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Fungi, Aflatoxins and Ochratoxins in Table Egg: Trials to control by Slightly Acidic Electrolyzed Water" SAEW" Treatment

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Abstract

EGG is a well-balanced food due to its high nutritional content, low calories, and ease of digestion. A total of 125 table eggs (100 from farms, 25 from markets) and 10 poultry feed samples were collected from Alexandria Governorate, Egypt. Yeast and mold counts were determined in eggshell, egg contents, and feed; total aflatoxins and ochratoxins were determined in egg content and feed. Trails to reduce eggshell fungal contamination were carried out using dry brushing and wet brushing with Slightly Acidic Electrolyzed Water (SAEW) and their combined effect with refrigeration. Farm table eggs showed a mean yeast and mold count of $8.34 \times 10^2 \pm 1.97 \times 10^2$ cfu/eggshell (eggshell) and $5.33 \times 10^2 \pm 0.88 \times 10^2$ cfu/g (content), whereas market eggs exhibited higher contamination on shells $6.64 \times 10^3 \pm 5.59 \times 10^3$ cfu/eggshell but none in contents. All feed samples were contaminated, averaging $9.86 \times 10^4 \pm 3.41 \times 10^4$ cfu/g. Mycotoxins were not detected in all egg contents. However, aflatoxins and ochratoxins were found in 30% (1.53 ± 0.46 ppb) and 70% (2.33 ± 0.33 ppb) of feed samples, respectively with 10% of farms exceeded the PL permissible limit in ochratoxin. Dry brushing inhibited fungal growth on eggshell for 3 days at room temperature and with reduction rate 53.7% at the end of day 21 and this inhibition was extended to 14 days under refrigeration with reduction rate 56.7%. While SAEW wet brushing achieved complete fungal suppression for 3 days and 93.2% reduction by day 21at room temperature. At refrigeration the results were more promising as the complete inhibition of fungal growth reaches the day 14 and at the end of the trail at day 21 the reduction rate reaches 85.5%for wet brushing. Analysis of the samples revealed clear evidence of fungal contamination in both eggs and poultry feed. Notably, the eggshell harboured significantly more contamination compared to the internal egg content, which tested negative for both Aflatoxins and Ochratoxins. In contrast, poultry feed samples did contain these toxins. Evaluation of decontamination methods showed that mechanical brushing, particularly when combined with a SAEW (slightly acidic electrolyzed water) wetted brush, was highly effective. This technique not only demonstrated strong antifungal properties but also proved to be cost-effective and environmentally sustainable. Additionally, storing eggs at low temperatures further enhanced the antifungal effect. Overall, the findings support the use of both dry brushing and SAEW brushing as practical, economical, and eco-friendly approaches to minimizing fungal contamination on eggshells, especially when paired with low-temperature storage.

Keywords: Brushing, Eggs, SAEW (slightly acidic electrolyzed water), Fungi.

Introduction

Table eggs are consumed worldwide and are an essential component of the modern human diet. They are a low-cost source of protein that is accessible and safe [1].

Several foodborne pathogens can contaminate eggs in various ways, and they have the capability to penetrate the egg's internal contents and survive beyond the egg's shelf life [2].

In addition to Gram-positive and Gram-negative bacteria, the eggshell and egg white can also be contaminated also been contaminated with pathogenic fungi [3].

Mycotoxins are secondary metabolites that fungi can metabolites produced by fungi, which represent a potential risk to numerous organisms, including humans and animals [4], Elsewhere, the health hazards in their presence, contamination with mycotoxin lead to extensive economic losses due to

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declined food quality and production efficiency [5], [6], [7].

Multiple factors can influence mycotoxin prevalence, including the fungus's species and strain, as well as to environmental and ecological factors [8].

Poultry can suffer from various health problems due to the consumption of feed contaminated with mycotoxins, resulting in significant financial losses for both the quantity and quality of eggs. Aflatoxins (AFs), ochratoxin (OTA), zearalenone (ZEA), and fumonisins are the most frequently detected mycotoxins in eggs [9].

Ochratoxins (OTs) are secondary hazardous metabolites formed by certain strains of *Penicillium verrucosum* and *Aspergillus ochraceus*. Different climates are suitable for the growth of these fungi, while Penicillia is abundant in temperate places and can flourish at temperatures as low as 5 ºC, Aspergillus is found in tropical climates [10].

Several mycotoxins have a significant effect on poultry health and production, including aflatoxin B1, ochratoxin A, zearalenone, and T-2 toxin. [11].

Acute and chronic exposure to mycotoxins can affect human and animal health in several ways, depending on each mycotoxin chemical structure depending on the chemical structure of each mycotoxin [12].

The presence of these fungi, mainly toxigenic ones, can lead to cereal contamination with mycotoxins.

Humans may be exposed to mycotoxins directly through the consumption of food contaminated with mycotoxins or indirectly through animals that consume contaminated feed. After consuming food products contaminated with mycotoxin, signs of severe sickness might quickly manifest due to the immediate action of certain food-borne mycotoxins. Additionally, mycotoxins found in food have been linked to long-term health consequences, such as immunological deficiencies and the development of malignancies [13]. The severity of these health effects can be determined by the exposure duration, the food consumption rate, and the ingested mycotoxins concentration [14].

Several microorganisms can contaminate eggs during production, which represents a risk of transmitting foodborne diseases to consumers. As a result, selecting a disinfectant that is both efficient and eco-friendly is becoming crucial in the marketing of eggs. The slightly acidic electrolyzed water (SAEW) with pH near-neutral is one of the most promising disinfectants for eggs because of its strong antibacterial activity and low toxicity to humans [15]. SAEW also shows fungicidal activity toward *Candida* species [16].

Therefore, the current study aims to highlight the contamination of eggs and poultry feed with fungi and aflatoxins & ochratoxins, and to conduct trials to control them in eggs.

Collection of Samples

Samples were collected from ten farms, each group containing 10 eggs and 2 kilograms of poultry feed. Additionally, 25 table eggs were sourced from various markets in Alexandria Governorate, Egypt. Each sample group was collected separately using clean, sterile bags and transported to the laboratory without delay for examination.

Physical Inspection of the Collected Samples

Any cracked eggs were discarded after a visual inspection of the fresh eggs. The weight of the eggs ranged from 55 to 60 grams. The poultry feed samples were in good condition, showing no signs of fungal growth.

Preparation of Test Samples, Initial Suspension, and Decimal Dilution for Microbiological Examination (ISO, 2017) [17].

Eggshell: The intact egg was placed in a sterile homogenizer bag, and 90 mL of sterile buffered peptone water (HIMEDIA\ INDIA) was added. The egg was gently rotated in the diluent. Once removed, the resulting liquid served as the initial suspension (10^{-1}). Additional decimal dilutions were prepared thereafter.

Egg Content: Approximately 20 ml of the yolk and white was put in a sterile homogenizer bag with 180 ml of sterile buffered peptone water (HIMEDIA\ INDIA), creating the initial suspension (10^{-1}). Further decimal dilutions were then prepared.

Poultry Feed: The feed sample was thoroughly mixed, and 50 g was transferred to a sterile homogenizer bag with 450 ml of 0.1 % peptone salt solution (HIMEDIA\ INDIA) to create the initial suspension (10^{-1}). Additional decimal dilutions were subsequently prepared.

Enumeration of Total Yeast and Mold Count (ISO, 2008) [18].

Aseptically, using sterile pipettes, 0.1 ml of the initial suspension (10^{-1}) was transferred to each of two Dichloran-Rose Bengal Chloramphenicol agar (DRBC) plates (HIMEDIA\ INDIA). This process was repeated using further decimal dilutions. The plates were incubated at 25 °C ± 1 °C for 5 days.

Detection of Aflatoxins and Ochratoxins in Egg Content Samples by LC-MSMS [19].

Aflatoxins (B1, B2, G1, G2) and Ochratoxin A in the egg content were determined using LC-MSMS at the Central Laboratory for the Analysis of Pesticide Residues and Heavy Metals in Food (QCAP) in Dokki, Giza.

Detection of Aflatoxins and Ochratoxins in Poultry Feed Samples by ELISA [20].

The feed samples were prepared in accordance with the ELISA kit manufacturer's instructions (ProGnosis Biotech).

Experimental work

1- Using Slightly Acidic Electrolyzed Water (SAEW) in eggshell [21].

Slightly acidic electrolyzed water (SAEW) was prepared in the laboratory by a simple apparatus consisting of two chambers containing tap water with NaCl salt (2 gm/L), through which an electric current from a 400-watt adapter was passed.

The test was repeated three times. The water had a pH of 5–6. slightly acidic. One hundred and twenty eggs were divided into six groups, each containing 20 eggs. Group 1, 4 (G1, G4) was left untreated; Group 2, 5 (G2, G5) was cleaned with a dry brush; and Group 3, 6 (G3, G6) was cleaned with a brush moistened with SAEW. Groups G1, G2, and G3 were stored at room temperature (25 °C), while Groups G4, G5, and G6 were kept in the refrigerator (4 °C). The total yeast and mold count was determined at days 1, 3, 7, 14, and 21.

Statistical analysis of the data

IBM SPSS software package version was used to analyze the data (IBM Corporation, Armonk, NY, 2011). Quantitative data are expressed as mean and standard error.

The various groups under study were compared using a one-way ANOVA test, and pairwise comparisons were then made using a post hoc test (Tukey). The significance of the results was determined at the 5% level**.**

Results

In Table 1, results revealed that yeast and mold could be detected on the farm eggshell in 82 % (41/50) and in 6 % (3/50) of examined farm egg content with a mean of $8.34 \times 10^2 \pm 1.97 \times 10^2$ cfu/eggshell and $5.33 \times 10^2 \pm 0.88 \times 10^2$ cfu/g, respectively, and in 60 % (15/25) with a mean of $9.64 \times 10^3 \pm 5.5 \times 10^3$ cfu/eggshell in market table eggshells, while they could not be detected in market egg content.

All the examined poultry feed was contaminated with yeast and mold (100%). The count ranges from 5.0×10^2 cfu/g to 7.9×10^5 cfu/g with a mean value of $9.86 \times 10^4 \pm 3.41 \times 10^4$ cfu/g, as shown in Table 2.

The obtained results in Table 3 showed that aflatoxins and ochratoxins were not detected in all examined egg content samples, either from the farms or from the markets. However, aflatoxins and ochratoxins were detected in 30% (1.53 ± 0.46 ppb) and 70% (2.33 ± 0.33 ppb) of feed samples, respectively with 10% of farms exceeded the PL permissible limit in ochratoxin. stated by Egyptian standards (ES 7136\2010)[22]**.**

An experimental work was done to study the antifungal effect of dry brushing and wet brushing (SAEW) on eggshells and the synergistic effect when combining these methods with refrigeration. The yeast and mold count was determined at day 1, 3, 7, 14 and 21 of storage day, and the reduction percent was calculated as in (Table 4) Dry brushing inhibited fungal growth on eggshell for 3 days at room temperature and with reduction rat 53.7% at the end of day 21 and this inhibition was extended to 14 days under refrigeration with reduction rat 56.7%. While SAEW wet brushing achieved complete fungal suppression for 3 days and 93.2% reduction by day 21at room temperature. At refrigeration the results were more promising as the complete inhibition of fungal growth reaches the day 14 and at the end of the trail at day 21 of storage the reduction rate reaches 85.5%for wet brushing.

Discussion

In this study, In Table 1, results revealed that yeast and mold could be detected on the farm eggshell in 82 % (41/50) and in 6 % (3/50) of examined farm egg content with a mean of $8.34 \times 10^2 \pm 1.97 \times 10^2$ cfu/eggsell and $5.33 \times 10^2 \pm 0.88 \times 10^2$ cfu/g, respectively, and in 60 % (15/25) with a mean of $9.64 \times 10^3 \pm 5.5 \times 10^3$ cfu/g in market table eggshells, while they could not be detected in market egg content which illustrate the probability of fungal contamination during handling, transportation, and storage.

The contamination of eggshells may happen through contact with contaminated soil, feed, and air [23]**.**

In our study the fungus was not identified in the content of all market eggs and 60% of farm egg content, which clarifies the significant role of natural egg barriers in preventing contamination [24]**.**

Because thicker cuticles contain antimicrobial proteins [26], they are more likely to prevent microorganisms from penetrating the eggshell [25]. Additionally, they block the pores in the shell, which reduces the movement of pathogens to the egg's contents. Thus, the fungal contamination of egg content, which was observed only on one farm may be due to high significant count in eggshell$8.34 \times 10^2 \pm 1.97 \times 10^2$ which under suitable conditions of temperature and humidity can penetrate eggshell and contaminate its content [11], or may be due to invisible cracks.

Eggs can spoil in the marketplace due to penetration of fungi into their contents, and certain species have been linked to health risks. From the perspective of public health, some mold strains have been linked to food poisoning outbreaks because they produce aflatoxins, and some molds can produce toxins that cause cancer, such as leukemia, and mycotoxicosis in humans [27].

To detect fungal contamination and assess the hygienic conditions of the farm, Neamatallah et al. (2009) randomly selected 100 hens' eggs from a chicken farm in the El-Behera Governorate, Egypt. Thirty eight percent (38%) of the examined eggs were contaminated with mold species with a count ranging from 11 to 17×10^3 CFU/g and a mean value of 3.4×10^3 CFU/g. *Aspergillus* represents 14% of the isolated mold species, followed by *Penicillium* (9%), *Fusarium* (1%), *Mucor* (6%), *Rhizopus* (4%), and *Cladosporium spp*. (5%). The genera *Aspergillus*, *Penicillium*, and *Fusarium* spp. were further identified as *A. fumigatus, A. niger, and A. flavus*; *P. regulosum* and *P. oxalicum ;* and *F. graminarium* [11].

Other research was done in India by Rajmani et al. (2011) they collected 100 table eggs (50 hen eggs from an organized poultry farm and 50 hen eggs from a backyard poultry farm) from Patna (Bihar) City, India, for isolation of molds from eggshell and egg content. Six fungal genera were isolated, including Mucor, *Aspergillus, Fusarium, Penicillium, Alternaria, and Rhizopus.* They found that the isolates of genus *Aspergillus* were found to be the predominant contaminant of eggshell and egg content (38.5%), followed by *Rhizopus* (20.51%), *Mucor* (11.28%), *Penicillium* (9.23%), *Alternaria* (6.66%), and *Fusarium* (6.66%). Eggs from the organized farm had less fungal contamination than those from the unorganized poultry farm. Also, the isolation rate was higher in eggshell (129 isolates) than in egg content (66 isolates), reflecting the effect of environment, storage, and transportation of eggs on fungal growth and contamination [28].

Researchers in [29] detected range level of fungal contamination in broiler and layer feed samples in their study 4.5 X 102CFUg-1 – 8.5 X 103CFUg-1and 7.9 X 102CFUg-1 – 12.8 X 103 CFUg-1respectively

Inadequate storage conditions that favour fungal growth typically range from 10 °C to 40 °C, with a pH level between 4 and 8, and a water activity exceeding 0.70, which may promote fungal proliferation and subsequently lead to mycotoxin synthesis. [3].

All examined poultry feed was contaminated with fungus, which may be resulted from preharvest and/or postharvest contamination of the raw materials, and the final feeds were exposed throughout production, processing, transportation, and storage [30]. In addition to producing various mycotoxins, molds can reduce the nutritional value of feedstuff. The health and production of animals are negatively impacted by mycotoxin-contaminated feed. Additionally, when poultry are fed on contaminated feed, mycotoxins may find their way into their flesh and eggs [31].

Mycotoxins may be transferred from the feed to the bird, affecting poultry growth, laying performance, egg production, and quality [32].

In this research, Aflatoxins and Ochratoxins could not be detected in all examined egg content samples. The concentration of mycotoxins in eggs can be affected by many factors, including the level of mycotoxin contamination in feed, the mycotoxin transmission ratio (the ratio of a particular mycotoxin's concentration in feed to its metabolites in the egg could determine the final concentration in the egg samples) [32].

The animal's health may also have an impact on the transmission ratio [33].

The absence of aflatoxins in examined egg samples may be due to the metabolization of aflatoxins by birds, the low accumulation ability of aflatoxins in the egg, and the accumulation and/or detoxification of aflatoxins in poultry tissues as the liver, or expelled from their body [34]. Also the meta-analysis carried out by[32] revealed that the prevalence of aflatoxins and ochratoxins was generally lower than beauvericin (BEA), and deoxynivalenol (DON) mycotoxins , also added that AFs in chicken feed were range between 3500 and 19700 ng/kg, which is below the maximum tolerable limit of 20 ng./kg (20000 ng/kg).

The presence of molds and mycotoxins varies by season and geographic area. Temperature and humidity are important factors in the growth of fungi and the synthesis of mycotoxins [30].

In our investigation the occurrence of Aflatoxins (30%) and Ochratoxins (70%) in the examined poultry feed may be due to the startup of growth of fungi and mycotoxin production in the cropland, during transportation or storage, also these are influenced by environmental conditions, including grain cultivation location, seasons, harvesting time, and drought [35].

Although aflatoxin and ochratoxin concentrations largely remained within established safety thresholds (with the exception of a single sample exceeding the permissible limit), the measured OTA levels in all chicken feed samples in [9] work —ranging from 800 to 2400 ng/kg—were still well below the maximum tolerable concentration of 5 μg/kg (5000 ng/kg). Nevertheless, these apparent "acceptable" levels should not be interpreted as risk-free. Chronic exposure, even to low concentrations of mycotoxins, poses a significant threat to avian health and productivity. In poultry, prolonged intake of small amounts of these contaminants is often implicated in cases of mycotoxicosis, leading to persistent yet subtle issues such as reduced feed efficiency, inhibited growth, and poor production outcomes. It is important to note that even minimal toxin exposure can accumulate over time, ultimately resulting in considerable physiological and economic consequences. Higher concentrations can provoke acute toxic effects, compromising vital organ function, weakening the immune response, and, in severe cases, causing mortality. The data underscore that compliance with regulatory limits does not guarantee the absence of biological risk [36]**.**

The data in Table (4) shows a significant effect of brushing and using SAEW on reducing yeast and mold count in eggshells, with 100 % reduction till day 3 at room temperature and in the refrigerator. At day 7, the synergistic effect of cooling became clear as yeast and mold count increased at room temperature (G1, G2, and G3), while the reduction percentage remained 100% in G5 and G6 till day 14. The results showed that the SAEW had a good effect on decreasing the total fungal count. Also, cleaning with a dry brush has a fair effect, but brushing with SAEW shows a better effect, and it is advisable to use cleaning with a dry brush to decrease the dirt on the egg surface, consequently decreasing the fungal contamination. Also, if it is possible, use wet brushing with SAEW. By this step, we will be able to minimize or even prevent the fungal contamination on the eggshell.

In this study, dry brushing of eggshells resulted in a 100% reduction in total yeast and mold counts up to day 3 at room temperature and up to day 14 under refrigeration. This highlights the synergistic effect of refrigeration and mechanical brushing, which not only enhances antifungal efficacy but also removes surface dirt that may serve as substrates for microbial growth [26].

SAEW is known to be a non-harmful and efficient disinfectant; meanwhile, its sterilizing efficiency may be affected by the presence of organic matter in eggshell [37], which explains the synergistic effect between SAEW and brushing that has an effect on removing dirt and organic matter and maximizes the antifungal effect of SAEW.

Similar studies have been carried out to study the effect of SAEW in eggshells. Ni et al. (2014) applied SAEW with sparing and immersion. The immersion was more efficient in removing yeast and mold from the eggshell[38] . A combined method of SAEW and UV exposure was used to improve egg internal quality during storage [39]. Wu et al. (2025) explained the antifungal effect of SAEW on Candida species[16].

Conclusion

The analysis clearly revealed fungal contamination in both the egg and poultry feed samples examined. Notably, eggshells exhibited a higher level of contamination compared to the egg contents, which, encouragingly, were entirely free from Aflatoxins and Ochratoxins. Unfortunately, these toxins were present in the poultry feed samples. Interestingly, the use of mechanical brushing—either dry or with a slightly acidic electrolyzed water (SAEW) brush—proved to be an effective, affordable, and environmentally friendly strategy to reduce fungal contamination on eggshells. This effect was further amplified when eggs were stored at lower temperatures. Looking ahead, further research is needed to identify additional methods for protecting consumers from the significant biological risks posed by molds, yeasts, and their associated toxins, which continue to threaten both human health and environmental safety

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

TABLE 1. Total yeast and mold count in farm table egg(Ten farms, n=5) and market table egg(n=25)

Parameters	Contents	Farm No.	Positive sample no. (%)	Min.	Max.	Mean ± SEM
Farm table egg	**Eggshell (CFU/eggshell)**	1	3 (60 %)	1.0×10^2	3.0×10^2	$1.67 \times 10^2 \pm 0.67 \times 10^{2a}$
		2	4 (80 %)	1.0×10^2	4.0×10^3	$1.08 \times 10^3 \pm 0.98 \times 10^{3a}$
		3	4 (80 %)	1.0×10^2	2.0×10^3	$8.75 \times 10^2 \pm 4.19 \times 10^{2a}$
		4	5 (100 %)	1.0×10^2	8.18×10^2	$2.96 \times 10^2 \pm 1.32 \times 10^{2a}$
		5	5 (100 %)	3.0×10^2	5.09×10^3	$2.46 \times 10^3 \pm 1.04 \times 10^{3a}$
		6	4 (80 %)	1.0×10^2	2.0×10^3	$6.25 \times 10^2 \pm 4.61 \times 10^{2a}$
		7	5 (100 %)	1.0×10^2	8.0×10^2	$2.80 \times 10^2 \pm 1.32 \times 10^{2a}$
		8	3 (60 %)	1.0×10^2	2.0×10^2	$1.66 \times 10^2 \pm 0.33 \times 10^{2a}$
		9	4 (80 %)	1.0×10^2	2.0×10^3	$1.08 \times 10^3 \pm 0.53 \times 10^{3a}$
		10	4 (80 %)	1.0×10^2	2.0×10^3	$8.50 \times 10^2 \pm 4.29 \times 10^{2a}$
		Total	**41(82 %)**	$\mathbf{1.0 \times 10^2}$	$\mathbf{5.09 \times 10^3}$	$\mathbf{8.34 \times 10^2 \pm 1.97 \times 10^2}$
	Egg content (CFU/ g)	5	3 (60 %)	4.0×10^2	7.0×10^2	$5.33 \times 10^2 \pm 0.88 \times 10^2$
		1,2,3,4 6,7,8,10	0 (0%)	ND	-	-
Market table egg	**Eggshell**		15(60 %)	1.9×10	6.91×10^4	$9.64 \times 10^3 \pm 5.59 \times 10^3$
	Egg content		0 (0%)	ND	-	-

Means with **a Common letter** $^{(a)}$ are not significant (P > 0.05).

TABLE 2. Total yeast and mold count (CFU/g) in poultry feed (Ten farms, n=3)

Farm No.	Min.	Max.	Mean ± SEM
1	1.38×10^4	4.0×10^4	$2.39 \times 10^4 \pm 0.81 \times 10^{4b}$
2	6.2×10^4	1.6×10^5	$9.76 \times 10^4 \pm 3.13 \times 10^{4b}$
3	1.2×10^4	3.0×10^4	$1.85 \times 10^4 \pm 0.57 \times 10^{4b}$
4	1.72×10^5	7.0×10^5	$3.64 \times 10^5 \pm 1.69 \times 10^{5a}$
5	5.0×10^2	1.0×10^3	$6.83 \times 10^2 \pm 1.59 \times 10^{2b}$
6	1.03×10^4	3.0×10^4	$1.78 \times 10^4 \pm 0.62 \times 10^{4b}$
7	5.27×10^4	9.0×10^4	$6.79 \times 10^4 \pm 1.13 \times 10^{4b}$
8	1.35×10^5	7.9×10^5	$3.73 \times 10^5 \pm 2.09 \times 10^{5a}$
9	1.8×10^4	3.0×10^4	$2.24 \times 10^4 \pm 0.38 \times 10^{4b}$
10	7.0×10^2	1.0×10^3	$8.39 \times 10^2 \pm 0.87 \times 10^{2b}$
Total	$\mathbf{5.0 \times 10^2}$	$\mathbf{7.9 \times 10^5}$	$\mathbf{9.86 \times 10^4 \pm 3.41 \times 10^4}$

Means with **any Common letter** $^{(a-b)}$ are not significant (P > 0.05) and means with **totally Different letters** $^{(a-b)}$ are significant (P < 0.05

TABLE 3. Concentration of Aflatoxins and Ochratoxins in examined egg content and poultry feed (n = 10):

Parameters	Contents	Aflatoxins (ppb)	Ochratoxins (ppb)
Egg content	Positive sample	0	0
	LOD	0.2	0.5
Poultry feed			
	Positive farms	3 (30 %)	7 (70 %)
	Min.	3.22	2.00
	Max.	6.59	5.25
	Mean ± SE	1.53 ± 0.46	2.33 ± 0.33
	Permissible limit (PL)*	-	5
	Farm exceeded PL	-	1 (10 %)
	LOD	2.5	2.0

ND not detected, LOD limit of detection
*PL according to **ES 7136\2010**

TABLE 4. Anti-fungal effect of dry brushing and wet brushing using slightly acidic electrolyzed water (SAEW) on the eggshell (n = 3)

Temp.	Group	Total yeast and mold count (CFU /eggshell)				
		Day 1	**Day 3**	**Day 7**	**Day 14**	**Day 21**
At Room Temperature	**G1 (Control)**	$29.83^{a} \pm 0.44$	$29.50^{a} \pm 0.50$	$152.7^{a} \pm 1.45$	$198.7^{a} \pm 1.86$	$299.7^{a} \pm 2.03$
	G2 (Brushing)	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$30.40^{b} \pm 0.56$	$50.10^{b} \pm 0.21$	$140.3^{b} \pm 1.45$
	Reduction (%) #	**100.0%**	**100.0%**	**80.1%**	**74.8%**	**53.2%**
	G3 (SAEW)	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$10.43^{c} \pm 0.43$	$10.07^{c} \pm 0.23$	$20.27^{c} \pm 0.65$
	Reduction (%) #	**100.0%**	**100.0%**	**93.2%**	**94.9%**	**93.2%**
	p_0	$<0.001^{*}$	$<0.001^{*}$	$<0.001^{*}$	$<0.001^{*}$	$<0.001^{*}$
At Refrigerator	**G4 (Control)**	$30.27^{a} \pm 0.54$	$29.83^{a} \pm 0.44$	$30.0^{a} \pm 0.58$	$40.07^{a} \pm 1.10$	$70.03^{a} \pm 0.26$
	G5 (Brushing)	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$30.33^{b} \pm 0.33$
	Reduction (%) #	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**56.7%**
	G6 (SAEW)	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$0.0^{b} \pm 0.0$	$10.17^{c} \pm 0.44$
	Reduction (%) #	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**85.5%**
	p_0	$<0.001^{*}$	$<0.001^{*}$	$<0.001^{*}$	$<0.001^{*}$	$<0.001^{*}$
	(p)	–	–	(0.002^{*})	$(<0.001^{*})$	$(<0.001^{*})$

p_0: p value for comparing between the three studied groups at room temperature and at refrigerator
p: p value for comparing between **G3 (**at room temperature) and **G6** (at refrigerator)
*: Statistically significant at $p \leq 0.05$
#: Reduction (%) of each group from control

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الفطريات، الافلاتوكسينات، الاوكراتوكسينات في بيض المائدة: محاولات للتحكم بالمعالجة بالماء المُحلل كهربياً قليل الحموضة

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الملخص

تمت هذه الدراسة لاستبيان نسبة انتشار الفطريات والخمائر وبعض السموم الفطرية (الافلاتوكسين و الأوكراتوكسين) فى بيض المائدة سواء قبل خروجه من المزرعة أو بعد وجوده في الاسواق للبيع للمستهلكين. وتمت الدراسة بتجميع عينات من عشر مزارع مختلفة في انحاء محافظه الإسكندرية جمهورية مصر العربية، حيث تم تجميع عشر بيضات وأثنين كيلو جرام من العلف من كل مزرعة، كما تم تجميع خمس وعشرون عينة بيض من مختلف الاسواق المحلية في الاسكندرية لتقييم حاله البيض ومعرفه مدى انتشار العدوى الفطرية وسمومها في البيض المباع للمواطنين. وتم عمل عد كلى للفطريات والخمائر في كلا من قشر ومحتوي البيض وعينات العلف بالإضافة الي تقدير نسب السموم الفطرية الموجودة داخل البيض والعلف.

بعد الحصول على النتائج تبين انتشار الفطريات والخمائر على قشر البيض سؤاء في المزارع أو المباع فى الاسواق وايضا وجودة بنسبة ليسه قليله فى العلف الذي تتناوله الدواجن البياضة. وتم عمل تجربة معملية لمحاوله ايجاد حلول للحد من انتشار الفطريات والخمائر على قشرة البيض. تم استخدام التبريش الجاف و التبريش بفرشاة مبلله بالمياه المحللة كهربيا قليل الحموضة لما لها من تأثير معقم وقاتل للميكروبات وكانت النتائج مبشره حيث قل عدد الفطريات والخمائر بصوره واضحة خاصة عند دمج هذه الطرق مع التبريد.

الكلمات الدالة: الفطريات والخمائر، الافلاتوكسين، الاوكراتوكسين، استراتيجيات التعقيم، السموم الفطرية، المياه المحلل كهربيا قليل الحموضه، بيض المائدة.