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# Quality Assurance of Some Heat Treated Meat Products

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## ABSTRACT

The aim of this work was to assure the quality of some heat treated meat products, through organoleptic, chemical and microbiological aspects of these products. These products were Luncheon, Frankfurter and Hot dog. A total of 75 samples of final products of Luncheon, Frankfurter and Hot dog (25 / each) were collected randomly from supermarkets in Cairo Province and transferred directly (in a dry icebox) to the laboratory under complete aseptic condition with a minimum of delay. All samples were subjected to organoleptic, chemical and microbiological examination to evaluate their quality status. The results of organoleptic examination revealed that the odour ranged from good to very good, medium to very good and fair to good in Luncheon, Frankfurter and Hot Dog respectively while colour and consistency was good to very good in the three products. The results of chemical analysis revealed that the chemical indicators pH, Total Volatile Nitrogen (T.VN.) and Thiobarbituric Acid (T.B.A.) were within the permissible limits according to EOS (2005). For the chemical examination the mean value of total mesophilic bacterial count was $5.73\times10^2 \pm 2.08\times10^2$cfu/g, $2.07\times10^6 \pm 3.04\times10^5$cfu/g, and $1.83\times10^6 \pm 2.76\times10^5$cfu/g. Also, it was revealed that 100% of the examined samples of total mesophilic count of luncheon were less than the permissible limits according to EOS, (2005) while, 100% of samples of frankfurter and hot dog exceeded the permissible limits when compared with the same standard. The mean value of *coliforms* count were 2.92 ± 0.31cfu/g, 5.12 ± 0.25 cfu/g, and 6.92 ± 0.27cfu/g for Luncheon, Frankfurter and Hot Dog respectively. The three products were free from *Salmonella*. Luncheon was free from *E.coli* and *S. aureus* while frankfurter and hot dog both of *E.coli* and *S. aureus* were isolated in the rate of 80 and 12% respectively. And obtained results indicated that the gram negative *coliforms* and gram-positive bacteria were present predominantly, Moreover, Moulds and Yeasts counts. Moulds counts cfu/g ranged from 0 to $2.1\times10^4$ with a mean value of $5.2\times10^2 \pm 1.5\times10^2$, from $2.2\times10^2$ to $3.5\times10^4$ with a mean value of $2.9\times10^3 \pm 2.1\times10^2$ and ranged from $3.1\times10^2$ to $4.6\times10^4$ with a mean value of $5.3\times10^3 \pm 2.2\times10^2$ in Luncheon, Frankfurter and Hot Dog respectively. Yeasts counts cfu/g were negative in Luncheon while, ranged from 0to $1.1\times10^4$ with a mean value of $3.8\times10^3 \pm 2.3\times10^2$ and ranged from 0to $1.6\times10^4$ with a mean value of $4.5\times10^3 \pm 2.1\times10^2$ in Frankfurter and Hot Dog respectively. So, it is highly recommended to apply restricted hygiene practices along all steps of processing and storage.

## 1. INTRODUCTION:

There is a general need in the food supply chain for rapid methods to monitor bacterial quality, and to identify hygienic and safety conditions in order to enable necessary corrective actions at the appropriate time. The importance of the link between nutrition and health becomes more and more a hot topic Aggett et al., (2005). Millions of people worldwide suffer from some sort of food poisoning each year. Uncontrolled and abusive use of unauthorized

additives, improper food quality control and handling practices during food processing and other abuses of food along the food chain can all contribute to introduce hazards or the failure to reduce hazards related to food Whitehead and Field, (1995). A hazard can be defined as any biological, chemical or physical agent or condition with the potential to cause harms WHO, (1993).

The microbiological and biochemical events taking place in meat and meat products depend on their history, with both being mostly affected by temperature and water activity. During the last decade, the demand of ready-to-eat meat products has increased in Egyptian food markets. So, the production of such types of food has been also grown rapidly and varied. These ready-to-eat meat products consumed by many Egyptians varied in social and income levels Hashim, (2009).

The meat products classified into three main categories, the 1st includes products require freezing (frozen meat products as minced meat, beef burger, beef paties…etc.), the 2nd category are products that stored and handled at the ordinary room temperature (closed loaf of basterma, luncheon…etc.). the 3rd includes products that require cooling (such as slices or thin cuts of luncheon, basterami, salami…etc.) Wafaa, (2009). It is clear that quality, food safety, nutrition and health are interrelated. Grunert, (2006) discussed lifestyle with regard to future trends in meat consumption from a marketing point of view and distinguished quality, shopping and cooking aspects. FAO, (1986) revealed that the control of food safety and quality is an integral part of national programs for development, and national food control systems are designed to protect the health and welfare of the consumer, to promote the development of trade in food and food product processor, or marketer against dishonest and unfair competition.

FAO/WHO, (1983) reported that processed meat products may at times constitute a public health hazard either due to presence of spoilage microorganisms responsible for objectionable changes or pathogens leading to infection and intoxication. So, this work was carried out to evaluate the organoleptic, chemical and microbiological status of luncheon, frankfurter and hotdog that retailed for sale in many districts through determination of mesophilic Bacterial Count, *coliforms* count and Moulds and Yeasts Counts. In addition, isolation and identification of *Staphylococcus aureus, E. coli* and *Salmonella.*

## 2. MATERIAL AND METHODS:

2.1. Samples:

A total of 75 randomly collected samples of some heat treated meat products; luncheon, frankfurter and hot dog (25 / each)were collected from a factory applied quality control at Cairo Province. Samples were intact packs and transferred in an insulated ice box under complete aseptic conditions with a minimum of delay to avoid contamination and harmful effects of heat or sun to the laboratory of Food Hygiene of faculty of veterinary medicine for chemical analysis and to the laboratory of food hygiene department at Animal Health Institute in Cairo for organoleptic and microbiological examination.

2- Preparation of the collected samples

The samples preparation was carried out according to Petternel, et al. (2014). Under possible aseptic conditions, 25g of each sample were weighed and transferred into a sterile stomacher bags containing 225 ml of sterile peptone water (0.1%). The content of the stomacher bags were homogenized at high speed for 3 minutes at room temperature. Tenth fold serial dilution were prepared by transferring one ml of the original dilution with sterile pipette to another tube containing 9 ml of sterile peptone water (0.1%) to prepare further decimal dilution up to $10^6$. The prepared samples were subjected to the following examination:

3- Determination of Organoleptic characteristics according to Morr-Mary.(1970).

4- Determination of chemical indicators as PH according to Chambers, et al, (1976), T.V.N and T.B.A according to FAO, (1986).

5- Determination of aerobic mesophilic bacterial count according to ISO, (4833/2003).

6- Determination of coliforms counts, according to ICMSF, (2002).

7- Isolation and identification of Salmonellae according to ISO, (6579/2003).

8- Isolation and Identification of E.Coli according to ICMSF, (2002).

9- Isolation and Identification of Staphylococcus aureus according to FDA, (2001).

10-Determination of Yeasts and Moulds counts ISO, (21527-1/2008).

## 3. RESULTS and DISCUSSION

### 3.1. Organoleptic (Sensory) evaluation:

The colour, flavour and textural qualities of meat products are the main causes of consumer acceptance in addition to the economic price FAO, (1986).

The results of organoleptic evaluation of examined samples were summarized as following;

Table (2) indicated that Odour ranged from good to very good with a mean value 8.56 ± 0.10, from medium to very good with a mean value 7.64 ± 0.13 and from fair to good with a mean value 7.00 ± 0.15 in Luncheon, Frankfurter and Hot Dog respectively.

While Colour ranged from good to very good in all examined samples. The mean values were 8.52 ± 0.10, 8.48± 0.10 and 8.44± 0.10 in Luncheon, Frankfurter and Hot Dog respectively.

But Consistency ranged from ranged from good to very good in all examined samples with mean values of 8.92± 0.05, 8.88± 0.06 and 8.84± 0.07 in Luncheon, Frankfurter and Hot Dog respectively.

Overall the organoleptic evaluation showed that the examined samples were in a good condition. The results agreed with those of Nelson et al. (2000) and Kukowski et al. (2005), where they observed that, the colour, odour and consistency of heat treated meat commonly related to normal level and rarely to be unfit to human consumption due to the heat which removed oxygen from the muscles and removed the blood and myoglobin with changes of the enzymes of the meat that causes improvement of organoleptic characters of meat.

**3.2. Chemical analysis:**

**3.2.1- Hydrogen ion concentration (pH)**

The ideal pH level for meat products is between 5.8 and 6.3 while 6.5 may be considered as an indicative for starting spoilage of meat (Pearson, 1968). At high pH (6.0 or higher) meat will spoil quicker than meat with a pH of (5.3 to 5.7) AMPC, (2002).

Table (3) illustrate the results of pH; in Luncheon ranged from 5.65 to 6.25 with mean value 5.946 ± 0.031 nearly similar to results recorded by Hala and Hoda, (2002) while ranged from 5.7 to 6.28 with a mean value 5.925 ± 0.034 in Frankfurter and ranged from 5.6 to 6.28 with a mean value 5.899 ± 0.035 in Hot Dog. Our results agreed with those of Ebia, (2016) where she reported that in heat treated meat the pH reached 6.04, 6.22 and 6.21 in Luncheon, Frankfurter and Hot Dog respectively.

**3.2.2- Total Volatile Nitrogen (T.V.N)**

Table (4) illustrated the results of T.V.N in the examined samples of studied heat treated meat products and the mean valueswere13.917 ± 0.733, 16.079 ± 0.421 and 12.80 ± 0.449 in Luncheon, Frankfurter and Hot Dog respectively, Similar results were obtained by Ebia, (2016) where she reported that T.V.N reached 13.37 and 10.33 in Luncheon and Hot Dog respectively.

Our results also were accepted and within the permissible limits according to EOS, (2005).

**Table (1) Statistical Analytical results of Organoleptic Evaluation of examined heat treated meat products (n=25):**

| Character \ Product | Luncheon | Frankfurter | Hot Dog |
|---|---|---|---|
| **Odour** | | | |
| Minimum | 8 | 7 | 6 |
| Maximum | 9 | 9 | 8 |
| Mean ± SE | 8.56± 0.10 | 7.64± 0.13 | 7.00± 0.15 |
| **Colour** | | | |
| Minimum | 8 | 8 | 8 |
| Maximum | 9 | 9 | 9 |
| Mean ± SE | 8.52 ± 0.10 | 8.48 ± 0.10 | 8.44 ± 0.10 |
| **Consistency** | | | |
| Minimum | 8 | 8 | 8 |
| Maximum | 9 | 9 | 9 |
| Mean ± SE | 8.92 ± 0.05 | 8.88 ± 0.06 | 8.84 ± 0.07 |

100 % of all samples of all products are accepted except 3 samples of Hot Dog represent 12%.

**Table (2) Statistical Analytical results of pH of examined heat treated meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | 5.65 | 6.25 | 5.946 ± 0.031 | 23 | 92 | 2 | 8 |
| **Frankfurter** | 5.7 | 6.28 | 5.925 ± 0.034 | 22 | 88 | 3 | 12 |
| **Hot Dog** | 5.6 | 6.28 | 5.899 ± 0.035 | 20 | 80 | 5 | 20 |

E.S. = 5.6-6.2 E.S. = Egyptian Standard (1522/2005)

**Table (3) Statistical Analytical results of T.V.N. mg/kg of examined heat treated meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | 6.03 | 19.02 | 13.917 ± 0.733 | 25 | 100 | 0 | 0 |
| **Frankfurter** | 11.34 | 19.08 | 16.079 ± 0.421 | 25 | 100 | 0 | 0 |
| **Hot Dog** | 9.33 | 19.01 | 12.80 ± 0.449 | 25 | 100 | 0 | 0 |

E.S. = 20 mg/ kg

**Table (4) Statistical Analytical results of T.B.A. mg/kg of examined heat treated meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | 0.062 | 0.43 | 0.182 ± 0.024 | 25 | 100 | 0 | 0 |
| **Frankfurter** | 0.07 | 0.311 | 0.159 ± 0.015 | 25 | 100 | 0 | 0 |
| **Hot Dog** | 0.055 | 0.113 | 0.088 ± 0.002 | 25 | 100 | 0 | 0 |

E.S. = 0.9 mg/kg

**Table (5) Statistical Analytical results of Aerobic Mesophilic bacterial count CFU/g of examined meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | $2.0 \times 10$ | $5.0 \times 10^3$ | $5.73 \times 10^2 \pm 2.08 \times 10^2$ | 25 | 100 | 0 | 0 |
| **Frankfurter** | $1.0 \times 10^5$ | $5.5 \times 10^6$ | $2.07 \times 10^6 \pm 3.04 \times 10^5$ | 0 | 0 | 25 | 100 |
| **Hot Dog** | $1.2 \times 10^5$ | $4.3 \times 10^6$ | $1.83 \times 10^6 \pm 2.76 \times 10^5$ | 0 | 0 | 25 | 100 |

E.S. = Less than$10^4$ according to 1114/2005 for Luncheon and 3492/2005 for Frankfurter and Hot Dog.

**Table (6) Statistical Analytical results of Coliforms count CFU/g of examined meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | 1.0 x 10 | 6.0 x 10 | 2.92 x 10 ± 0.31 x 10 | 25 | 100 | 0 | 0 |
| **Frankfurter** | 3.0 x 10 | $7.0 \times 10^2$ | $5.12 \times 10^2 \pm 0.25 \times 10^2$ | 5 | 20 | 20 | 80 |
| **Hot Dog** | 5.0 x 10 | $9.0 \times 10^2$ | $6.92 \times 10^2 \pm 0.27 \times 10^2$ | 5 | 20 | 20 | 80 |

E.S. = Less than $10^2$ according to 1114/2005 for Luncheon and 3492/2005 for Frankfurter and Hot Dog.

**Table (7) Statistical Analytical results of Moulds count of examined heat treated meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | $1.1 \times 10$ | $2.1 \times 10^4$ | $5.2 \times 10^2 \pm 1.5 \times 10^2$ | 8 | 32 | 17 | 68 |
| **Frankfurter** | $2.2 \times 10^2$ | $3.5 \times 10^4$ | $2.9 \times 10^3 \pm 2.1 \times 10^2$ | 0 | 0 | 25 | 100 |
| **Hot Dog** | $3.1 \times 10^2$ | $4.6 \times 10^4$ | $5.3 \times 10^3 \pm 2.2 \times 10^2$ | 0 | 0 | 25 | 100 |

Samples should be free according to E.S. 1114/2005 for Luncheon and 3492/2005 for Frankfurter and Hot Dog.

**Table (8) Statistical Analytical results of Yeast count of examined heat treated meat products (n=25):**

| Product | Minimum | Maximum | Mean ± SE | Accepted | | Unaccepted | |
|---|---|---|---|---|---|---|---|
| | | | | No. | % | No. | % |
| **Luncheon** | 2.0 x 10 | $1.6 \times 10^3$ | $5.9 \times 10^2 \pm 1.0 \times 10^2$ | 10 | 40 | 15 | 60 |
| **Frankfurter** | $2.5 \times 10^2$ | $1.1 \times 10^4$ | $3.8 \times 10^3 \pm 2.3 \times 10^2$ | 0 | 0 | 25 | 100 |
| **Hot Dog** | $3.5 \times 10^2$ | $1.6 \times 10^4$ | $4.5 \times 10^3 \pm 2.1 \times 10^2$ | 0 | 0 | 25 | 100 |

Samples should be free according to E.S. 1114/2005 for Luncheon and 3492/2005 for Frankfurter and Hot Dog.

**Table (9) Incidence of isolated microorganisms from examined heat treated meat products (n=25):**

| Product | *Salmonella* | | | | *E.Coli* | | | | *Staph. aureus* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Accepted | | Unaccepted | | Accepted | | Unaccepted | | Accepted | | Unaccepted | |
| | No | % | No | % | No | % | No | % | No | % | No | % |
| **Luncheon** | 25 | 100 | 0 | 0 | 25 | 100 | 0 | 0 | 25 | 100 | 0 | 0 |
| **Frankfurter** | 25 | 100 | 0 | 0 | 5 | 20 | 20 | 80 | 23 | 92 | 2 | 8 |
| **Hot Dog** | 25 | 100 | 0 | 0 | 5 | 20 | 20 | 80 | 21 | 84 | 4 | 16 |

Samples should be free according to E.S. 1114/2005 for Luncheon and 3492/2005 for Frankfurter and Hot Dog.

**2.3- Thiobarbituric Acid (T.B.A)**

Table (5) illustrated the results of T.B.A. in the examined samples of studied heat treated meat products and the mean values were 0.182 ± 0.024, 0.159 ± 0.015 and 0.088 ± 0.002 in Luncheon, Frankfurter and Hot Dog respectively, Similar results were obtained by Ebia, (2016) where she reported that T.B.A values reached 0.18, 0.10 and 0.14 in Luncheon, Frankfurter and Hot Dog respectively. Our results were accepted and within the permissible limits according to EOS, (2005).

**3-Microbiological examination**

**3.1-Aerobic Mesophilic Bacterial Count**

The aerobic mesophilic bacterial count gives an idea about the hygienic measures applied during processing of products, also helps in the determination of keeping quality of meat. So, the total mesophilic count was the most reliable method which reflects the sanitary status of the products.

The illustrated data in Table (6) showed that the mean values of aerobic mesophilic bacterial count cfu/g was $5.73 \times 10^2 \pm 2.08 \times 10^2$ for luncheon, $2.07 \times 10^6 \pm 3.04 \times 10^5$ for frankfurter and $1.83 \times 10^6 \pm 2.76 \times 10^5$ for Hot Dog. Also, the presented data in Table (6) depicted that 100 % of the examined samples of frankfurter and Hot Dog had an aerobic mesophilic bacterial count more than the permissible limits when compared with EOS, (2005) and Our results were similar to those obtained by Ibrahim. (2009) where he reported that mesophilic count in heat treated products was $3.78 \times 10^4$ and $1.82 \times 10^6$ in Luncheon and sausage respectively.

**3.2- Coliforms Count**

Table (7) illustrated that coliforms count cfu/g of examined samples ranged from 1.0 x 10 to 6.0 x 10 with a mean values of 2.92 x 10 ± 0.31 x 10, from 3.0 x 10 to 7.0 x $10^2$ with a mean value of 5.12 x $10^2$ ± 0.25 x $10^2$ and ranged from 5.0 x 10 to 9.0 x $10^2$ with a mean value of 6.92 x $10^2$ ± 0.27 x $10^2$ in Luncheon, Frankfurter and Hot Dog respectively.

All results of coliforms count in Luncheon were within the permissible limits according to the EOS, (2005) while 20% for Frankfurter and Hot Dog were accepted and within the permissible limits according to EOS, (2005). These results were similar to those obtained by Ebia, (2016), where she reported that Coliforms count reached 4.20x$10^2$, 1.5x102 and 2.5x102 in Luncheon, Frankfurter and Hot Dog respectively. Presence of coliforms in food pointed to the unsanitary condition of processing plants as they are indicators of fecal pollution which begin from slaughter house as a result of skinning of animals using unclean knives and or infected workers during evisceration as well as contamination may come from intestinal contents, air and water used for washing and rinsing of carcasses or from plant itself due to lack of hygienic measures during production.

**3.3- Moulds Count**

Moulds count was used as an index of the proper sanitation and high quality products. Moulds can assists in putrefactive processes and in other cases; they may impart a mouldy odor and taste of food stuffs.

Moulds can grow over an extremely wide range of temperature. Therefore, one can find Moulds particularly all foods at almost any temperature under which food are held. Besides Moulds can assists in the putrefactive processes and may produce toxic substances namely mycotoxins which are harmful to man and animal Frazier and Wasthoff, (1983).

Table (8) illustrated that Mould count cfu/g ranged from 1.1 x 10 to 2.1×$10^4$ with a mean value of 5.2×$10^2$ ± 1.5×$10^2$, from 2.2×$10^2$ to 3.5×$10^4$ with a mean value of 2.9×$10^3$ ± 2.1×$10^2$ and ranged from 3.1×$10^2$ to 4.6×$10^4$ with a mean value of 5.3×$10^3$ ± 2.2×$10^2$ in Luncheon, Frankfurter and Hot Dog respectively.

Our results agreed with those of Ebia, (2016) where she reported that Moulds and Yeats count reached 1.88x$10^3$, 1.22x$10^2$ and 1.34x$10^3$ in Luncheon, Frankfurter and Hot Dog respectively. According to EOS, (2005) these three products should be free from Moulds and Yeasts.

**3.4-Yeasts count**

Yeast normally play a small role in spoilage because they constitute only a small portion of the initial population, because they grow slowly in a comparison with most bacteria and because their growth may be limited by metabolic substances which can produced by bacteria.

Spoilage yeast is those find their way into food being widely distributed into nature resulting in undesirable changes in physical appearance of food Walker, (1976).

Table (9) illustrated that Yeast count cfu/g was 2.0 x 10 to 1.6 x $10^3$ in Luncheon with mean value of 5.9 x $10^2$ ± 1.0 x $10^2$ while, ranged from 2.5 x $10^2$ to 1.1×$10^4$ with a mean value of 3.8×$10^3$ ± 2.3×$10^2$ and ranged from 3.5 x $10^2$ to 1.6×$10^4$ with a mean value of 4.5×$10^3$ ± 2.1×$10^2$ in Frankfurter and Hot Dog respectively. These results of both Moulds and Yeats counts were lower than those of both Ebia, (2016) and Kassem, (2016). According to EOS, (2005) all these products should be free from Yeast.

**3.5- Incidence of *Salmonella, E.coli* and *Staphylococcus aureus***

Table (10) illustrated that the three products are free from *Salmonella* species, while *E.coli* incidence was 0, 80 and 80% in Luncheon, Frankfurter and Hot Dog respectively. Our results agreed with those of Ibrahim, (2009) he reported that Luncheon and Sausage were free from *Salmonella* while incidence of *E.coli* was 5.71% in Luncheon. *E.coli* in food mainly associated with outbreaks of gastroenteritis syndrome Varnam and Evans, (1990).

For *Staphylococcus aureus* the incidence was 0, 8 and 16 % in Luncheon, Frankfurter and Hot Dog respectively and the three products should be free from these pathogens according to the EOS, (2005). The ability of Staphylococcus to form enterotoxic substances seems highly probable that some of the earlier cases of food poisoning, where the causal agent was considered to be heat stable toxin in heat treated meat products Bang et al., (2008).

**4. CONCLUSION:**

Heat processing of meat is one of the most technological methods that help in improving the

microbiological quality of meat products and decreasing the biological hazards. The obtained results confirmed that these heat treated meat products contain some pathogens like *E.coli*, *S.aureus* and fungi with variable incidence level which is considered as public health hazard so it is highly recommended to consider these quality choices:

1- Good quality raw material should be inspected properly on delivery by trained staff and should be stored under proper conditions to be used in manufacture of meat products.
2- Cleaning of vehicles and equipment used in manufacturing of meat products.
3- Distinct instructions for workers about their personal hygiene and handling of raw materials.
4- Application and implementation of Hazard Analysis and Critical Control Point system (HACCP) in meat products processing as reported by WHO, (1993)
5- Adoption of food safety management system (ISO 9001 and ISO 22000) in factories will achieve high quality and safety of meat products.

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