^{a}$±3.39 | 2.54$^{b}$±0.09 | 41.58$^{b}$±1.09 | 21.96$^{a}$±0.83 | 12.50$^{b}$±0.39 |
| | 3 | 6.44$^{b}$±0.071 | 1.25$^{a}$±0.35 | 13.98$^{a}$±1.68 | 1.99$^{c}$±0.14 | 44.38$^{ab}$±1.41 | 21.40$^{a}$±0.98 | 15.52$^{c}$±1.05 |
| | 4 | 5.98$^{ab}$±0.29 | 0.85$^{a}$±0.28 | 14.87$^{a}$±2.59 | 1.02$^{a}$±0.06 | 45.14$^{a}$±0.86 | 14.83$^{b}$±0.40 | 11.73$^{b}$±0.45 |
| | 5 | 5.90$^{ab}$±0.39 | 0.71$^{a}$±0.23 | 14.75$^{a}$±1.65 | 1.14$^{a}$±0.16 | 41.93$^{b}$±0.56 | 16.83$^{b}$±0.50 | 12.91$^{b}$±0.47 |
| | Mean | 5.83±0.40 | 0.81±0.64 | 13.47±1.50 | 1.49±0.50 | 43.87±1.10 | 19.50±1.30 | 12.37±0.95 |
| Luncheon | 1 | 6.36$^{a}$±0.08 | 3.18$^{a}$±0.72 | 6.60$^{a}$±0.50 | 0.34$^{a}$±0.14 | 49.42$^{a}$±0.11 | 22.38$^{a}$±0.05 | 16.01$^{a}$±0.01 |
| | 2 | 6.20$^{ab}$±0.10 | 0.90$^{b}$±0.23 | 7.72$^{a}$±1.26 | 0.31$^{b}$±0.12 | 51.63$^{b}$±0.30 | 19.15$^{b}$±0.11 | 17.96$^{b}$±0.09 |
| | 3 | 6.04$^{b}$±0.02 | 0.4$^{b}$±0.05 | 6.19$^{a}$±0.63 | 0.27$^{d}$±0.09 | 52.33$^{c}$±0.14 | 21.48$^{c}$±0.05 | 16.38$^{c}$±0.04 |
| | 4 | 6.26$^{ab}$±0.02 | 0.46$^{b}$±0.08 | 6.18$^{a}$±0.31 | 0.16$^{e}$±0.10 | 52.97$^{d}$±0.33 | 21.43$^{c}$±0.15 | 12.95$^{d}$±0.05 |
| | 5 | 6.16$^{ab}$±0.08 | 0.71$^{b}$±0.22 | 7.74$^{a}$±1.11 | 0.31$^{b}$±0.12 | 51.56$^{b}$±0.02 | 26.72$^{d}$±0.03 | 9.93$^{e}$±0.00 |
| | 6 | 6.09$^{b}$±0.10 | 0.54$^{b}$±0.16 | 13.33$^{b}$±1.59 | 0.24$^{f}$±0.08 | 51.38$^{b}$±0.10 | 19.03$^{b}$±0.65 | 10.66$^{f}$±0.05 |
| | 7 | 6.09$^{b}$±0.13 | 0.54$^{b}$±0.08 | 7.51$^{a}$±0.68 | 0.32$^{b}$±0.11 | 54.51$^{e}$±0.09 | 20.05$^{e}$±0.06 | 11.31$^{g}$±0.02 |
| | 8 | 6.06$^{b}$±0.03 | 0.58$^{b}$±0.11 | 6.37$^{a}$±0.46 | 0.21$^{c}$±0.08 | 49.66$^{af}$±0.01 | 17.66$^{f}$±0.01 | 12.85$^{d}$±0.03 |
| | 9 | 6.05$^{b}$±0.04 | 0.88$^{b}$±0.10 | 5.93$^{a}$±0.28 | 0.23$^{f}$±0.19 | 50.07$^{f}$±0.08 | 17.89$^{f}$±0.02 | 12.82$^{d}$±0.11 |
| | Mean | 6.15±0.10 | 0.91±0.20 | 7.50±1.72 | 0.26±1.12 | 51.50±1.23 | 19.53±3.11 | 11.76±2.30 |

*a-g Means with different superscripts differ significantly at p<0.05.*

TVBN expressed as mg/100 mg sample.

TBARS expressed as miligrams of malonaldehyde/kg

**Table (3):** Bacterial counts ($log_{10}$cfu/g) of Egyptian beef frankfurter and Luncheon sausage produced by different processing plants.

| | Processing plant | A.P.C | Anaerobic bacterial count | Aerobic spore former count |
|---|---|---|---|---|
| Beef Frankfurter | 1 | $3.06^{a}\pm0.16$ | $1.64^{a}\pm0.14$ | $1.29^{a}\pm0.16$ |
| | 2 | $4.36^{ab}\pm0.64$ | $1.48^{a}\pm0.18$ | $1.69^{a}\pm0.18$ |
| | 3 | $2.77^{a}\pm0.26$ | $1.62^{a}\pm0.08$ | $1.55^{a}\pm0.22$ |
| | 4 | $5.71^{b}\pm0.77$ | $1.69^{a}\pm0.08$ | $1.37^{a}\pm0.43$ |
| | 5 | $4.45^{ab}\pm0.35$ | $1.65^{a}\pm0.16$ | $1.52^{a}\pm0.32$ |
| | Mean | 4.07±0.55 | 1.29±0.38 | 1.48±0.33 |
| Luncheon | 1 | $4.25^{a}\pm0.18$ | $1.26^{a}\pm0.06$ | $1.96^{a}\pm0.23$ |
| | 2 | $3.42^{bd}\pm0.13$ | $1.30^{a}\pm0.12$ | $1.81^{ac}\pm0.26$ |
| | 3 | $3.00b^{c}\pm0.25$ | $1.40^{ab}\pm0.17$ | $1.94^{ac}\pm0.24$ |
| | 4 | $3.74^{bd}\pm0.18$ | $1.41^{ab}\pm0.14$ | $2.50^{b}\pm0.11$ |
| | 5 | $2.42^{bc}\pm0.09$ | $1.59^{ab}\pm0.16$ | $2.45^{b}\pm0.16$ |
| | 6 | $2.81^{bc}\pm0.16$ | $1.75^{b}\pm0.17$ | $2.27^{ab}\pm0.12$ |
| | 7 | $1.60^{c}\pm0.18$ | $0.61^{bc}\pm0.05$ | $2.22^{ab}\pm0.09$ |
| | 8 | $1.55^{c}\pm0.10$ | $0.77^{bc}\pm0.12$ | $1.45^{cd}\pm0.12$ |
| | 9 | $1.32^{c}\pm0.11$ | $1.23^{ab}\pm0.11$ | $1.25^{d}\pm0.07$ |
| | Mean | 2.55±0.90 | 1.03±0.22 | 1.87±0.43 |

***a-d Means with different superscripts differ significantly at $p<0.05$.**

## DISCUSSION

Results in (Table 1) illustrated proximate chemical analysis of investigated samples of beef frankfurter and Luncheon produced by different processing plants. The results showed significant difference between the different processing plants. The mean values for moisture, protein, fat and ash were 61.39, 15.74, 7.66 and 3.50 % in frankfurter and 57.24, 7.35, 8.68 and 4.09% in luncheon sausage respectively.

The results also showed that samples of the 3rd processing plant in frankfurter and the 6th one in luncheon sausage had the lowest moisture and consequently the highest fat content. **(Yilmaz *et al.,* 2002**) found that an increase in fat content as a result of added oil would reduce moisture content of the sausage samples. Difference in chemical composition of both products between different processing plants may be due to differences in amount of meat and non-meat additives, added water, extenders, and fillers **(Jin *et al.,* 2016; Mahmoud *et al.,* 2016**).It is clear from data in (Table 2) that was slight but significant in physicochemical criteria in products produced by different processing plants. The mean values for pH, TBARS and TVBN were 5.83, 0.81 and 13.47 for frankfurter and 6.15, 0.91 and 7.5 for luncheon sausage respectively. **(Abdullah, 2007)** found that pH values of luncheon meat ranged from 5.0 to 7.5. TBARS values considered as an index of lipid oxidation **(Salem, 1992; Raharjo and Sofos, 1993**). High TBARS values may be due to incorporation of mechanically deboned meat where most of meat processors in Egypt use mechanically deboned poultry meat a cheap ingredient in formulation of meat products **(Emara, 2005; Mahmoud *et al*.,2016**), which contributes to a high phospholipid contents and rapid rancidity (**Gray *et al.*,1994**). Concerning TVBN, all samples were acceptable according to **ESS (1114/2005)** which established that TVBN values in meat products not exceed 20mg/100gm. TVBN considered as a reliable indicator of protein breakdown due to microbial growth and its proteolytic enzymes and production of volatile compounds **(Allina, and Ovidiu, 2007)**. A significant difference ($P<0.05$) was observed in shear force and instrumental color values in investigated samples. Shear force recognizing tenderness of meat product that has direct effect on eating quality and the perception of taste. **(Wheeler *et al.,* 1990)** showed that lower shear force values denote higher tenderness of meat product. Data in (Table 3) showed the microbiological findings of the investigated samples of beef frankfurter and luncheon from different processing plants. Mean values of Aerobic plate count were significant ($p<0.05$) differ in both beef frankfurter and luncheon, while anaerobic bacterial and aerobic spore

formers counts showed slight significant different between the processing plants of beef frankfurter. The results also showed that samples of the 5th processing plant in beef frankfurter and that of 1st one in luncheon sausage had the highest counts. These results are nearly similar to those obtained by **(Soliman, 2013; Hemmat et al., 2014)** who found that the incidence of aerobic spore formers in the examined luncheon, hot dog and frankfurter samples, on the other hand results were lower than obtained by **(Khalifa, 1997)** whose result was $l.63x10^2 \pm 2.82x10^2$ and **(Abosrea-Nadia, 2005)** "5Xl03 cfu/g ". lower results may be attributed to heat treatment of beef luncheon that may have effect on this bacteria. (**Youssif,1982**) .The differences in bacterial counts may be due to differences in type, quality and quantity of raw material used as well as lack of the sanitary measures during processing, handling and storage may act as the main source of food contamination with aerobic spore formers (**Torky, 2004**),and other bacterial hazards in processed meat products.

## CONCLUSION

The aforementioned results of investigated samples of beef frankfurter and luncheon from different processing plants declared that proximate chemical composition showed significant differences between the different processing plants probably due to using different rates of extenders and fillers. PH, TBARS and TVBN values declared that most products were of inferior quality.

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