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Study of some chemical, physical, sensory and bacteriology characteristics of canned chicken meat imported to Sulaymaniyah markets, Iraq

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This study was conducted to assess the quality of imported four brands of canned chicken meat that were (A, B, C and D) by using different quality standard inspection tests; these are, determination the chemical compositions of moisture, protein, fat, ash, energy and as well as studying the changes in the organoleptic characters represented by measuring peroxide value, free fatty acids, thiobarbituric acid and total volatile nitrogen were carried out. The microbiological investigations involved examination of total bacteriological count, coliform bacteria, proteolytic, lipolytic and sporoforming bacteria (anaerobic) also were tested. In addition, sensory attributes were measured. There are significant differences ($p \leq 0.05$) among trademarks in chemical analyses that indicated that A trademark of canned chicken meat had the highest percentage of moisture (67.05%) compared to the lowest percentages of D trademark (59.31%) and high protein contents were in B (32.10%) trademarks, while lower contents were in A 20.72% trademark. B trademarks contained low percentage of lipid (2.69%), while D trademark contained a high percentage of lipids (12.53%). C trademark appeared to have higher contents of ash (3.40%), while lower contents were in A (2.66%) trademark, and the total volatile nitrogen values for the all trademarks were non-significant. There were no significant differences ($p \leq 0.05$) among all trademarks in contents of free fatty acids and thiobarbituric acid (TBA), but there are significant differences ($p \leq 0.05$) among all trademarks in contents of peroxide values. Peroxide values (PV) for A, B, C and D trademarks were 0.95, 0.45, 0.65 and 0.80 meq oxygen/kg fat, respectively. Also, PV was through the allowance limits for all trademarks. There are not significant differences ($p \leq 0.05$) in microbial tests among all trademarks that indicated there were no aerobic bacteria in any of these trademarks. Significant differences in the sensory properties among the four trademarks observed, while there are non-significant differences in the overall acceptability of the four trademarks.

Key words: Canned chicken meat, quality analysis, sensory evaluation.

INTRODUCTION

Food composition data are important to a spectrum of users ranging from international organizations and private individuals, to food assistance programs, epidemiologists correlate patterns of disease with dietary components and nutritional assessment of individual intake and dietetic counseling (Rand et al., 1991). Applying food safety standards on a product is very important because it relates closely to human's health. Good food products

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have a high nutritional quality, as well as being free from physical, chemical and biological contaminations. The food industry development encourages food manufacturer's to produce more practical and durable products, but still must have high nutrition. For example, beef processing to produce meatballs, corned beef, beef burgers and sausages have the purpose to form more practical and durable products, as well as having high nutritional value (Farmer and Farmer, 2000; Javed et al., 2009).

Chicken meat can make many positive contributions to the diet of those on low incomes. Although not all meat is seen as healthy, chicken meat is, and is frequently more affordable than other meats. It is of a consistently high quality, is low in saturated fats, can be enriched with some essential nutrients and is sought after worldwide (Yu et al., 2008; Bingham, 2006). Chicken meat does not contain the trans fats that contribute to coronary heart disease, and can be found in high amounts in beef and lamb. In Canada, values of 2 to 5 percent have been reported for beef and as high as 8 percent for lamb. The World Cancer Research Fund and others (Bingham, 2006) and Acuff (2006) clarified the difference between spoilage organisms and pathogens by stating, "spoilage organisms will not make you sick, as in instigating an infection and creating a real illness." However, spoilage organisms make food undesirable. The meat industry works diligently to prevent, reduce and eliminate both pathogenic and spoilage bacteria before meat are delivered to consumers for purchase.

Canned luncheon meat is an emulsion-type, cured meat product that is sterilized by heat and has a shelf-life of about three years at ambient temperature (Standard, 1998). It is a popular food item in many countries and it is also used in 'fast food' (Al-Bachir and Mehio, 2001). The basic raw material is either beef or poultry in chopped or comminuted form, and additional ingredients may include spices, soya protein, starch, nitrite, salt, ascorbate, and phosphate (Abdullah, 2007). Meat can be contaminated with foodborne human pathogens and is a highly perishable type of food; heat treatment of the canned product is essential in relation to its safety and stability, and must be sufficient to ensure that no microbiological hazard arises during storage (Ostoja et al., 2002). The quality of luncheon products is strongly influenced by the temperature, time of processing and fat content of the meat. If too severe, heat treatment can cause denaturation of protein and changes in product appearance, water-binding capacity and tenderness (Pena-ramos and Xiong, 2002).

As one of the ways to keep safety of food in Sulaymaniyah-Iraq, this study aims to assess the quality of canned meat by parameters used in quality control included sensory, physical, chemical, microbiological, also having knowledge about International and national food laws of meat and poultry act, prevention of food adulteration Act and food additives.

MATERIALS AND METHODS

Sampling

This study was conducted in the laboratories of Faculty of Agricultural Science and Quality Control Laboratories of Veterinary Directorate. Samples included canned chicken meat to four different brands, A, B, C and D. The brands are most commercially available in Sulaymaniyah governorate. The total number of samples used in the study was 24 samples of 6 replicates for each brand, and taken into account when the acquisition of samples was done to date.

Moisture content

Moisture content was observed according to the method of Association of Official Analytical Chemistry (AOAC, 2000).

Ash content

Ash percentage was determined by Gravimetric method as described by AOAC (2000).

Total protein content

Protein content was determined according to the method as described by AOAC (2000).

Fat content

Total fat content was extracted in Soxhlet extraction unit as described by AOAC (2000).

Calculation of caloric value

The caloric value of 100 g meat was calculated according to Atwater and Woods (1986).

Free fatty acids (FFA)

This was estimated by the way of Egan et al. (1981).

Thiobarbituric acid (TBA)

The value analysis was measured by the way of Tarladgis et al. (1960) as adopted by Witte et al. (1970).

Peroxide value (PV)

This was analyzed by the way of Egan et al. (1981).

Total volatile nitrogen (TVN)

This was estimated by the way of Malle and Poumeyrol (1989).

Bacteriological analyses

Sample preparation

For the microbiological analysis of all trademarks, 25 g of samples

Table 1. Evaluation form for descriptions of sensory properties for all trademarks.

Overall acceptability	Color	Flavor	Juiciness	Tenderness
(5) Very acceptable	(5) Very dark	(5) Very good	(5) Very juice	(5) Very soft
(4) Acceptable	(4) Dark	(4) Good	(4) Juice	(4) Soft
(3) Middle	(3) Acceptable	(3) Middle	(3) Middle	(3) Middle
(2) Unacceptable	(2) Light	(2) Weak	(2) Dry	(2) Hard
(1) Rejected	(1) Very light	(1) Very weak	(1) Very dry	(1) Very hard

Table 2. Chemical analysis of four canned chicken meat imported to sulaymaniyah markets.

Trademarks	Moisture%	Dry matter%	Protein%	Fat%	Ash%	Energy
A	67.05±0.98^{a}	32.94±0.9^{b}	20.72±2.36^{c}	6.97±3.34^{ab}	2.66±0.0^{c}	170±1.96^{b}
B	59.93±2.53^{b}	40.07±2.5^{a}	32.10±0.18^{a}	2.69±2.40^{b}	3.22±0.0^{b}	160±2.25^{c}
C	60.18±0.07^{b}	39.81±0.0^{a}	28.18±0.42^{ab}	6.22±0.42^{ab}	3.40±0.0^{a}	176±2.17^{b}
D	59.31±0.42^{b}	40.68±0.42^{a}	23.59±0.62^{bc}	12.53±1.10^{a}	3.22±0.0^{b}	212±2.33^{a}

Means having the same letter in the same sections are not significantly different at $P \leq 0.05$.

taken from different parts of the canned meat, was homogenized using a Waring blender at 6000 rpm in 225 ml of sterile salt solution (0.85% NaCl). All the tests performed on the samples were determined by the power plate technique. Decimal dilutions were prepared, and then by using a pipette 1 ml of each dilution was put into separate, duplicate, sterilized and appropriately marked petridishes, the petridishes were incubated but in a reverse manner. Finally, the colonies were calculated. The whole procedure was done according to (APHA, 1984). The performed tests are as follows:

Total viable aerobic count: The aerobic bacteria were enumerated on nutrient agar (Himedia labs. Pvt. Ltd) incubated at 35°C for 48 h.

Total coliform bacterial counts: Coliforms were determined on MacConkey agar containing bile salts (Himedia labs Pvt. Ltd) incubated at 37°C for 48 h.

Proteolytic bacterial counts: Proteolytic bacteria were determined using nutrient agar medium plus 10% sterilized skim milk. The plates were inoculated with the diluted sample homogenated and incubated at 30°C for 72 h and examined for clear zone around growth to indicate proteolytic activity.

Lipolytic bacterial counts: They were determined using nutrient agar medium plus 10% sterilized olive oil and plates were incubated at 30°C for 48 h. The lipolytic colonies were identified by copper sulphate 20% where blue colonies were counted.

Total sporoforming bacterial counts: Enumeration is carried out for bacteria belonging to species of (*Clostridium* and *Bacillus*), where the former is anaerobic while the latter is aerobic, using diluted solution 10^{-1} and 10^{-2} and were heated to 80°C for 10 min. Then, 1 ml of each diluted solution was transferred to a sterilized petridish. Consequently, sterilized nutrient agar was added and incubation was done as suitable for each bacterium. The plates were incubated for *Clostridium* in anerobic circumstances and at 37°C for 72 h while for *Bacillus* species, they were incubated aerobically at 35°C for 48 h.

Sensory evaluation

Sensory evaluation was carried out by a nine-member semi trained panel. Panel members with ages ranging from 25 to 50 were from faculty members and graduate students of Animal production Department of Sulaimani University, Faculty of Agricultural Science and all were experienced in sensory evaluation of various food products. Panelists were asked to evaluate the samples of each brand for tenderness, juiciness, flavor, color and overall acceptability as described in Table 1. The descriptions of sensory properties and how to rate a sample for the particular sensory property were on the evaluation form.

Statistical analysis

All data were subjected to one-way analysis of variance (ANOVA) using XL Stat program for windows. The level of significance was chosen at $P \leq 0.05$ and the results are presented as mean ± SE. Duncan's multiple range tests was used to determine the significance of differences among means (Duncan, 1955).

RESULTS AND DISCUSSION

Moisture, dry matter, protein, fat, ash and energy contents of canned chicken meat are described in Table 2. There were significant differences ($p < 0.05$) in the chemical composition (moisture, dry matter, protein, fat, ash and energy) amongst the four trademarks of canned chicken meat examined. A contained high percentage of moisture (67.05%), while D contained low percentage (59.31%); however there are not significant difference between B, C and D. It is clear from the same table that the percentage of dry matter was on the exact opposite proportion of moisture, the highest ratios had been achieved in canned chicken meat containing the lowest

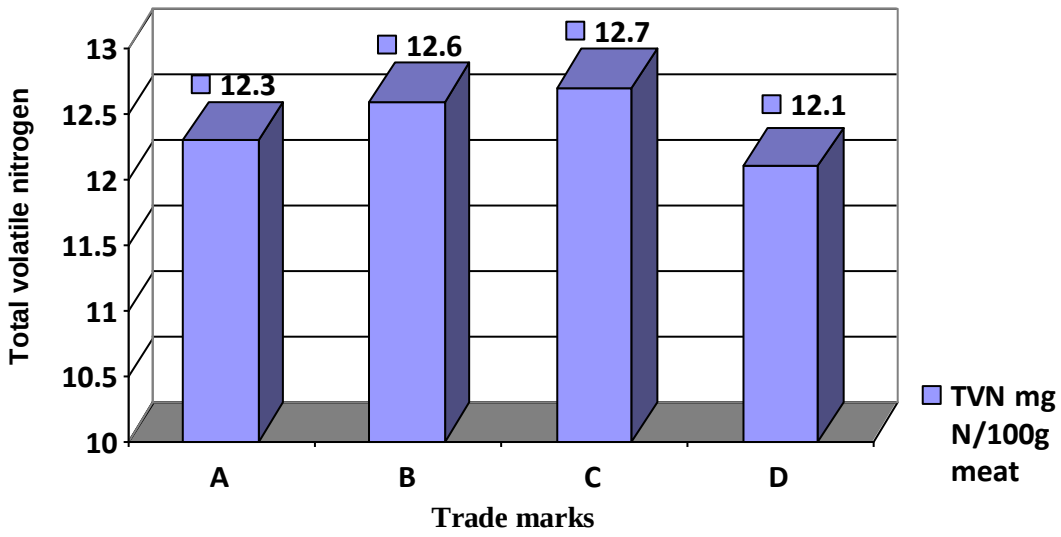

Figure 1. Total volatile nitrogen (TVN) value for four trademarks (mg N/100 g).

percentage of dry matter so that the moisture content and dry matter will be as a whole constituent of 100%. The percentage of moisture in the canned meat of A was high on the permissible limits by the Central Agency for Standardization and Quality Control (1988) but B, C and D trademarks was within the allowed limits. There were significant differences ($p < 0.05$) in the protein contents that the High protein contents were shown in B and C trademarks while lower contents were in A trademark.

A and D trademarks contained a moderate percentage (20.75 and 23.59%, respectively) of protein. Some studies reported similar protein content in canned meat, Alobaidi (2005) recorded the range of protein between 20.28 and 21.17% in canned meat. Romans and Ziegler (1977) found that the percentage of protein in fresh meat was 20% and in the canned meat, 22%. Thomas and Corden (1977) stated the chemical composition of different types of food, noticed that the percentage of protein in the canned meat was 20.9%. The proportion of protein in the majority of transactions are comparable to the minimum allowed, which amounts to 21% and this is not acceptable that we need a relatively high-protein sources to increase the protein consumption locally.

There were significant differences ($p < 0.05$) in the fat contents that the B trademarks contained low percentage of fat (2.69%) while D trademark contained high percentage of fat (12.53%). Fat in the canned meat samples were within the limits allowable of the Central Agency for Standardization and Quality Control (1988). The Central Agency for Standardization and Quality Control (1988) recorded that the percentage of fat in luncheon meat must not be greater than 25%. The results that are obtained here are within the range of fat content determined by many researchers as being 0.37 to 8% (Abeni and Bergoglio, 2001; Al-Najdawi and Abdullah, 2002; Van Heerden et al., 2002; Wattanachant et al., 2004; Chuaynukool et al., 2007). Nevertheless, the differences in fat content in the inspected samples could be due to the differences in genetic and non-genetic factors (Lin et al., 1980; Bogosavljevic-Boskovic et al., 2010).

In conclusion, fat content of all samples were within the fat ranges that have been published by many researchers, but from the nutrition site, the fat content in all inspected samples were higher than what is being specified by United States Department of Agriculture (USDA) (2010). Significant difference in ash was shown among the four trademarks of canned meat. C appeared that have higher contents of ash that was higher than the permissible limits by Alobaidi (2005) that recorded the range of ash between 2.55 and 2.95%. Ash content was high in some samples, especially in the sample C that content 3.40%; as the ash content is an indication of the content of salts, it might indicate that preservatives present are salts in concentrations higher than specified. The ratio of carbohydrates came within the limits allowable which must not exceed 2%. The differences of ash content among the trade marks for all samples may be due to the decrease of moisture content which is associated with storage and handling proceedings with extension in storage period (Xiong et al., 1999).

Figure 1 shows the total volatile nitrogen value for four trademark of canned meat. No significant differences between the values of total volatile nitrogen for canned meat samples at a level ($p < 0.05$) and these values range from (12.1 to 12.7) mg N/100 g meat. These results were within the limits allowable of Iraq and the international specification (the Central Agency for Standardization and Quality Control, 1987), while the free nitrogen from proteins in canned meat does not exist and chemical changes as well were non-existent because the canned meat have detected components of salt and

Table 3. Lipid oxidation evaluation for four trademarks.

Trademarks	Free fatty acids %	Peroxide value (meq oxygen/kg lipid)	Thiobarbituric acid (mg malonldehyde/kg lipid)
A	0.05±0.01^{a}	0.95±0.05^{a}	0.39±0.02^{a}
B	0.03±0.01^{a}	0.45±0.05^{c}	0.37±0.08^{a}
C	0.04±0.01^{a}	0.65±0.05^{bc}	0.45±0.005^{a}
D	0.07±0.005^{a}	0.80±0.10^{ab}	0.43±0.01^{a}

Means having the same letter in the same sections are not significantly different at $P \leq 0.05$.

Table 4. Microbial assessment for four trademarks.

Trademarks	Total aerobic bacteria	Coliform Bacteria	Proteolytic bacteria	Lipolytic bacteria	*Bacillus*	*Clostridium*
A	0.00	0.00	0.00	0.00	0.00	0.00
B	0.00	0.00	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00	0.00	0.00
D	0.00	0.00	0.00	0.00	0.00	0.00

Table 5. Sensory evaluation of four trademarks.

Trademarks	Tenderness	Juiciness	Flavor	Color	Overall acceptability
A	4.25±0.25^{a}	2.5±0.28^{ab}	2.75±0.25^{a}	2.75±0.47^{b}	4.0±0.00^{a}
B	4.25±0.47^{a}	3.5±0.28^{a}	3.5±0.50^{a}	2.0±0.40^{b}	4.5±0.50^{a}
C	3.25±0.47^{ab}	2.75±0.49^{ab}	2.75±0.75^{a}	3.0±0.40^{ab}	4.25±0.47^{a}
D	2.50±0.64^{b}	1.75±0.47^{b}	2.5±0.50^{a}	4.0±0.00^{a}	4.0±0.75^{a}

Means having the same letter in the same sections are not significantly different at $P \leq 0.05$.

nitrate which helps to prevent the meat inside the cans from spoilage.

Free fatty acid (FFA), peroxide value and thiobarbituric acid for all trademarks of canned chicken meat are shown in Table 3. There are not significant differences among trademarks ($p \leq 0.05$). All inspects samples A, B, C and D recorded 0.05, 0.03, 0.04 and 0.07% FFA, respectively. These percentages were within the limits recommended by the Central Agency for Standardization and Quality Control (1987). The canned meat was acceptable if the percentage (FFA) was not more than 1.5%. Peroxide values (PV) for A, B, C and D trademarks were 0.95, 0.45, 0.65 and 0.80 meq oxygen/kg fat, respectively. Overall were acceptable, the reason for the decline is due to the addition of nitrate salts and ascorbate, and this reduced the value of PV in meat (Al-Obaidi, 2005; Richards et al., 1998). Thiobarbituric acid (TBA) values were not significant between all trademarks, and it was acceptable because these values were within the limits recommended by the Central Agency for Standardization and Quality Control (1987), and it is not more than 2 mg.

The microbiological evaluation of the four trademarks of inspects samples are shown in Table 4. No significant difference ($p < 0.05$) was found in total aerobic bacteria, coliform bacteria, proteolytic bacteria, lipolytic bacteria, *Bacillus* and *Clostridium*. The reason for not having bacteria in samples indicates the proper preparation of this meat and correct canning, and possibly the addition of some preservatives to it, especially nitrates, which have an important role in reducing the growth of anaerobic bacteria and their inhibition, especially *Clostridium* (Al-obaidi, 2005). According to the results, the process of canning scientifically was done properly and the handling and transporting were correctly carried out, so we have no contamination or any means of indication of aerobic bacteria.

The results in Table 5 show there were significant differences ($p < 0.05$) in the sensory properties (tenderness, juiciness and color) among the four trademarks of canned chicken meat, while no significant differences ($p < 0.05$) in the overall acceptability of the four trademarks of canned chicken meat by consumer. A trademark scored between 2.5 to 4.25 for tenderness, juiciness, flavor, color and overall acceptability, and B trademarks character was a light in color mark, while C trademarks character was dryness and weakness for juiciness and flavor, respectively but acceptable in color. D trademark

scored between 1.75 and 4, and acceptable in overall acceptability. Al-Rubeii et al. (2000) observed significant differences for the effect of genetics on the tenderness, flavor and juiciness that agree with the studied results according to the different companies with different meat samples.

Conclusion

From the results of this study, there were significant differences in chemical analyses among all trademarks of canned chicken meat. There were no significant differences among all trademarks in contents of free fatty acids and thiobarbituric acid, but there were significant differences among all trademarks in contents of peroxide values, and the total volatile nitrogen values for all trademarks were non-significant. There were no significant differences in microbial tests among all trademarks that indicated there were no aerobic bacteria in any of these trademarks. Significant differences in the sensory properties among the four trademarks were observed, while there were no-significant differences in the overall acceptability of the four trademarks.

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