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Seasonal Impact on the Prevalence of Yeast Contamination of Chicken Meat Products and Edible Giblets

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Abstract

Total of ninety random samples of raw chilled whole chicken carcass, chicken fillet and chicken giblet, 30 of each, were randomly collected from butchers located in Qalubiya governorate, Egypt, and were subjected to mycological examination for the incidence of yeast species contamination during summer and winter seasons, samples were collected equally during each season (15 samples of each product/season). Results revealed contamination of 100 and 93.3% of the whole examined samples during summer and winter seasons, respectively; where giblet samples showed the highest contamination levels with mean count of 3.8 and 3.0 $\log_{10}$ CFU/g, respectively, followed by fillet and whole carcass, respectively. *Candida* and *Rhodotorula* species were detected in the incidence of 60% and 40% of the examined samples during summer and winter seasons, respectively indicated that the levels of chicken meat contamination with yeast is higher in summer season than winter season. After all, the application of strict hygienic measures is highly recommended during processing and storage of raw chicken meat cuts, as well as keep raw chicken cuts chilled to avoid the enhancement of hot and humid climate of summer season on the microbial growth.

KEYWORDS
Seasonal variation, Yeast count, Chicken meat, Egypt.

INTRODUCTION

Many the as of late noticed environmental changes have not been common throughout the first of twentieth century (Edris *et al*., 2012a; IPCC, 2013). The global extended environmental changes, including temperature and precipitation measurements, are well known recently that is affecting the lifestyle not only for human being, but also for the microbial populations (Edris *et al*., 2012b; Lucette *et al*., 2018).

Although it is of high nutritious value, chicken and chicken meat products are strongly affected by climate changes microbiologically (Abioja and Abiona, 2021).

Yeast is a saprophytic microscopic organism, while few species are pathogenic (Abd-Elrahman *et al*., 2013). Yeast's chicken meat contamination usually occurs during the processing sequence starts from the slaughtering plan during scalding, defeathering, evisceration, cooling, packing, in addition to transportation and storage (Marmion *et al*., 2021).

Yeast represents a great cause of chicken meat spoilage due to its ability to proliferate in a wide range of pH and temperatures, resulting in different scales of flavor, color, and wholesome affects (Shaltout *et al*., 2014a). Moreover, *Candida* species, as a yeast genus, was reported to have a great health hazard as it may cause many lesions in the gastrointestinal tract such as stomatitis, diarrhea, and intestinal disturbance and in different other organs as vaginitis, pulmonary thrush, meningitis as was recorded by CDC (2022).

Rhodotorula sp. are universal saprophytic yeasts that can be recuperated from numerous natural sources. It has been arisen as pioneering microorganisms that is capable to colonize and infect immunocompromised human and animals. The most well-known *Rhodotorula* caused sicknesses included solid and hematologic malignancies, some of the other localized infections include skin, ocular, peritoneal, and joint infections (Shaltout and Edris., 1999; Wirth and Goldani, 2012).

In Egypt, seasonal humidity and temperature wide variation between summer and winter quarters is significantly affects the susceptibility of microbial growth and rate of foodborne contamination. The high temperature and humidity in summer support bacterial and fungal growth in various food items (Koluman *et al*., 2017). Therefore, the current investigation aimed to correlate the seasonal variation with the prevalence of yeast contamination in different chicken meat products in Qalubiya governorate, Egypt.

MATERIALS AND METHODS

Collection of chicken meat product samples

A grand total of ninety random samples of raw chilled whole chicken carcass, chicken filler and chicken giblets (liver, gizzard and heart) (30 of each) were randomly collected from different

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butchers in Qalubiya governorate, Egypt, during the period of summer and winter seasons, where 15 samples of each product were collected per each season.

Samples were insulated separately in sterile plastic bag and transported in ice box as soon as possible to Animal Health Research Institute-Mycology lab. for enumeration, detection, and identification of yeast sp. isolated from the examined products.

Determination of the yeast count in the examined chicken meat products

After preparation of the samples following ISO 6887-2 for preparation of tenfold serial dilutions, 0.1ml of each serial dilution was spread over Dicloran rose Bengal chloramphenicol agar (DRBC) (lab M) and incubated at 25.0±1.0°C for 5-7 days aerobically according to ISO 21527-1. Yeast colonies was counted, recorded, and sub-cultured for further identification.

Identification of yeast isolates

The simplified identification method (SIM), according to Deák and Beuchat (1996), was used. The procedure was carried out in two phases. First, a preliminary grouping of the isolates was made on the basis of the results of six tests (urease reaction, growth in the presence of 0.1% cycloheximide, and the assimilation of nitrate, erythritol, mannitol and cellobiose). In addition, all isolates were examined microscopically and for colony morphology. In the second phase, additional tests selected according to each group were performed to achieve and confirm identification. These tests included growth at 37°C, the formation of starch-like compounds, the assimilation of L-arabinose, cadaverine, ethylamine, galactose, glucuronate, inositol, 2-ketogluconate, lysine, maltose, melibiose, methyl-a-glucoside, raffinose, and fermentation of glucose.

Statistical analysis

The obtained data were subjected to two-way ANOVA using SPSS software (version 18) according to IBM (2019).

RESULTS

Referring to the obtained results in Table 1, Yeast sp. was detected in 100% of the examined samples during summer season, while 93.3% of the examined samples had yeast contamination during winter season. In addition, chicken giblets showed the highest yeast count during summer and winter seasons with mean values of 3.9±0.05 and 3.0±0.05 $\log_{10}$ CFU/g, respectively. significant difference was detected between the same examined chicken meat product in different seasons when P≤0.05.

In addition, identification of the detected yeast isolates revealed isolation of different *Candida* and *Rhodotorula* genera in different incidence as was recorded in Table 2; where the examined samples showed higher yeast contamination levels during summer than the winter seasons as was tabulated in Table 3, where 181 yeast isolates were defined as 101 and 80 *Candida* and *Rhodotorula* isolates. The examined giblet samples showed the highest contamination levels with 46 (25.4%) and 32 (17.7%), followed by fillet and whole carcass samples during summer and winter seasons, respectively, indicating the higher affinity of yeast contamination and multiplication in hot humid environment of summer season than in winter season.

Table 1. Statistical analytical results of yeast in the examined chicken meat samples (n=15/season).

Product	Positive samples				Yeast count ($\log_{10}$ CFU/g)	
	Summer		Winter		Summer	Winter
	No.	%	No.	%	Mean ± SD	
Chicken carcass	15	100	12	80	3.5 ± 0.04^{a1}	2.4 ± 0.2^{b2}
Chicken fillet	15	100	15	100	3.7 ± 0.07^{a1}	2.9 ± 0.13^{a2}
Chicken giblets	15	100	15	100	3.9 ± 0.05^{a1}	3.0 ± 0.05^{a2}
Total	45	100	42	93.3		

[a,b] Different superscript letter means significant difference between the examined products within the same column when P≤0.05.
[1,2] Different superscript letter means significant difference between the same examined product within the same row when P≤0.05.

Table 2. Identification of the isolated yeast genera from the examined whole chicken carcasses (n=15/season)

Season	Summer						Winter					
Chicken meat product	Carcass		Fillet		Giblet		Carcass		Fillet		Giblet	
Isolated yeast genera	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Candida species												
C. albicans	2	13.3	9	60	12	80	ND	-	5	33.3	7	46.7
C. glabrata	ND	-	3	20	6	40	ND	-	2	13.3	4	26.6
C. Jamata	6	40	11	73.3	13	86.6	1	6.6	7	46.6	6	40
C. tropicalis	1	6.6	5	33.3	3	20	2	13.3	2	13.3	3	20
C. dubliniensis	ND	-	ND	-	1	6.6	ND	-	ND	-	ND	-
C. zeynoides	ND	-	4	26.6	4	26.6	1	6.6	2	13.3	3	20
Rhodotorula species												
Rho. mucilaginosa	7	46.6	9	60	5	33.3	5	33.3	6	40	6	40
Rho. glutinis	3	20	3	20	3	20	2	13.3	2	13.3	3	20
Rho. minuta	3	20	2	13.3	8	53.3	4	26.6	4	26.6	5	33.3

Table 3. Relation between incidence of yeast sp. and seasonal variation.

	Total No. of isolates	Summer								Winter							
		Carcass		Fillet		Giblet		Total		Carcass		Fillet		Giblet		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Candida species	125	9	7.2	32	25.6	39	31.2	80	64	4	3.2	18	14.4	23	18.4	45	36
Rhodotorula species	80	13	16.25	14	17.5	16	20	43	53.75	11	13.75	12	15	14	17.5	37	46.25
Total	205	22	10.7	46	22.4	55	26.8	123	60	15	7.31	30	14.6	37	18	82	40

DISCUSSION

Fungal organisms are diligent commensal microorganisms in the environment. Contamination of meat and meat products may be occurred along the production steps of meat products starting from the abattoirs which is really considered the primary source of contamination, followed by packaging, transportation, and storage conditions, as well as contamination through feeding of the food animals on fungal contaminated feed. *Candida*, *Rhodotorula*, Pichia and *Trichosporon* species are the most recorded yeasts in meat products (Hassanin *et al*., 2019; Nair *et al*., 2020).

Referring to the recorded results of the total incidence and mean count of the detected yeast species in different chicken meat products (Table 1), it came higher than those recorded by Ibrahim *et al*. (2014) and El-Matary and Zaki (2016) who detected *Candida* sp. and *Rhodotorula* sp. in incidence of 59.5 and 29.7%, respectively in the examined chicken pane. Shaltout *et al*. (2014b) detected yeast sp. in 84% of the examined chicken fillet samples with mean count of $5.7x10^2$ CFU/g. In addition, Shaltout *et al*. (2016) reported that the mean value of the total yeast count in their examined chicken carcasses was $2.9x10^2$ CFU/g, Ogu *et al*. (2017) recorded the detection of yeast sp. in 63.3% of the total examined samples, where *Candida* sp. ranged from 0-6.3% of the yeast isolates. Furthermore, Shaltout *et al*. (2019) could not detect yeast sp. in the examined whole chicken carcass samples while it was detected in all the examined fillet samples with mean count of $2.3x10^2$ CFU/g. While Shaltout (2020) could not detect yeast species in the examined samples of chicken meat carcasses.

Referring to the obtained results, the examined whole carcass samples revealed the lowest contamination levels, followed by fillet and giblet samples, which showed higher levels of contamination. It may be attributed to the possibility of more contamination loads which could associate more processing and handling, especially in the unhygienic conditions in the processing at abattoirs and butcher's levels (Shaltout, 2020).

The high proportion of *Candida* sp. in all the examined chicken samples, especially *C. albicans*, as mentioned in Tables 2 and 3, agreed with those observed by Abd-Elrahman *et al*. (2013) and Shaltout *et al*. (2016). The results of mycological identification of yeast genera revealed that *Candida* sp. was the most predominant species isolated from chicken carcasses, fillet and giblets which came in harmony with that obtained by Ouf *et al*. (2010), Abd-Elrahman *et al*. (2013), Shaltout *et al*. (2014 b) who detected *Candida*, *Rhodotorula*, Saccharomyces, Torulopsis and Cryptococcus spp. in incidence of 32.5, 22.1, 18.2, 15.5 and 11.7% of the examined chicken carcass samples, and Shaltout *et al*. (2016) who detected *Candida*, *Rhodotorula* and Torulopsis sp. in incidence of 40, 20 and 6% of the examined chicken carcass samples; while Shaltout *et al*. (2014b) could not isolate *C. albicans* in the examined fillet samples.

Food safety, food security and food system challenges are thought to represent the most significant climate change-related threats to human health globally (Shaltout *et al*., 2014a and Smith *et al*., 2014). Researchers anticipated a link between foodborne illness and climate change, since the pathogens that cause many foodborne infectious diseases are known to be influenced by climate and weather variables (Hassan and Shaltout, 2004 and Lake, 2017).

Regarding the seasonal variation, the obtained results revealed high contamination rates in the collected samples during summer season, which may be attributed to the significant relationship between foodborne infections and environmental change, as the foodborne microbe's contamination and growth rates were reported to be more active during warm and humid weather patterns (Smith and Fazil, 2019). Afterall, chicken giblet has the highest susceptibility to yeast contamination, followed by fillet and whole carcass samples, respectively. *Candida albicans* is the predominant detected strain among the isolated yeast genera. The collected samples during summer season revealed higher incidence of yeast contamination than the collected samples during winter season.

CONCLUSION

It is concluded that the susceptibility of yeast contamination and proliferation in food items is more in hot and humid climate of summer season.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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