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Assessment of the Microbiological and Mycotoxins Quality of Selected Dried Fruits with Special Reference to Microwave Treatment

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Abstract: *Dried fruits are susceptible products for microbial growth and consequent toxin production. In this study, fruits (figs, apricots, raisins and plumes) were dried and exposed to further microwave treatment (30, 60, 90 and 120 seconds) then determined and compared the incidence of microbial and mycotoxin quality to select non-compliant samples. Standard and established methods were used for both microbial and mycotoxins analysis, in home-made and commercial samples. The results indicated that all of the commercial samples were contaminated with aerobic mesophilic bacteria, moulds and yeasts count as well as spore-forming bacteria. They were* $(4.4\pm1.8)x10^2$*~*$(9.6\pm6.3)x10^3$*,* $(4.7\pm2.4)x10^3$*~*$(6.3\pm2.3)x10^4$ *and* $(2.5\pm0.84)x10^2$*~*$(7.8\pm2.8)x10^2$ *cfu/g, respectively. Pathogines such as Bacillus cereus, Staphylococcus aureus, Salmonella spp, Shigella spp, Clostridium perfringens and Eschereichia coli were not detected neither in home-made nor in commercial samples. Minimum efficiency of microwave treatment was observed at 30 seconds exposure time resulted in significant* $(p<0.05)$ *reduction of the microbial population. At 60 seconds exposure, aerobic mesophilic bacteria, moulds and yeasts count and spore-forming bacteria were decreased by 1-3 log cycle and decimal reduction time 0.59-4.90 minuets. Mycotoxins occurrence were recorded in low frequency, following the Egyptian standards for total aflatoxins and ochratoxin A, i.e.,* $\leq$ *4 and 10 µg/kg, respectively. Finally, microwave treatment is a suggested step to reduce microbial population during drying process by time, while was not effective against mycotoxins.*

Keywords: *Home-made; Dry fruits; microwave; D-value.*

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I. Introduction

Dried fruits could offer high nutritional value in the human diet **(Chang et al., 2016)**. It is processed by drying either by the sun or by other recognized methods of dehydration, which may be preceded by sulphuring, with or without added sweetening agent and food additives, into a form of marketable dried product (**Uganda Standard US: 877/2009).**

The traditional sun drying is often a slow process and this increases the chances of microbial contamination **(Karam et al., 2016)**. Even though dried fruits are a very low moisture food, they did appear to harbor bacteria and other microorganisms **(Torres, 2007).** The numbers of microorganisms on most dried fruits vary from a few hundreds per gram of fruits to thousands and they are mostly on the outer surfaces. Spores of bacteria and moulds are likely to be the most numerous **(Alghalibi and Shater, 2004)**. Presence of spores of bacteria and moulds are responsible for degradation of quality of fruits by mycotoxins before or after drying processes. Spoilage of most dry fruits usually occurs during storage, handling and transportation **(Zulfiqar et al., 2015).** The economic loss resulting from fungal and mycotoxin contamination of the dried fruits is difficult to estimate. These losses constitute direct fruit spoiling, human illness and reduced productivity **(Gupta et al., 2015).**

The possible pathogens of the genera *Salmonella, Shigella, Bacillus* and other Enterobacteriaceae were isolated from home dried samples. Faecal coliforms were detected in 55% of the home dried food products. More than 60% of the samples recorded high microbial levels than recommended. While half of commercially dried fruits exceeded international standards, all home dried fruits recorded unacceptably high levels of fungal contamination (**Victor et al., 2017)**. Dried fruits are produced in and sourced from many countries worldwide, but they have been increasingly reported to be involved in outbreaks and alerts due to the presence of foodborne pathogens such as *Salmonella* **(Bourdoux et al., 2016)**. *Zygosaccharomyces* and related genera tolerate high sugar concentration and are the usual spoilage organisms in foods such as dried fruit **(Rawat, 2015)**. On the

other hand, **FDA (2013)** has regulated the moulds, osmophilic yeasts and *E. coli* counts should not exceed 10^4 cfu/g, 10^3 cfu/g and 11 MPN/g in sun dried fruits, respectively. The Egyptian Standards have issued the dried figs **(ES: 2801/2013)** and raisins **(ES: 285/2005)** shall be free from microorganisms which may represent a hazard to health, whereas moulds and yeasts count should be below 10^3 cfu/g.

Dried fruits may harbor a variety of fungi especially those that can grow in low water activity conditions. Knowledge on the occurrence of fungi on dried fruits is an important step to predict the possibility of mycotoxin contamination **(Zakaria et al., 2015).** Mycotoxin contaminations constitute not only an economic problem for dried fruit-producing countries but also a serious health risk for consumers all over the world **(Karaca et al., 2010)**. Natural occurrence of mycotoxins and fungal contamination of dried fruits have been investigated in many parts of the world by different authors **(Toma and Rajab, 2014; Ashiq, 2015; Gupta et al., 2015; Masood et al., 2015; Saadullah and Abdullah, 2015; Tournas et al., 2015; Zakaria et al., 2015; Zulfiqar et al., 2015; Heshmati et al., 2017 and Wei et al., 2017)**. Although a large number of mycotoxins exist, two of them, namely aflatoxins and ochratoxin A are frequently detected from dried fruits **(Saadullah and Abdullah, 2015)**. The maximum acceptable levels of mycotoxins in dried fruits have been established. The Egyptian Standards **(ES:7136/2010)** and the commission regulation of the European Communities **(EC: 1881/2006)** is often considered as being the most comprehensive and strict in relation to mycotoxins in foods, but only aflatoxins and ochratoxin A in dried fruits are subject to legal guidelines. They set the maximum permitted levels of total aflatoxins in dried fruits intended for direct consumption and ochratoxin A in dried vine fruit, i.e. 4 and 10 µg/kg, respectively.

All sun-dried fruits must be pasteurized to destroy any insects and their eggs. This can be done with heat or cold. To pasteurize with heat, place dried food evenly in shallow trays no more than one inch in depth. Fruits should be heated at 160°F for 30 minutes **(Boyer and Huff, 2008 and Paul and Enkerud, 2017)**. Microwave drying is based on a unique volumetric heating mode involving the application of electromagnetic radiation at 915 and 2450 MHz and it has been increasingly used in a large variety of materials making it a very promising drying technology **(Da Silva et al., 2016).** Its disinfestation is considered safe and competitive alternative method to fumigation as it avoids environmental pollution. Also, it can provide a continuous process to allow large quantities of products to pass in a shorter period of time **(Yadav et al., 2014)**. The advantages of microwave combination drying techniques include shorter drying times, improved product quality and flexibility in producing a wide variety of dried products (**Parit and Prabhu, 2017)**. It apparently produced lethal effects on the examined bacteria by heat generated during microwave exposure. Water activity was not changed microwave efficiency for the each examined bacteria under the determined optimum conditions **(Gedikli et al., 2008)**. Non-ionizing microwave radiations can reduce or eliminate pathogenic microorganisms, but partly also mycotoxins in food **(Karlovsky et al., 2016).**

The aim of this work was to evaluate the microbiological and mycotoxin contamination of commercial and home-made selected sun dried fruit with respect to microwave treatment.

II. Materials And Methods:

Two groups, home-made sun dried fruits with microwave conditioning treatment and commercial dried fruits, were used to compare the incidence of microbiological and mycotoxin contamination. The fruit samples represented as figs, apricots, raisins and plumes with sample size was not less than 500g.

Home-made samples:

Firm and fully ripped fruits were collected from open market in Cairo, Egypt during 2017, prepared (skins cracked and pretreated), sun-dried, conditioned, packaged and stored according to **Paul and Enkerud (2017)**. The test performance was done using microwave oven as a conditioning step.

Microwave treatment:

Home-made dried fruits were exposed to microwave radiation in oven type Galanz, D10043AP/H, China, capacity of 1000 w and 2450 MHz for 30, 60, 90 and 120 sec., with 3 replications for each time. Other samples non-exposed were used as control to show the effect of microwave on microbial and mycotoxin degradation **(Hussein et al., 2015)**.

Commercial samples:

A total of 120 commercial dried fruit samples, represented as (30 samples each of figs, apricots, raisins and plumes) were collected from open market and from exporters and stored at 2-8ºC until further analysis.

Microbiological analysis:

Laboratory analysis was done to determine microbiological contamination which involved analysis as presented in table (1).

Mycotoxin analysis:

For the quantitative analysis of mycotoxin (total aflatoxin and ochratoxin A), samples were prepared and subjected to Competitive Direct-Enzyme Linked Immunoscorbent Assay (CD-ELISA) technique. These were extracted and performed using Affinitech, LTD, USA, testing kits following its instructions **(Toma and Rajab, 2014)**. The test was in MRX microwell reader (Dynatech Laboratories, UK) with Software Version 1.2 to values in µg/kg.

Table (1): Methods for enumeration and detection of microbiological contamination in dried fruit samples.

Microorganisms	Media and incubation conditions	References
Aerobic mesophilic bacteria	Plate Count Agar (35ºC/48±2h)	AOAC 966.23/2000
Spore-forming bacteria*	Plate Count Agar (35ºC/48±2h)	McHugh et al. (2017)
Moulds & yeasts count	Sabouraud D-glucose Agar (25±1ºC/5d)	ISO 21527-2:2008 (E)
Coliform group (MPN)	MacConkey's Broth (37±1ºC/48h)	ISO 4831: 2006 (E)
Escherichiae coli	EMB (37ºC/24h), Tryptone water (37ºC/24h) + indol reagent, MRVP (37ºC/5days) + Methyl red solution and (37ºC/48h) + α-naphthol solution, Simmon Citrate Agar (37ºC/48h)	ISO 16649-2: 2001 (E)
Bacillus cereus	PPEMBA (30 ºC/24 and 48h).	ISO 7932: 2004 (E)
Staphylococcus aureus	Baird-Parker's medium (37ºC/24 and 48h) and Brain Heart Infusion Broth (37ºC/1-24h)	ISO 6888-1: 1999/ Amd.1: 2003 (E)
*Clostridium perfringens***	OPSP + Selective Supplement A and B (35 ºC/18-24h)	ISO 7937: 2004 (E)
*Salmonella spp.****	Lactose Broth, LIA and TSI (37ºC/24h); Selenite Cystine Broth and Tetrathionate Brilliant Green Broth (43ºC/24h) and Bismuth Sulphate Agar and Brilliant Green Agar (37ºC/24 and 48h)	ISO 6579-1: 2017 (E)

** Sample dilutions were heated at 80ºC/15min in water-bath.*

*** Incubated with H2/CO2 gas generating pack in a conventional gas-jar.*

**** Serological identification of Salmonella isolates using Bacto Salmonella O-antiserum.*

Statistical analysis:

According to **Ostadrahimi et al. (2014),** the individual observations were analyzed and expressed in terms of Mean ± Standard Deviation (SD). Comparing the mean differences among the observed data was done by analysis of variance (ANOVA) using statistical software (IBM-SPSS, 20; USA).

The destruction effect of microwave radiation on the reduction of microorganisms count was calculated based on a first-order kinetic **(Dababneh, 2013)**:

$$D=2.303/K_D \quad \text{..... Equation 1}$$

where decimal reduction time (D) is the time necessary for the disappearance of 90% of the initial bacterial population and K_D is the slope of a linear regression line of the plot relating microorganisms count to exposure time; the lower the D value, the higher the destruction efficiency. Portion of inactivation curves from 0 to 120 seconds were used for regression analysis using Excel, Microsoft Office 2000.

III. Results And Disscusion

The results of microbial and mycotoxin analysis in commercial and home-made dried fruit samples represents four kinds (figs, raisins, apricots and plumes) are described as follow:

None of the samples were of unsatisfactory with respect to microbial and mycotoxin content, neither in commercial nor in home-made dried fruit samples according to the Egyptian standards. Regarding to pathogenic bacteria, *B. cereus, Staph. aureus*, coliform group, *E. coli, Salmonella spp, Shigella spp,* and *Cl. perfringens* were not detected in any of the samples regardless of the fruit kind or time of microwave treatment.

Table (2) presents the microbial and mycotoxin content (Mean ± SD) of the commercial dried fruits. Samples considered as satisfactory by all microbial parameters, i.e., aerobic mesophilic bacteria, moulds and yeasts count and spore-forming bacteria ranged between $4.4x10^2 \pm 1.8x10^2$ ~ $9.6x10^3 \pm 6.3x10^3$, $4.7x10^3 \pm$

$2.4x10^3$ ~ $6.3x10^4$ ± $2.3x10^4$ and $2.5x10^2$ ± $8.4x10^1$ ~ $7.8x10^2$ ± $2.8x10^2$ cfu/g, respectively. The highest mean count of total mesophilic aerobic bacteria was detected in raisins samples ($9.6x10^3$ ± $6.3x10^3$ cfu/g) followed by figs ($6.0x10^3$ ± $5.2x10^3$ cfu/g) and plumes ($8.4x10^2$ ± $2.3x10^2$ cfu/g), while the lowest mean count was detected in apricots samples ($4.4x10^2$ ± $1.8x10^2$ cfu/g).

In the same context, the incidence of moulds and yeasts count and spore-forming bacteria in raisins, figs, plumes and apricots samples were ($6.3x10^4$ ± $2.3x10^4$ and $7.8x10^2$ ± $2.8x10^2$), ($4.6x10^4$ ± $3.5x10^4$ and $5.7x10^2$ ± $3.1x10^2$), ($2.0x10^4$ ± $1.3x10^4$ and $7.0x10^2$ ± $2.6x10^2$) and ($4.7x10^3$ ± $2.4x10^3$ and $2.5x10^2$ ± $8.4x10^1$ cfu/g), respectively. The mean concentrations of total aflatoxins and ochratoxin A were 2.5 ± 1.1 and 2.6 ± 1.6 µg/kg in raisins, 2.0 ± 1.4 and 1.1 ± 0.9 µg/kg in figs, 0.8 ± 0.5 and 1.0 ± 0.8 µg/kg in plumes and 0.7 ± 0.6 and 0.6 ± 0.4 µg/kg in apricots, respectively. In addition, mycotxin content including total aflatoxins and ochratoxin A were 0.7 ± 0.6 ~ 2.5 ± 1.1 and 0.6 ± 0.4 ~ 2.6 ± 1.6 µg/kg, respectively.

Table (2): Microbial and mycotoxin contamination of selected commercial dried fruits.

	Microorganisms (cfu/g)			**Mycotoxins (µg/kg)**	
	Aerobic mesophilic bacteria	**Moulds and yeasts**	**Spore-forming**	**Total aflatoxins**	**Ochratoxin A**
Figs	$6.0x10^3$±$5.2x10^3$	$4.6x10^4$±$3.5x10^4$	$5.7x10^2$±$3.1x10^2$	2.0±1.4	1.1±0.9
Raisins	$9.6x10^3$±$6.3x10^3$	$6.3x10^4$±$2.3x10^4$	$7.8x10^2$±$2.8x10^2$	2.5±1.1	2.6±1.6
Apricots	$4.4x10^2$±$1.8x10^2$	$4.7x10^3$±$2.4x10^3$	$2.5x10^2$±$8.4x10^1$	0.7±0.6	0.6±0.4
Plumes	$8.4x10^2$±$2.3x10^2$	$2.0x10^4$±$1.3x10^4$	$7.0x10^2$±$2.6x10^2$	0.8±0.5	1.0±0.8

- The data were represented by (Mean ± Standard Deviation).
- *B. cereus, Staph. aureus, Salmonella spp, Shigella spp, Cl. perfringens,* coliform group and *E. coli* were completely absent from all sample.

The drying of fruits allows for their better preservation by reducing water activity, thus inhibiting microbial growth and enzymatic modifications **(Gupta et al., 2015)**. It is simple, safe and easy to learn, and drying removes moisture from food so bacteria, yeast and mold cannot grow and spoil food **(Sarwar, 2015)**. Hence, dried fruits are known to carry natural non-pathogenic epiphytic microbiota but can be contaminated with pathogens from human, animal or environmental sources during growth, harvest, transportation, processing and handling. While the prevalence of food-borne pathogens on dried fruits and their involvement in food-borne outbreaks are not well documented, fresh fruits have been implicated in a number of documented outbreaks of food-borne illnesses **(Victor et al., 2017).** Typically, fruits have low pH since fruits increase in acidity as they ripen and this may not favour growth of pathogenic microorganisms (commercially dried products), although some moulds and yeasts can endure such high acidity **(Uzeh et al., 2009)**. Poor hygienic conditions in fig harvesting, drying procedures, collecting sites, sorting and packaging plants caused higher mould contamination and risk of the *A. flavus* growth in dried fig production **(Javanmard, 2010)**. Similar findings were also reported by **Zakaria et al. (2015)**, in which Aspergillus and Penicillium were isolated in higher frequency from different types of dried fruits.

According to **Saadullah and Abdullah (2015),** dried fruits harbor a diversity of fungal contaminants. Some of these fungi isolated are capable of producing aflatoxins and ochratoxin A and thus there may be risk through consumption of these dried fruits**.** Some insect pests that are active at fruit ripening stage may act as vectors in transferring the aflatoxigenic fungi to the fruit cavity **(CAC/RCP 65-2008)**. They are vulnerable to fungal infection and subsequent mycotoxin occurrence. The fruits are usually contaminated with molds during the drying in trays **(Ashiq, 2015)**. The presence of aflatoxins and ochratoxin A in dried fruits probably also reflects the presence of various species of *Aspergillus* moulds in these products **(Heshmati et al., 2017).**

During the process of fruit drying, the sugar is concentrated as the moisture content decreases resulting in an almost selective medium for xerotolerant moulds such as *A. niger* section nigri species. Among black aspergilli, *A. carbonarius* is the most important as OTA producing isolate observed more frequently **(Rahimi and Shakerian, 2013)**. If such mold-inactivating treatment was applied, any mycotoxins or spoilage byproducts formed before this treatment most likely would still be active and hazardous to human health **(Tournas et al., 2015)**.

Our results for qualitative and quantitative estimation of mycotoxins are in contrast with natural mycotoxins detection in dried fruit samples in which high levels of mycotoxins were detected, this may be due to, and some fungi lose their toxin production ability **(Toma and Rajab, 2014)**.

Some types of fruits, e.g. apricots, are treated with high levels of sulphur dioxide before drying, which is essential to preserve fruit appearance by preventing browning from the Maillard reaction. The SO_2 also completely eliminates the microflora, even during prolonged storage **(ICMSF, 2005)**. Microflora can be eliminated after treatment of fruits with commonly used sulfur dioxide followed by drying, as well as, the low incidence of mycotoxin contamination **(Trucksess and Scott, 2008; Karaca et al., 2010 and Wei et al., 2017)**.

For microwave treatment of the selected dried fruit samples, average inactivation profile for microbial population was compared in all tested samples at different exposure time (Figure, 1). In general, a decrease in the microbial load was noted as exposure time increased from initial time to 120 second.

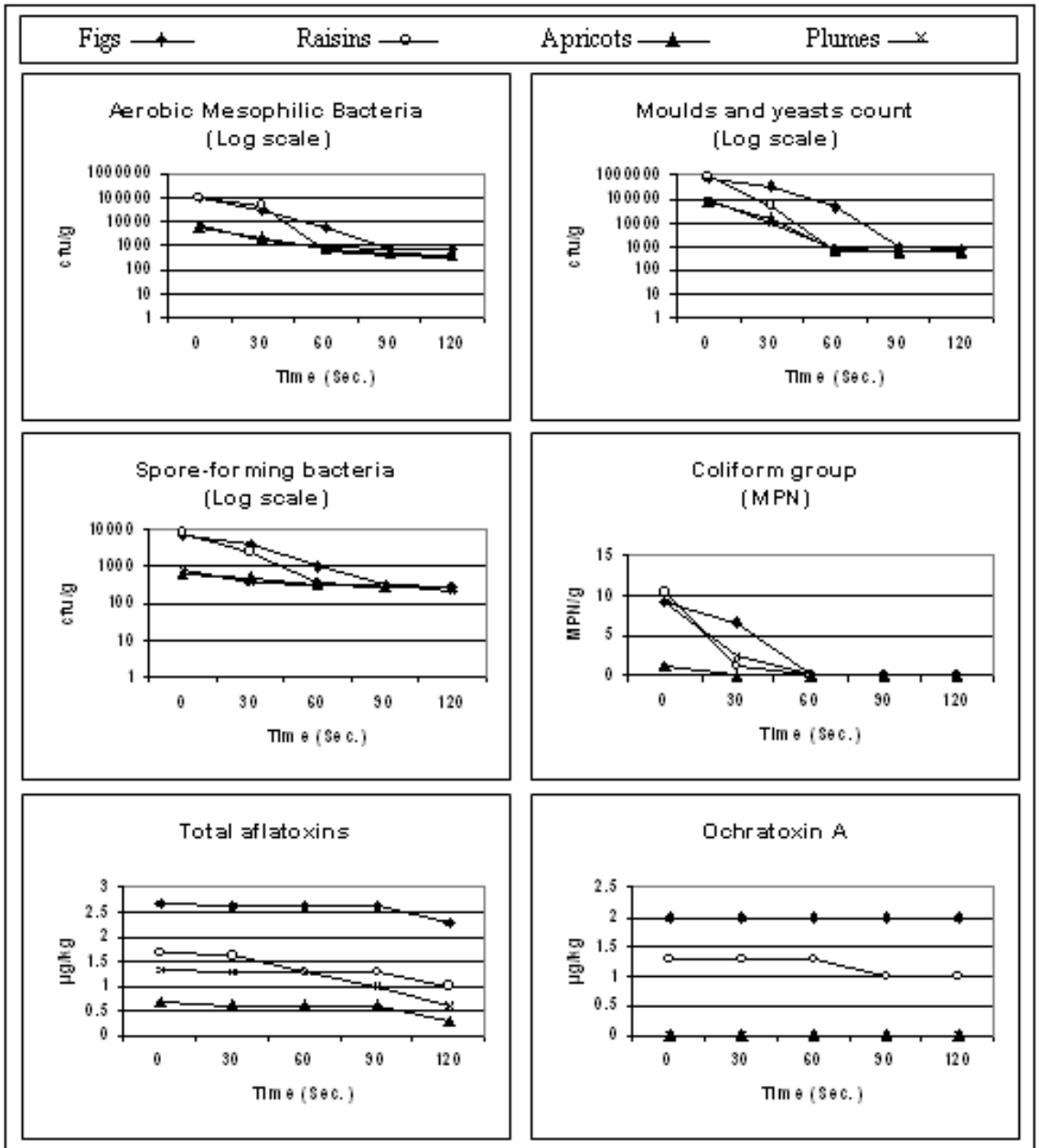

Figure (1): Microwave inactivation curves of microbial and mycotoxin contamination in selected dried fruits. [Aerobic mesophilic bacteria, moulds and yeasts count, spore-forming bacteria and coliform group ($p<0.05$); Total aflatoxins and ochratoxin A ($p>0.05$)].

Similar to the commercial samples, the home-made samples showed the highest mean count level was detected in raisins followed by figs and plumes while the lowest was detected in apricots samples. Concerning the microbial profile in zero time (before microwave treatment), aerobic mesophilic bacteria was noticed at

different levels, ranging from $5.2x10^3$ to $1.0x10^5$ cfu/g, moulds and yeasts count from $7.2x10^4$ to $8.4x10^5$ cfu/g, spore-forming bacteria from $6.3x10^2$ to $8.4x10^3$ cfu/g and coliform group from 1.2 to $1.0x10^1$ MPN/g.

The presence of non pathogenic microbes in food does not necessitate unfitness for consumption, but may indicate the hygiene status of the preparation and processing. However, certain levels may indicate serious case of poor hygiene and the food becomes unfit for consumption **(Simforian et al., 2015)**.

Exposure of samples to microwave resulted in a reduction of the microbial population, in which the statistical analysis indicated that there is a significant ($p<0.05$) differences of the distraction effect of microwave on microorganism decontaminated samples.

A considerable linear reduction slope was obtained at 30 to 120 seconds microwave treatment, where a logarithmic increase response was observed with time (Figure 1), i.e., the aerobic mesophilic bacteria were mainly decreased by 1-3 log, moulds and yeasts counts 1-4 log and spore-forming bacteria1-2 log. The coliform group bacteria was reduced to <3 MPN/g by 30 and 60 seconds.

Surface sterilization method (microwave) generally will reduce the number of fungi isolated as this method will removes most of the surface contaminants of the samples. The fungal isolates successfully isolated from surface sterilization method were considered as internal fungi which invade the dried fruits and grow inside the samples **(Zakaria et al., 2015).**

Table (3) presents D-Value, the decimal reduction time (time required at a given temperature for destruction of 90% of the cells), of the microbial population in the dried fruit samples. They were calculated for aerobic mesophilic bacteria (0.72-2.03 min.), moulds and yeasts counts (0.59-0.92 min.), spore-forming bacteria (1.26-4.90 min.) and coliform group (1.81-33.33 min.). The overall D-value for the samples ranged between 0.72 and 33.33 min. Most destruction of aerobic mesophilic bacteria and spore-forming bacteria was observed in raisins samples (0.72 and 1.26 min.) whilst moulds and yeasts count and coliform group was obtained in figs samples (0.59 and 1.81 min.), respectively.

Table (3): Destruction effect of microwave on the survival of microbial contamination.

	D-value (minute)			
	Aerobic mesophilic bacteria	**Moulds and yeasts count**	**Spore-forming bacteria**	**Coliform group**
Figs	0.86	0.59	1.27	1.81
Raisins	0.72	0.60	1.26	2.38
Apricots	1.71	0.89	4.90	33.33
Plumes	2.03	0.92	3.88	2.16

Recent results agreed with these studies. Overall, the microbial inactivation effect of the presented technologies has not yet been thoroughly assessed, even for traditional methods like. The results obtained by **Gedikli et al. (2008)**, using continuous power application of 2450 MHz microwaves at the different power levels, indicated that the microwaves apparently produced lethal effects on the examined bacteria by heat generated during microwave exposure. Microwaves have been applied in the sterilization of packed food products, so the inactivation of microorganisms induced by microwave in microwave-assisted drying is not surprising. The destruction of microorganisms with microwave radiations at sublethal temperatures has been explained by selective heating, electroporation, cell membrane rupture, and disruption of internal components **(Bourdoux et al., 2016).** In addition, the effect of microwave radiation may came from that, microwave cause increase temperature which effect the transcription of DNA to mRNA and inhibited synthese of proteins, including enzymes, leading to stop several metabolism activities in the cell, leading finally to cell death. It has been reported that thermal energy caused by microwave radiation effect enzymes and nucleic acid in addition of damaging cellular membrane **(Hussein et al., 2015)**.

In contrast to the above mentioned microbiological results, no mycotoxin response was observed against microwave treatment. The incidence of total aflatoxin and ochratoxin A was below the critical limits established by the Egyptian standards (**ES: 7136/2010)** and the commission regulation of the European Communities **(EC: 1881/2006)**, i.e., 4 and 10 µg/kg, respectively. Total aflatoxin was detected at the following levels in all of dried fruit samples treated by microwave: 2.67-2.30 µg/kg in figs, 1.67-1.00 µg/kg in raisins, <1.00 µg/kg in apricots and 1.33- <1.00 µg/kg in plumes. Ochratoxin A was found to be as follow: 2 µg/kg in figs, 1.3-1 µg/kg in raisins, while was <2 µg/kg in apricots and plumes.

Unlike microbial inhibition, microwave treatment was not effective to decrease aflatoxins **(Udomkun et al., 2017)**. Since dried fruits are thought to be suitable products for mold contamination and growth, they have been tested for mycotoxin contaminations for years **(Karaca *et al.*, 2010)**. Fruits dried for preservation

purposes are more vulnerable to fungal infections and mycotoxins. The preserved fruits are exposed to mycotoxins during drying process in trays **(Zulfiqar et al., 2015).** Nonetheless, mycotoxin co-occurrence was recorded in low frequency. Although, the level of AFB1 and OTA were not so high, efficient methods to provide the safeguard for the consumers against their toxic effects and furthermore to keep the public health should be approached. In this context, the employment of good agricultural practices (GAP) with the aim of reducing fungal growth in all the processing steps (in the field and during storage) as well as the general improvement of quality of all the process are crucial **(Heshmati et al., 2017)**. Most mycotoxins are highly stable during processing and, therefore, can reach the consumer **(Barkai-Golan and Paster, 2008)**. Most mycotoxins are chemically and thermally stable though. While conventional food preparation with temperatures up to 100°C has little effect on most mycotoxins **(Karlovsky et al., 2016)**. However, one might expect that the more heat-tolerant the mycotoxin, the harder it will be to affect its molecules; nevertheless, specific electromagnetic effects, which can cause ion shifts, must be considered **(Magan and Olsen, 2004)**. The lower efficacy of microwave heating in decontamination of aflatoxins could be due to the result of shorter heating time. Also, the natural aflatoxins might be less likely to be degraded with radiation treatments, because they are within the commodity protected from radiation versus being on the surface when artificially applied **(Herzallah et al., 2008)**.

IV. Conclusion:

It is worth noting that, all commercial and home-made dry fruit samples agreed with the microbial and mycotoxin levels recommended. Food processing can further reduce microbial and mycotoxin levels by physical removal, Sulphur Dioxide treatment and Good Manufacturing Practices (GMP). Finally, this investigation proved that microwave treatment duration of 30 seconds was found to be capable of reducing the microbial load. Unlike the microorganisms, mycotoxin content showed no response against microwave radiations. This simple effective and innovative process could be suitable for use in home-drying fruits. Therefore, strict hygienic mycological investigation should be done during production to minimize contamination with such fungi.

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