



Sensory, Deterioration and Bacteriological Assessment of Some Ready to Eat Poultry Products

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ABSTRACT

This study was carried out to assess the quality of some RTE (ready to eat) chicken meat products collected from different poultry meat processing plants in Menofia and Gharbia governorate. A total of 60 commercially produced RTE poultry products such as chicken ham, chicken shawarma, chicken with herbs, smoked turkey and turkey smoked lobes (12 each) were collected from supermarkets and examined for sensory, deterioration criteria and bacteriological quality. The results revealed that the sensory panel scores of all examined RTE poultry meat products samples were generally low especially in chicken with herbs, chicken ham and smoked turkey RTE poultry meat products. Moreover, pH values of most of the examined samples were relatively alkaline whereas the lowest value was recorded in smoked turkey samples and highest value was observed in chicken with herbs samples. In addition, higher thiobarbituric acid (smoked turkey) and slightly increases of total volatile basic nitrogen values (chicken with herbs) were recorded in most of the examined samples. All investigated bacterial counts were significantly high in all examined RTE poultry meat products samples. *Staph. aureus* was isolated from chicken ham and *E. coli* strains were isolated from chicken shawarma, smoked turkey and turkey smoked lobes. However, *E. coli* O₁₅₇:H₇ and salmonella strains failed to be isolated from all the examined samples. It could be concluded that all the examined RTE poultry meat products were deteriorated in terms of sensory, chemical and bacteriological terms and exceeded the limit described by E.S. (3493/2005) for cooked poultry meat products. In addition, these samples were probably produced and prepared under bad hygienic measures which could be responsible for lowering their quality and reduce shelf life.

Key words: RTE; Sensory; Deterioration criteria, Bacteriological examination

INTRODUCTION

Consumption of poultry meat such as chicken meat continues to increase all over the world especially in developing countries. This may be due to the fact that chicken meat is not target to any culture or religious restrictions (Kralik *et al.*, 2018). In addition, chicken meat is considered as an easily accessible high-quality protein source, of low saturated fat and rich with other nutrients that are essential for consumers and recommended for consumption by all age groups (Cavani *et al.*, 2009). Chicken meat is suitable for fast and simple preparation and more available with affordable prices which making it as the best choice for consumers to be match with the modern lifestyle (Kralik *et al.*, 2018). In addition to chicken meat, turkey meat is also preferred than red meat in terms of health purpose because of having protein/calorie ratio and low cholesterol. Moreover, turkey meat is rich in vitamins such as thiamin (B1), riboflavin (B2), niacin (B3),

pyridoxine (B6), and r minerals like calcium, phosphorus and potassium (Çolak *et al.*, 2011).

The great diverse in our life attitudes, in addition to increase working hours force the consumers to depend on ready to eat (RTE) meat products in their daily meals. RTE poultry products can be eaten without preparation, heating or cooking or requiring some preparation such as reheating before consumption (Howard *et al.*, 2012). There is a wide variety of RTE meat products such as luncheon, frankfurter, shawarma, kebabs, ham, smoked turkey and other deli meats. The shelf life of these products depends on the degree of cooking, composition of the cure, smoke protocol, storage temperature, and type of packaging. Cooking method, spices, herbs and their extracts, in addition to contributing to taste and flavor represent an increasing source of natural antimicrobials for food preservation. However, the microbiological quality problems of RTE products rely on low quality raw meat & ingredients used in processing, imperfect sanitary practices

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for personnel & processing utensils and inefficient cooking process (Kayaardi *et al.*, 2006). In addition, Kralik *et al.*, (2018) found that contamination during post processing such as slicing and repackaging with pathogenic organisms can also occur, causing food borne diseases. Moreover, the presence of spoilage organisms on the products as a result of contamination may deteriorate its quality attributes and decrease storage shelf life.

Consumers become more aware about obtaining safe food and of high quality. Consumer's decision to select the RTE products is depending mainly on some criteria such as appearance, taste, aroma, and texture. Safe food is the main human right despite the fact several foods are often contaminated with microorganisms which cannot be noticed organoleptically. The major components which affect the keeping quality and shelf life of the chicken meat products are lipid oxidation and protein degradation. Lipid oxidation reaction in chicken meat occurs very rapidly because it is rich in unsaturated fatty acid (Sabadinde, 2014). Several studies focus on the microbiological assessment of RTE meat products, however, the studies on the assessment of deterioration and sensorial quality of RTE are rare. Therefore, the present study was designed to determine the quality of some RTE poultry meat products such as chicken ham, chicken shawarma, chicken with herbs, smoked turkey and turkey smoked lobes in term of sensory, deterioration and bacteriological assessment.

MATERIALS AND METHODS

Collection of samples

A total of 60 commercially produced RTE poultry products (12 each from chicken ham, chicken shawarma, chicken with herbs, smoked turkey, turkey smoked lobes) produced by different meat processing plants were collected. These samples were collected within one month after processing from supermarkets and restaurants at Menofia and Gharbia governorate, Egypt. Each sample was represented ~500g from the same processing lot. All samples were transferred immediately after purchasing in cooling ice box to the laboratories of Animal Health and Research Institute at Gharbia governorate and kept chilled at 4°C until the time of investigation.

Parameters studied

Sensory quality

Sensory panel analysis was performed by 5 panelists from the members of Animal Health and Research Institute. All samples were evaluated for color, taste, flavor, consistency and overall acceptability using a 10-point scale (where 10 denotes extremely acceptable and 1 denotes extremely unacceptable) according to the method recommended by AMSA (1995). Prior to the analysis panelists were trained in the definition and intensities of all investigated sensory parameters.

Deterioration criteria

To measure pH value of RTE poultry meat product samples, the pH meter was firstly calibrated by two buffers (7.0 and 4.0). Using pH meter (Lovibond Senso Direct Ltd), three reading e for each sample were taken and the average was calculated (Kandeepan *et al.*, 2009). Measurement of total volatile basic nitrogen (TVBN) of

RTE poultry meat product samples was done as per the procedure of Kearsley *et al.* (1983) using macro-Kjeldahl distillation apparatus. In addition, thiobarbituric acid (TBA) was determined by the procedure recommended by Du and Ahn (2002).

Bacteriological examination

For enumeration of total mesophilic and psychrotrophic bacterial count, standard plate count agar plates (Oxoid CM 463) were incubated after the inoculation at 32 °C for 48 hours (Swanson *et al.*, 1992) at 7 °C for 7 days (Cousin *et al.*, 1992), respectively. For enumeration of *staph.aureus*, the inoculated Baird-Parker agar plates (Oxoid CM 145) were incubated at 37 °C for 48 hours according to the method recommended by Bailey and Scott (1982). Moreover, enumeration of coliforms "was done by Most Probable Number technique "MPN" adopted by Hitchins *et al.* (1992). For isolation of *E. coli*, loopful from each of the positive *E. coli* broth tube was inoculated over the surface of Eosine Methylene Blue (EMB) agar plates (Krieg and Holt, 1984). In addition, all samples were analyzed to determine the presence of any *E. coli* O157:H7 serotype according to the procedure proposed by (FDA, 2001). The suspected colonies of *E. coli* were biochemically and serologically identified. Salmonella isolation was carried out by streaking onto each of Xylose-Lysine Desoxycholate (XLD) and MacConkey agar according to procedure recommended by FAO (2002).

Statistical analysis

All data were statistically analyzed by ANOVA using SPSS 17.0 for windows (SPSS Inc, Chicago, IL, USA) and represented as means±SE. The differences between the mean values were determined by least square difference test (LSD) procedure and the main effects were considered significance at $P < 0.05$.

RESULTS AND DISCUSSION

Sensory quality

Sensory attributes of meat and meat products are widely considered to be the most important determinant factor of consumer acceptability, with special consideration to appearance, flavor and texture. Moreover, sensory analysis permits evaluating sensory properties that are directly related to consumer understanding of quality. Data in Table 1 represents summarized results of sensory panel scores of RTE poultry meat products samples collected from local markets at Menofia and Gharbia governorate. Sensory panel scores for all examined RTE poultry meat products samples including chicken ham, chicken shawarma, chicken with herbs, smoked turkey and turkey smoked lobes indicated that the overall acceptability was generally low as they scored 4.97, 5, 4.88, 4.98 and 5.57, respectively. As a rule, chicken with herbs, chicken ham and smoked turkey RTE products showed the lower sensory panel scores.

Overall acceptability of all examined RTE poultry meat products was low probably due to the marked decrease in all the investigated sensory attributes specially flavor, taste and consistency. The obtained results were in agreement with Ramarathnam and Rubin (1994) who reported that the overall acceptability of meat products

Table 1: Sensory panel scores of RTE poultry meat products samples (n=60)

	Chicken ham	Chicken shawarma	Chicken with herps	Smoked turkey	Turkey smoked lobes
	Mean±SE				
Color	6.12 ^a ±0.30	6.57 ^a ±0.23	6.62 ^a ±0.22	6.32 ^a ±0.21	6.63 ^a ±0.21
Taste	5.63 ^a ±0.14	5.87 ^a ±0.29	5.47 ^a ±0.29	6.08 ^a ±0.15	5.98 ^a ±0.20
Flavor	4.97 ^a ±0.26	5.00 ^a ±0.28	4.88 ^a ±0.40	4.98 ^a ±0.22	5.57 ^a ±0.42
Consistency	5.28 ^a ±0.23	5.45 ^a ±0.23	5.30 ^a ±0.29	5.28 ^a ±0.24	5.78 ^a ±0.26
Overall acceptability	4.97 ^a ±0.26	5.00 ^a ±0.28	4.88 ^a ±0.40	4.98 ^a ±0.22	5.57 ^a ±0.42

Table 2: Deterioration criteria of RTE poultry meat products samples (n=60)

	Chicken ham	Chicken shawarma	Chicken with herps	Smoked turkey	Turkey smoked lobes
	Mean±SE				
pH	6.61 ^a ±0.09	6.53 ^a ±0.08	6.63 ^a ±0.10	6.30 ^b ±0.05	6.41 ^{a,b} ±0.05
TBA	0.61 ^{a,c} ±0.03	0.62 ^a ±0.06	0.47 ^c ±0.03	0.99 ^b ±0.08	0.48 ^{a,c} ±0.03
TVBN	9.38 ^{a,d} ±0.53	10.38 ^{a,c} ±0.56	13.41 ^b ±0.44	9.00 ^d ±0.32	10.81 ^c ±0.44

*a-d: Means with different superscripts in rows differ significantly at P<0.05; TBA (Thiobarbituric acid) expressed as milligrams of malonaldehyde/kg; TVBN (Total volatile basic nitrogen) expressed as mg/100g sample.

Table 3: Bacterial load (log₁₀ CFU/g) of RTE poultry meat products samples (n=60)

	Chicken ham	Chicken shawarma	Chicken with herps	Smoked turkey	Turkey smoked lobes
	Mean±SE				
Total mesophilic bacterial counts	4.49 ^{a,c} ±0.16	4.37 ^{a,c} ±0.19	4.11 ^{a,b} ±0.07	4.78 ^c ±0.16	3.94 ^b ±0.14
Total psychrotrophs	2.73 ^{a,b} ±0.22	2.74 ^{a,b} ±0.10	2.54 ^a ±0.20	3.09 ^b ±0.10	2.83 ^{a,b} ±0.15
Total staphylococcus counts	2.16 ^a ±0.26	2.61 ^{a,b} ±0.29	2.80 ^b ±0.10	2.84 ^b ±0.21	2.49 ^{a,b} ±0.14
Coliforms counts	2.44 ^a ±0.20	2.82 ^a ±0.43	1.20 ^b ±0.22	2.63 ^a ±0.42	1.28 ^b ±0.20

*a-c: Means with different superscripts in rows differ significantly at P<0.05

Table 4: Incidence (%) of pathogens in RTE poultry meat products samples (n=60)

Organisms	Chicken ham		Chicken shawarma		Chicken with herps		Smoked turkey		Turkey smoked lobes	
	No.	%	No.	%	No.	%	No.	%	No.	%
<i>Staph. aureus</i>	1	8.33	0	0	0	0	0	0	0	0
<i>E. coli</i>	0	0	1	8.33	0	0	0	0	0	0
<i>E. coli poly3: O151</i>										
<i>E. coli poly1: O1</i>	0	0	1	8.33	0	0	1	8.33	1	8.33
<i>E. coli poly1: O26</i>	0	0	0	0	0	0	0	0	1	8.33
Salmonella	0	0	0	0	0	0	0	0	0	0

depends on their flavor. Flavor is a complex sensation includes taste and aroma or smell and considered one of the most important factors affecting consumers' meat-buying habits and preferences even before eating the meat. Development of off-flavors (rancidity) is due to lipid oxidation which can be determined by sensory evaluation and measurement of the degradation products such as TBA (Naveena *et al.*, 2005).

The obtained data of chicken ham was in agreement with Abdel-naem *et al.* (2010) who observed that chicken ham samples had very low score for all sensory attributes. The mean sensory panel scores for appearance, color, flavor, tenderness, juiciness, binding and overall acceptability were 3.98, 3.81, 2.78, 3.1, 2.73, 4.22 and 3.23 respectively. The low sensory panel scores for the examined chicken ham may be due to incorporation of low-quality materials. Jackman *et al.* (2010) reported that ham differs in quality mostly due to the number of muscle pieces forming the ham. To produce highest quality ham, it should be processed from a single muscle with least or without brine injection to increase cooking yield. However, the obtained results for chicken shawarma were not in agreement with Ibrahim *et al.* (2014) who observed relatively high sensory scores which ranged from 6.3 and 7.45 with overall acceptability of 7.05.

Deterioration criteria

pH value is one of keeping quality parameter which is used to assess the shelf-life of the meat products. The

variations of TBA values may be attributed to fat content of the examined chicken meat products and is usually considered as an index of lipid oxidation related to the sensory characteristics as rancidity (Raharjo and Sofos, 1993). Furthermore, TVBN measurement is considered as a reliable indicator of various chicken meat products especially during storage where protein break down (ammonia) may occur due to microbial growth and its proteolytic enzymes (Alina and Ovidiu, 2007). The results of the deterioration criteria of RTE poultry meat products samples are presented in Table (2). pH values of most of the examined RTE poultry meat samples were relatively alkaline and the lowest value was recorded in smoked turkey samples (6.30) while, the highest value was observed in chicken with herps samples (6.63). The relatively alkaline pH values may be attributed to metabolites accumulation through bacterial action of spoilage microorganism on protein and amino acids (Kumar and Tanwar, 2011).

TBA values of chicken ham, chicken shawarma, chicken with herps, smoked turkey and turkey smoked lobes were 0.61, 0.62, 0.47, 0.99 and 0.48 mg malonaldehyde/kg, respectively. The highest TBA value was recorded in smoked turkey products and exceeded the limit described by E.S. (3493/2005) for cooked poultry meat products. This relatively high TBA value may be due to fat oxidation throughout storage or due to the use of low quality meat ingredients in the processing of such product

and/or to the high level of lipids and unsaturated fatty acids present (Tang *et al.*, 2001). In this consideration, Gomes *et al.* (2003) pointed out that *the development of TBA is used as indication for fat oxidation of chicken meat products*. Moreover, Al-Dughaym and Altarabi (2010) claimed that relatively higher TBA value is responsible for the changes in nutritional, sensory quality, acceptability and reduced shelf life of poultry products. Furthermore, lipid oxidation has economic importance for meat industry as it leads to the development of rancidity and chemical spoilage in food (Tang *et al.*, 2001). The obtained result concerning the higher TBA of smoked turkey products than other RTE poultry meat products is in agreement with Wilson *et al.* (1976) who found that turkey meat was the most susceptible to development of fat rancidity by TBA analysis. Al-Dughaym and Altarabi (2010) observed that higher degree of TBA value is associated with noticeable objectionable flavor and lower degrees of acceptability in further processed poultry products.

TVBN values of the examined RTE poultry products samples ranged from 9.00 to 13.41 mg/100g. There were significant ($P < 0.05$) differences in TVBN values between the examined RTE poultry meat samples and the highest value was recorded in chicken with herbs samples. Decreasing of TVBN of examined samples may refer to its low protein content. The obtained results were in disagreement with Ibrahim *et al.* (2014) who recorded higher TVBN values of shawarma samples.

Bacteriological examination

The bacteriological quality of RTE foods is assessed by estimation of its total viable bacterial and coliform counts which can give general idea about the hygienic measures taken during handling preparation and processing of foods (Aberle *et al.*, 2001). Safety of RTE cooked chicken meat products are depending on the correct cooking and post processing sanitary practices. The presence of food borne pathogens on the equipment surfaces or the environment, especially in post-cooking zone are the most important routes for contamination of RTE meat products which lead to outbreaks of food-borne disease (Ansari, 2015).

Table (3) reveals the results of bacterial load (\log_{10} CFU/g) of RTE poultry meat products samples. All investigated bacterial counts (APC, psychrotrophs, total staph and coliforms) in all examined RTE poultry meat products samples were significantly high and exceeded the limit established by E.S. (3493/2005) for cooked poultry meat products. *Staph. aureus* was isolated from chicken ham, *E. coli poly3: O₁₅₁* was isolated from chicken shawarma, *E. coli poly1: O₁* was isolated from chicken shawarma, smoked turkey and turkey smoked lobes and *E. coli poly1: O₂₆* was isolated from turkey smoked lobes. However, *E. coli O_{157:H7}* and salmonella strains failed to be isolated from all the examined samples (Table 4). According to E.S. (3493/2005) for cooked poultry meat products, these products must be free from *staph. aureus*, *E. coli* and Salmonella. The obtained results concerning higher bacterial counts of RTE poultry meat products were in agreement with El-Mossalami (2003). In addition, isolation of *E. coli* from RTE poultry meat products were in agreement with Kakar and Udipi (2002) and failing of isolation of salmonella strain was in agreement with El-

Mossalami (2003). The high microbial load of marketed chicken products may be due to mishandling, incorporation of contaminated raw material & ingredients, and contact with insanitary equipment (Andrés *et al.*, 2006). Moreover, poultry products offer ideal medium for microbial growth due to their suitable chemical composition and favorable pH (Johnston and Tompkin, 1992). This necessitates the improvement of the microbiological quality of such products.

Conclusions

From this study it could be noticed that overall acceptability of all examined RTE poultry meat products samples (chicken ham, chicken shawarma, chicken with herbs, smoked turkey and turkey smoked lobes) collected from Menofia and Gharbia governorate were significantly low. In addition, higher pH, TBA values, APC, psychrotrophs, total staph and coliforms were observed in all examined samples. Moreover, *E. coli poly3: O₁₅₁*, *E. coli poly1: O₁*, *E. coli poly1: O₂₆*, and *staph. aureus* strains were isolated from some samples. A matter which suggested an improvement of the microbiological quality of poultry meat products is necessary. While, *E. coli O_{157:H7}* and salmonella were absent in all examined RTE poultry meat products samples.

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