



QUALITY SURVEY OF FROZEN CHICKEN MEAT CONSUMED AT GOVERNMENT HOSPITALS THROUGHOUT DIFFERENT SEASONS IN ASSIUT CITY, EGYPT

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Summary

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This study was conducted to evaluate the quality of frozen chicken meat received at government hospitals in Assiut city, Egypt, during hot and cold seasons. A total of 308 chicken meat samples were collected randomly and subjected to sensory, chemical, physical and microbiological testing. The findings showed that frozen chicken meat samples examined during the cold season had a better sensory evaluation than those examined during the hot season. The mean values of the physical quality tests, which included pH, drip loss, and water-holding capacity (WHC), were 6.12 ± 0.017 , 4.13 ± 2.8 , and 63.60 ± 0.55 in the hot season and 5.9 ± 0.013 , 3.32 ± 3.09 , and 81.28 ± 0.48 in the cold season, respectively. The total bacterial count, psychrotrophic count, total yeast and mould counts were $6.9 \times 10^5 \pm 8.7 \times 10^4$, $1.1 \times 10^6 \pm 1.0 \times 10^5$, $3.9 \times 10^4 \pm 3.8 \times 10^3$, and $7.4 \times 10^4 \pm 2.7 \times 10^3$ CFU/g in the hot season and $4.4 \times 10^4 \pm 2.2 \times 10^3$, $1.9 \times 10^5 \pm 1.6 \times 10^4$, $1.4 \times 10^4 \pm 2.0 \times 10^3$, and $3.8 \times 10^4 \pm 3.1 \times 10^3$ CFU/g in the cold season, respectively. These findings indicate that temperature has a significant impact on meat quality; the frozen chicken meat samples examined in the cold season were in better condition than those examined in the hot season. It is necessary to maintain sanitary hygienic conditions during handling, packaging, storage and distribution particularly in the hot season.

Key words: frozen chicken, hot and cold season, microbiological tests, physical evaluation

INTRODUCTION

Poultry meat remains an essential component of the human diet, and consumers are influenced by its nutritional and sensory qualities, as well as its low price, abundant supply, and diverse assortment, compared with red meat and other animal products. The culinary qualities of poultry

meat, as well as the convenience with which it can be prepared, contribute to its widespread popularity. Chicken meat has easily digestible protein as well as a low percentage of saturated fat and is safe for consumption by people of all ages. Moreover, the attraction of poultry meat as

food is enhanced by promotions and advertising strategies, as well as an increased understanding of the nutritional significance of foods and correct dietary practices (Kralik *et al.*, 2018; Augustyńska-Prejsnar *et al.*, 2019).

Freezing is one of the most essential and extensively utilised preservation strategies for extending the shelf life of meat, thereby allowing the processors and customers to maintain meat quality and safety. After thawing frozen meat, several harmful physical, biochemical, and physicochemical changes, such as freeze-thaw water loss, may occur. Both meat species and freezing rate are high on the list of factors that can cause poor water retention in thawed meat (Leygonie *et al.*, 2012a).

Inspection of frozen meat plays a vital role in controlling various diseases of public health relevance. In simplistic words, sensory evaluation can be defined as a scientific specialty that analyses the attributes of a product using human senses (Sharif *et al.*, 2017).

The denaturation and aggregation of proteins produced by the production and development of ice crystals, as well as the processes associated with dehydration and the concentration of solutes in the muscle tissue, are altered by freezing (Damoradan *et al.*, 2010). Studies have shown that thawed meat loses various functional qualities, such as water-holding capacity (WHC) and proteins, in addition to water, which may influence the gelling of the final product using this raw material (Olivo & Olivo, 2006; Xia *et al.*, 2012; He *et al.*, 2013).

The pH value is an indicator of chicken meat quality, used to evaluate the shelf life and quality of products because pH values influence microbiological growth, which in turn affects the shelf life of products (Hathout & Aly, 2010).

Microbiological examination of chicken meat is often conducted to evaluate conformance to the chicken meat standard (microbiological criteria) to protect consumers from food poisoning and/or food-borne diseases (Mahmoud-Randa & Saleh, 2020).

Nevertheless, the most essential feature influencing the growth of bacteria in chicken flesh is the storage temperature. Temperature can affect microbial growth factors such as the maximal growth rate and total bacterial count. Psychrotrophic bacteria can appear in chilled settings (Mataragas *et al.*, 2006). According to Doulgeraki *et al.* (2012), temperature can alter the spoiling potential of bacteria, and various strains of the same species do not always grow at the same rate.

The aerobic bacterial count is a food quality indicator that indicates hygienic measures used during processing and helps in determining how long a food item will hold its quality (Aberle *et al.*, 2001). Food contamination by yeasts and moulds is considered as a useful indicator of food quality. The degree of deterioration is critical for microbiological assurance systems (Marta *et al.*, 2001).

The major preventable causes of spoiling are inappropriate storage temperatures or temperature variations. Temperature abuse can occur during product distribution, storage, retail display, or customer handling. Processors can tell whether a product has been tampered with by checking the temperature or examining the bacterial populations throughout the distribution system.

Therefore, this study was conducted to analyse the influence of different seasons (hot and cold) on the quality of frozen chicken meat consumed at government hospitals in Assiut city, Egypt.

MATERIALS AND METHODS

Collection of chicken meat samples

A total of 308 random samples of frozen chicken meat were collected between October 2020 and September 2021 from government hospitals in Assuit city. The collected samples were immediately transported to the laboratory in an icebox under aseptic conditions and then subjected to the following examinations after thawing overnight in the refrigerator.

Sensory assessment

Thawed chicken meat samples were coded and served to three semitrained panelists after being thawed at 4 °C. The colour, odour, texture, and overall acceptability were evaluated. The evaluations were graded on a scale of 10 (very acceptable) to 1 (extremely unacceptable) as described by Elzamzamy (2014).

Chemical and physical evaluations

The pH of the chicken meat samples was determined using the method described by Sabikun *et al.* (2019) using a portable pocket pH meter (AD11, Adwa pH-Tem waterproof, Romania).

The drip loss was calculated by weighing the samples (thawed chicken) and comparing them with the initial sample weight (frozen chicken immediately upon receiving) using the following equation (Hakan, 2016): Drip loss % = [(initial weight - weight after thawing)/initial weight] × 100.

The WHC was calculated according to Hung and Zayas (1992) using the volume of free water squeezed from the sample (280–300 mg) and a 2-kg load for 5 min using a Whatman No. 2 filter paper (Grau and Hamm, 1953). The WHC was determined by comparing the mass difference between the sample before and after

squeezing in relation to the sample weight before squeezing × 100. It was calculated using the following equation:

$$\text{WHC}\% = [(W1 - W2)/W1] \times 100$$

where W1 is the weight of the sample before squeezing; W2 is the weight of the sample after squeezing.

Microbiological examination

As described previously (Zerabruk *et al.*, 2019), 25 g of chicken meat samples were transferred aseptically into a sterile stomacher bag containing 225 mL of sterile distilled water and homogenised using a stomacher laboratory blender. The homogenized samples were serially diluted to prepare a 10-fold suitable dilution. A 0.1-mL portion was spread-plated on corresponding media after suitable dilution for the detection and counting of different groups of organisms.

The microbiological quality and safety of meat were evaluated by determining the total viable bacterial count (TVBC), psychrotrophic count, and total yeast and mould counts using plate count agar (Himedia, India) and Sabouraud dextrose agar (Himedia, India) and incubated at 37 °C for 24 h, 0–4 °C for 5 days, and 25 °C for 5 days, respectively, as described previously (ISO/TS 11133-1, 2009)

Statistical analysis

Statistical analysis was conducted using the t-test (SPSS Inc., Chicago, IL, USA).

RESULTS

Sensory evaluation

As shown in Table 1, the mean colour values of the evaluated chicken meat samples in the hot and cold seasons were 7.83 ± 0.45 and 7.86 ± 0.6, respectively, with

Table 1. Results from sensory evaluation (colour, odour, texture, and acceptance) of the examined frozen chicken meat samples.

		Hot season (n=154)	Cold season (n=154)	P value
Colour	Range	7–9	6–9	0.588
	Mean \pm SD	7.83 \pm 0.45	7.86 \pm 0.6	
Odour	Range	5–7	5–8	<0.001
	Mean \pm SD	6.13 \pm 0.51	6.47 \pm 0.64	
Texture	Range	5–9	5–9	0.361
	Mean \pm SD	6.9 \pm 0.65	6.99 \pm 0.78	
Acceptance	Range	6–9	6–9	0.328
	Mean \pm SD	7.47 \pm 0.53	7.54 \pm 0.56	

Table 2. Results from chemical and physical evaluation: pH, drip loss, water holding capacity (WHC) of the examined frozen chicken meat samples.

		Hot season (n=154)	Cold season (n=154)	P value
pH	Range	5.8–6.5	5.6–6.2	<0.0001
	Mean \pm SEM	6.12 \pm 0.017	5.9 \pm 0.013	
Drip loss %	Range	4.6–14.55	2.4–18.42	0.002
	Mean \pm SEM	4.13 \pm 2.8	3.32 \pm 3.09	
WHC %	Range	47.27–72.19	71.68–91.45	<0.0001
	Mean \pm SEM	63.60 \pm 0.5456	81.28 \pm 0.4810	

no statistically significant differences ($P < 0.588$).

The mean odour values of the investigated chicken meat samples were 6.13 \pm 0.51 and 6.47 \pm 0.64 in the hot and cold seasons, respectively, with a significant difference ($P < 0.001$).

The average texture scores of the chicken meat samples were 6.9 \pm 0.65 and 6.99 \pm 0.78 in the hot and cold seasons, respectively, with no statistically significant value.

The mean acceptance values of the examined chicken meat samples were 7.47 \pm 0.53 and 7.54 \pm 0.56 in the hot and cold seasons, respectively, and the difference was not statistically significant ($P < 0.328$).

Chemical and physical evaluations

As shown in Table 2, the pH value of the examined chicken meat samples varied from 5.8 to 6.5, with a mean value of 6.12 \pm 0.017, during the hot season and from 5.6 to 6.2, with a mean value of 5.9 \pm 0.013, during the cold season, with the difference being highly significant ($P < 0.0001$).

The drip loss value of the examined chicken meat samples varied from 4.6 to 14.55, with a mean value of 4.13 \pm 2.8, during the hot season and from 2.4 to 18.42, with a mean value of 3.32 \pm 3.09, during the cold season. The difference in drip loss between the hot and cold seasons was significant ($P < 0.002$).

The mean WHC values of the examined chicken meat samples during the hot and cold seasons were 63.60 ± 0.5456 and 81.28 ± 0.4810 , respectively, with a significant difference ($P < 0.0001$).

Microbiological examination

As shown in Table 3, the total bacterial count/g in the examined samples ranged from 2.0×10^4 to 5.2×10^6 CFU/g, with an average count of $6.9 \times 10^5 \pm 8.7 \times 10^4$ CFU/g, in the hot season and from 3×10^3 to 1.1×10^5 CFU/g, with an average count of $4.4 \times 10^4 \pm 2.2 \times 10^3$ CFU/g, in the cold season. The difference in TVBC of the chicken meat samples between the two seasons was significant ($P < 0.0001$).

The total psychrotrophic count/g in the examined chicken meat samples varied from 7.0×10^3 to 4.8×10^6 , with a mean count of $1.1 \times 10^6 \pm 1.0 \times 10^5$ in the hot season and from 2×10^3 to 9.0×10^5 , with a mean count of $1.9 \times 10^5 \pm 1.6 \times 10^4$ in the cold season, with the difference being significant ($P < 0.0001$).

The mean total yeast counts in the examined chicken meat samples in the hot and cold seasons were $3.9 \times 10^4 \pm 3.8 \times 10^3$ and $1.4 \times 10^4 \pm 2.0 \times 10^3$, respectively, and the difference was significant ($P < 0.0001$).

Table 3 also shows the total mould count of the analysed chicken meat samples, which varied from 2×10^4 to 1.8×10^5 (mean count of $7.4 \times 10^4 \pm 2.7 \times 10^3$) in the hot season and from 1×10^3 to 17×10^4 (mean count of $3.8 \times 10^4 \pm 3.1 \times 10^3$) in the cold season. The difference in count between the two seasons was significant ($P < 0.0001$).

DISCUSSION

One of the most important markers for determining the quality of the majority of meats and foods is organoleptic evaluation. The organoleptic qualities of chicken meat samples including colour, odour, texture, and overall acceptability, are illustrated in Table 1. Except for odour, there were no significant differences in the colour, texture, or general acceptability of all the investigated meat samples ($P < 0.05$). This could be related to the hot season's high temperature, as well as the freezing and thawing processes, which had a significant effect on odour and pH changes. The odour of most samples was unpleasant but did not indicate deterioration; one sample had a rancid odour. In the hot season, some chicken meat sam-

Table 3. Results from the microbiological analysis: total viable bacterial count (TVBC), total psychrotrophic count (TPC), total yeast count (TYC) and total mould count (TMC) of the examined frozen chicken meat samples.

		Hot season (n=154)	Cold season (n=154)	P value
TVBC	Range	$2.0 \times 10^4 - 5.2 \times 10^6$	$3 \times 10^3 - 1.1 \times 10^5$	< 0.0001
	Mean \pm SEM	$6.9 \times 10^5 \pm 8.7 \times 10^4$	$4.4 \times 10^4 \pm 2.2 \times 10^3$	
TPC	Range	$7.0 \times 10^3 - 4.8 \times 10^6$	$2 \times 10^3 - 9.0 \times 10^5$	< 0.0001
	Mean \pm SEM	$1.1 \times 10^6 \pm 1.0 \times 10^5$	$1.9 \times 10^5 \pm 1.6 \times 10^4$	
TYC	Range	$1 \times 10^3 - 1.7 \times 10^5$	$1 \times 10^3 - 1.7 \times 10^5$	< 0.0001
	Mean \pm SEM	$3.9 \times 10^4 \pm 3.8 \times 10^3$	$1.4 \times 10^4 \pm 2.0 \times 10^3$	
TMC	Range	$2 \times 10^4 - 1.8 \times 10^5$	$1 \times 10^3 - 1.7 \times 10^5$	< 0.0001
	Mean \pm SEM	$7.4 \times 10^4 \pm 2.7 \times 10^3$	$3.8 \times 10^4 \pm 3.1 \times 10^3$	

Table 4. Number of samples acceptability based on various physical and microbial quality parameters according to ES*.

Item	Allowed limit*	Samples within limits		Total (n=308)	Samples over limit		Total (n=308)
		Hot (n=154)	Cold (n=154)		Hot (n=154)	Cold (n=154)	
		No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
pH	5.5–6.5	154 (100)	154 (100)	308 (100)	–	–	–
Drip loss	5%	117 (75.9)	128 (83.1)	245 (79.5)	37 (24.1)	26 (16.8)	63 (20.5)
TVBC	10 ⁵	37 (24.1)	120 (77.9)	157 (50.9)	117 (75.9)	34 (22.1)	151 (49.1)
TPC	10 ⁵	27 (17.5)	102 (66.2)	129 (41.8)	127 (82)	52 (33.8)	197 (58.1)
TYC	free	–	–	–	154 (100)	154 (100)	308 (100)
TMC	free	–	–	–	154 (100)	154 (100)	308 (100)

*Maximum permissible limit according to EOS (2005); total viable bacterial count (TVBC), total psychrotrophic count (TPC), total yeast count (TYC), total mould count (TMC).

ples had a slimy texture, which could be due to microbial contamination of the meat and inappropriate storage conditions.

The mean pH values of the examined chicken meat samples in the cold season were better than that in the hot season, as shown in Table 2, although 100% of samples during the hot and cold seasons (Table 4) were within the approved level of the safe allowed limits of pH stated by the EOS (1090/2005).

The pH value of the chicken meat samples in our study during the cold season was consistent with values found by Hassanien-Fatin *et al.* (2016), who reported mean pH values of breast and thigh of chicken meat of 5.84±0.10 and 5.91±0.11, respectively, and those reported by Fathy-Eman (2012) – 6.03±0.18 for breast and 5.77±0.01 for thigh.

The pH values in the hot season in our study were almost similar to those observed by Afifi-Jehan (2000), who re-

ported values of 6.15 and 6.21 for chicken breast and thigh, respectively.

The higher pH values of chicken meat during the hot season could be due to partial proteolysis, which could cause an increase in free alkaline groups depending on the circumstances, as well as an increase in ammonia and amino acid products following the utilisation of amino acids by microorganisms, whose activity increases in the hot season compared with the cold season (Zhang *et al.*, 2016; Puolanne, 2017).

Drip loss is a watery solution that emerges from frozen meat without the need of any external force, and it is a good measure of the quality of meat that has been frozen (Leygonie *et al.*, 2012b; Gambuteanu *et al.*, 2013). The amount of meat leakages during thawing measured using various methods is believed to indicate the degree of damage to meat muscle

tissues during freezing (Chwastowska & Kondratowicz, 2005).

The drip losses in the examined chicken meat samples during the hot and cold seasons (Table 2) showed significant differences ($P < 0.0001$), and the percentage of chicken meat samples examined during the hot and cold seasons which weren't within the permissible limits of percentage drip loss established by the EOS (2005) were 24% and 16.8%, respectively (Table 4). Drip loss measurements indicate the potential of chicken meat to lose moisture as exudate during raw meat storage.

In Assiut, Egypt, higher drip losses in chicken meat during the hot season affect the efficacy of cool devices, leading to increased chilling temperature throughout summer transport, handling, and storage, particularly in the afternoon. Moreover, enhanced protein breakdown due to partial proteolysis would certainly allow water discharge from intramyofibrillar spaces to drip production (Huff-Lonergan & Lonergan, 2005; Lawrie & Ledward, 2006).

Another explanation is that longer storage of frozen chicken meat in the hot season than in the cold season induces freezing effects on the muscle fibres due to the deformation and damage caused by the production of ice crystals inside the muscular tissues; the protein damage is generally a function of time and freezing temperature (Xiong, 1997). The extent of denaturation of both sarcoplasmic and myofibrillar proteins increases with the duration of freezing. Augustyska-Prejsnar *et al.* (2019) found that the volume of drip loss increased in direct proportion to the duration of frozen storage. Moreover, thawed meat loses functional qualities, such as water retention ability and proteins, as a result of protein denaturation, which may impede the gelling of the final

meat-based products (Oliveira *et al.*, 2015).

Yu *et al.* (2005) also mentioned that the amount of drip loss is determined by the thawing temperature, with the amount increasing with temperature increases.

Water constitutes approximately 75% of fresh meat weight. WHC is an important criterion to evaluate meat quality, which is reflected by drip loss, although the amount of water in meat may alter after processing due to drip loss (Offer & Trinick, 1983).

Our results revealed a higher WHC in the examined frozen chicken meat samples (Table 2) in the cold season than in the hot season, with a significant difference ($P < 0.0001$).

Despite the lower WHC of the analysed frozen chicken meat samples during the hot season, the result was in agreement with the scientific literature, indicating how temperature affects the WHC of meat during freezing, storage, thawing, and transportation (Ngapo *et al.*, 1999; Vieira *et al.*, 2009; Leygonie *et al.*, 2012b).

According to Xiong (1997), protein damage is generally a function of freezing duration and temperature. In general, the denaturation of sarcoplasmic and myofibrillar proteins increases with storage time and temperature. Muscle proteins are sensitive to oxidation during meat frozen storage and thawing, which contributes to drip loss in thawed meat in addition to physical damage from ice crystals and instability by concentrated solutes (Utera *et al.*, 2014).

The total bacterial count in the examined chicken meat samples was higher in the hot season than in the cold season (Table 3), with a highly significant different difference ($P < 0.0001$). During the hot season, 75.9% of the samples examined exceeded the limits according to the safe

permissible limits stipulated by the EOS (2005), but 77.9% of samples examined during the cold season were within the safe permissible limits for the total bacterial count (not exceeding 10^5 CFU/g = 5 log₁₀ CFU/g) (Table 4). The mean value of the total bacterial count in the examined samples during the hot season was almost similar to that obtained by Hassan *et al.* (2020), who recorded mean values of breast and thigh of chicken samples were $5.58 \times 10^5 \pm 0.43 \times 10^5$ and $6.76 \times 10^5 \pm 0.37 \times 10^5$ CFU/g, respectively.

However, our results of the mean total bacterial count during both hot and cold season were lower than those recorded by Mahmoud-Randa & Saleh (2020), who reported mean values of breast was 7.6×10^5 and 4.9×10^6 CFU/g for thigh of chicken, and also those obtained by Habib (2017), who reported mean values of 3.6×10^6 CFU/g in frozen carcasses. Similarly, Hassanien-Fatin *et al.* (2016) reported mean total bacterial count values of $3.78 \times 10^6 \pm 0.93 \times 10^6$ and $4.38 \times 10^6 \pm 0.59 \times 10^6$ CFU/g for breast and thigh of chicken, respectively. Ola (2015) and Saikia & Joshi (2010) reported mean values of $4 \times 10^7 \pm 5 \times 10^6$ in 50 chicken meat samples and 3.7×10^6 CFU/g, respectively.

Our results were higher than those obtained by Daoud (2012), who reported mean total bacterial count values of 2.1×10^3 CFU/g for breast and 2.7×10^3 CFU/g for thigh.

The higher total bacterial count in chicken meat during the hot season was attributed to the influence of high temperatures, which caused insufficient cooling temperatures during storage and handling, thereby exposing the chicken meat to temperature dangerous zone (TDZ), allowing mesophilic microorganisms to multiply more rapidly. It could also be attributed to the handlers' habits of storing

frozen chicken in a semi-chilled state during the hot season, exposing them to recurrent freezing and thawing.

The higher mean total bacterial count values in the frozen chicken meat could also be due to contamination from handling, transportation, and cross-contamination, as mentioned by Mahmoud-Randa & Saleh (2020).

As shown in Table 3, the mean psychrotrophic count of the chicken meat samples in the hot season was higher than that in the cold season, with a significant difference ($P < 0.0001$). The rates of 82% and 33.8% of samples examined during hot and cold season, respectively (Table 4) were considered higher than the safe permissible limits stipulated by the EOS (2005) (the maximum level of count did not exceed 10^5 CFU/g).

The results obtained during the hot season are consistent with those observed by Al-Hamadany (2009), who reported a psychrotrophic count of 1.06×10^6 CFU/g in the examined frozen chicken meat cut samples. The count in the cold season was almost similar to that observed by Abd El-Magied *et al.* (2009), who reported a psychrotrophic count of $1.43 \times 10^5 \pm 0.37 \times 10^5$ /g in breast chicken. However, our results were higher than those obtained by Belal (1997), who reported a mean psychrotrophic count of 6.2 ± 5.68 (log₁₀) CFU/g in chicken meat.

The results of total psychrotrophic count in our study were lower than those observed by Hassan *et al.* (2020), who reported a count of breast chicken samples were 3.88×10^5 CFU/g. Hassanien-Fatin *et al.* (2016) reported mean psychrotrophic counts were $5.71 \times 10^6 \pm 1.44 \times 10^6$ and $4.59 \times 10^6 \pm 1.26 \times 10^6$ CFU/g for breast and thigh respectively and Azab-Amira (2016) reported psychrotrophic counts of $9.2 \times$

$10^6 \pm 12.49 \times 10^6$ and $8.5 \times 10^6 \pm 14.61 \times 10^6$ in chicken breast and thigh, respectively.

In contrast, our results were higher than those obtained by Hassan *et al.* (2020), who reported values of chicken breast and thigh of $8.17 \times 10^3 \pm 1.42 \times 10^3$ and $1.95 \times 10^4 \pm 2.06 \times 10^4$, respectively. Dan *et al.* (2008) demonstrated 2.88 ± 0.32 (log₁₀) CFU/g in chicken meat on the average and Eid *et al.* (2014) reported a mean value of $11.5 \times 10^3 \pm 2.2 \times 10^3$ CFU/g in chicken breast.

The psychrotrophic counts were slightly higher than the total bacterial count in this study, because of the fact that several types of microorganisms will cease to grow during the freezing of chicken meat, but others, particularly psychrotrophic bacteria, can grow until medium freezes (Davies & Board, 1998). Moreover, hygienic precautions throughout extensive preparation, processing, handling, and packaging, as well as cold storage, were overlooked. In addition, we considered all the psychrotrophic microorganisms, not only bacteria, during the count and the incubation period in our results (Cenci *et al.*, 1990).

Hot season is responsible for fluctuations in freezing temperatures during handling, storage, and long-distance transportation of frozen chicken meat, providing a suitable environment and sufficient time for the psychrotrophic microorganisms to grow and increase its count.

As shown in Table 3, the total yeast count of frozen chicken meat samples in the hot season was higher than that in the cold season, with a highly significant difference ($P < 0.0001$) and all samples examined exceeding the permissible limit (Table 4).

These results are higher than those reported by Mahmoud-Randa & Saleh (2020), who found that the mean value of

yeast counts in chicken breast was 1.9×10^3 CFU/g, and Habib (2017), who found mean yeast counts in frozen carcasses 8.9×10^3 CFU/g. They are also higher than those reported by Nader *et al.* (2016), who reported mean values of $1.83 \times 10^5 \pm 3.98 \times 10^4$ in broiler carcasses. Our results were still greater than those reported by Captia *et al.* (2001), Abd El-rahman *et al.* (2013), Ibrahim (2013), and Ola (2015).

Yeasts play a minor role in spoilage in most cases as they constitute a small proportion of the starting population and grow slowly compared with most bacteria, and their growth could be restricted by a metabolic chemical produced by bacteria. Spoilage yeasts find their way into foods due to widespread distribution in nature, resulting in an unfavourable change in food appearance (Walker, 1977; Hasanien *et al.*, 2021).

Table 3 shows that the mould counts in the chicken samples in the hot season were higher than those in the cold season, with a highly significant difference ($P < 0.0001$). All examined samples exceeded the allowed limit (Table 4).

The total mould count obtained in this study was higher than that recorded by Mahmoud-Randa & Saleh (2020), who clarified that the mean mould count in breast chicken samples were from 3.6×10^2 to 6.2×10^2 CFU/g, and for thigh samples: 6.2×10^2 CFU/g, and those recorded by Habib, (2017), who reported a mean value of 6.6×10^2 CFU/g in frozen carcasses. In addition, the results were higher than those recorded by Nader *et al.* (2016), who reported average total mould count of $3.43 \times 10^2 \pm 5.78 \times 10^2$ in broiler carcass.

The high count of moulds in the examined chicken meat samples was attributed to contamination with mould that can develop in a wide range of temperatures.

As a result, moulds can be found on practically any food at almost any temperature. Moulds can also aid in the putrefaction process by producing toxic compounds such as mycotoxins, which are dangerous to both humans and animals (Frazier & Weshoff, 1998).

CONCLUSION

Temperature is an important factor in the quality of meat, especially in Assiut city, Egypt, throughout the year the season is almost hot or cold and generally hot rather than cold. The examined frozen chicken meat samples in the cold season have a satisfactory condition than those in the hot season. Therefore, to maintain chicken meat with high quality to safeguard consumer's health in the hot season, strict hygienic precautions must be followed without delay in the loading of frozen chicken meat. The vehicles used for transport should be fitted with temperature records to monitor the environment, especially on an afternoon, and the transfer must be as rapid as possible at sufficient temperatures and hygiene conditions during handling, packaging, and distribution. Chicken meat must be well inspected, rapidly consumed, and not stored for long periods, and the stock must also be properly rotated to avoid the effect of hot season.

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