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HEALTH HAZARDS ASSOCIATED WITH SPICES AND MEDICINAL PLANTS IN THE EGYPTIAN MARKET: 1- MOULDS AND MYCOTOXINS

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ABSTRACT

A total of 110 different samples belonging to 7 kinds of spices (black pepper, cumin, fennel, ginger, rosemary, mixed spices and thyme) and 6 kinds of medicinal plants used by both infants and adults (caraway, anise, cinnamon, Peppermint, tilio and chamomile) were estimated for contamination by moulds and mycotoxins. Samples were collected from different places at Cairo governorate, Egypt. Results revealed that the highest mould content was obtained in Tilio while the lowest count was found in Fennel. The isolated moulds contained mycotoxins producing types like *Aspergillus flavus* (Aflatoxin) and *Penicillium verrucosum* and *Aspergillus ochraceus* (Ochratoxin A) which were found in high percentages (71.56%, 55.05% and 19.27%, respectively). Other pathogenic types also were isolated from the examined samples in a high percentage like *Aspergillus niger* (77.06%) which has a strong allergic effect. The examined samples revealed detection of Aflatoxin in one mixed spices sample at a concentration of 11.7 ug/kg while Ochratoxin A was not detected in any of the examined samples. Microwave, roasting and boiling were used to elevate the microbial quality of some types of examined samples.

Keywords: Spices, medicinal plants, moulds, mycotoxins.

INTRODUCTION

Medicinal plants are widely used as home remedies and raw material for the pharmaceutical industries. The past decade has seen a significant increase in the use of herbal medicine (Abou-Arab *et al.*, 1999). Food (raw material and products) can be contaminated with spores and mycelium fragments from the environment. Contamination can occur at different stages of production such as growth and ripening of the crops (pollution from irrigation water, atmosphere and soil) transportation and storage conditions. Fungal growth only occurs under favorable conditions which vary for each species but generally moisture content of any commodity plays an important role in fungal growth and mycotoxins production. Filamentous fungi are in general able to produce a large number of different secondary toxic metabolites called mycotoxins which, if ingested, can cause acute or chronic toxic effects (such as carcinogenic, mutagenic, teratogenic, estrogenic effects) in humans and animals (Robert *et al.*, 1995). Among the mycotoxins, the Aflatoxins are produced by *Aspergillus flavus* and *Aspergillus parasiticus*. The Aflatoxins are very dangerous for humans not only because of their acute toxicity in high doses but also because of their strong carcinogenic properties. Epidemiological evidence points to a higher incidence of liver tumers in people who regularly eat food contaminated with Aflatoxins (Shank, 1976). Nephrotoxic ochratoxin A is produced by several species, among which *Penicillium verrucosum* and *Aspergillus ochraceus* has been traced in

different foodstuffs including spices (Krogh, 1977). Fungal spores also have dangerous hazards for human if inter its body from any rcut especially by inhalation. *Aspergillus fumigatus, Aspergillus niger* and *Aspergillus nidulans* have a very harmful effect on human health as they cause aspergillosis which is an acute and some times chronic granulomatus infection of sinuses, bronchi, lungs and occasionally other parts of the body. These fungi also may cause severe allergic reaction in human body (Ashoub *et al.*,1986). Several trials were followed by many investigators to increase the quality of medicinal plants. These methods included microwave, roasting and boiling. Emam *et al.*, 1995 found that microwave treatment is a safe and suitable technique for decontamination of some types of spices which also does not result in a great loss of flavorgni compounds.

The aim of this work is to evaluate the mycological quality of some Egyptian medicinal plants and spices, to detect the occurrence of some mycotoxins and to investigate the effect of different treatments on increasing their quality.

MATERIAL AND METHODS

Samples:

A total of 110 different samples belonging to 7 kinds of spices (black pepper, cumin, fennel, ginger, rosemary, mixed spices and thyme) and 6 kinds of medicinal plants (caraway, anise, cinnamon, peppermint, tilio and chamomile) were collected (100 g each) from various retailers in Cairo city in clean labeled containers. The samples were sent to the laboratory as soon as they were collected and either tested on arrival or stored at 4°C to arrest any mycotoxins formation before analysis. Table (1) shows the botanical names, the part of plant used, uses and the number of examined samples.

Moisture content:

Medicinal plants and spice samples were dried at 60°C under vacuum for 8 to 12 hrs until their weight remained constant. The weight difference after drying was considered as the moisture content (Aziz, 1987).

Mycological studies:

Ten grams of each sample were added to a 90 ml sterile saline solution in 500 ml Erlenmeyer flasks and homogenized thoroughly on an electric shaker at a constant speed for 15 min. Tenfold serial dilutions were then prepared (Aziz and Yousef, 1991). One ml portion of three suitable dilutions of the resulting sample suspension were used to inoculate Petri dishes, each containing 15 ml Sabaroud Dextrose Agar containing 0.5 mg Chloramphenicol / ml medium to inhibit bacterial growth. Plates were then incubated for 7-15 days at 28°C and examined visually and microscopically for the growth of moulds (Aziz *et al.*, 1998). The isolated moulds were subcultured on the abovementioned media for identification of different types of moulds according to Robert *et al.*, 1995.

Quantitative determination of Mycotoxins:

Aflatoxins were determined using HPLC technique according to (Roos et al., 1997) while ochratoxin A was determined using HPLC technique according to (AOAC 1992).

Table (1): Description and number of medicinal plant and spices samples:

English name	Scientific name	Part of plant used	Use	No. of samples
esinA	*Pimpinella anisum*	Fruits	Gas relief – Analgesic - Meduritic	9
reppep kcalB	*Piper nigrum*	Fruits	Appetizer - Tonic	9
yawaraC	*Carum carvi*	Fruits	Rich nutrient for children - Gas relief - Flavoring	9
limomahC	*Cymbopogom schoerenthus (L.)*	Leaves and stems	Gas relief - Cosmetics	6
nomaniC	*Cinnamomum cassia* Blume	Bark	Gas relief - Analgesic	9
nimuC	*Cuminum cyminum*	Fruits	Spice – Gas relief – Analgesic	9
lenneF	*Foeniculum vulgare*	Dry fruit	Gas relief - Analgesic	9
Ginger	*Zingiber officinale*	Rhizomes	Spice - Flavoring	9
secips dexiM	-	-	-	9
Thyme	*Thymus vulgaris*	Leaves	Spice – Gas relief – Antiparasitic - Analgesic	9
tnimreppeP	*Mentha spicata*	Leaves	Spice – Cosmetics	9
Rosemary	*Rosmarinus officianalis*	Leaves	Spice – Gas relief – Analgesic - Cosmetics	6
oiliT	Tilia cordata	Leaves	Gas relief – Analgesic	8

Effect of different treatment techniques on fungal count:

Boiling: Ten grams of anise, caraway, cinnamon, ginger, peppermint and tilio samples were added each to 90 ml sterile saline solution in 500 ml Erlenmeyer flasks and hold on a heater to increase their temperature up to boiling. Ten ml were pipetted from the flask before heat treatment (zero time) and also after 1, 2, 3, 4 and 5 min. Total Fungal Count was estimated using the previously described method.

Microwaves: Black pepper, cinnamon, cumin, fennel, ginger, thyme and peppermint samples were divided in Pyrex beakers into 6 groups after good homogenization. The first group was left without treatment and considered as control. The groups 2, 3, 4, 5 and 6 were exposed to microwaves for 15, 30, 45, 60 and 75 seconds, respectively. The beakers were placed on the rotating tray of microwave oven which rotates slowly to ensure uniform heating. The microwaves generated from the oven were at medium power setting (Abou Haggar, 2000) Ten grams of the treated samples were added to a 90 ml sterile saline solution in 500 ml Erlenmeyer flasks and homogenized thoroughly on an electric shaker at a constant speed for 15 min. and total fungal count was estimated using the previously described method.

Roasting: 10 g of both cumin and black pepper were roasted in a pan on a heater and 10 gm were withdrawn before heating (zero time) and after 1, 2, 3, 4 and 5 min and added each to 90 ml sterile saline solution in 500 ml Erlenmeyer flasks. Total fungal count was estimated using the previously described method.

RESULTS AND DISCUSSION

The differences in fungal population isolated from the medicinal plant samples and spices are shown in Tables 3, 4 and 5. In all cases, a total of 41 species of fungi belonging to 15 genera were isolated and identified. Eighteen species were isolated from Anise samples, 17 from Caraway, 15 from each of fennel and thyme, 14 from each of ginger and peppermint, 13 from each of chamomile and rosemary, 12 from cumin, 11 from mixed spices, 10 from tilio and 9 from cinnamon.

In this study, the isolated species of fungi belonging to the genera: *Alternaria, Aspergillus, Byssochlamys, Chrysonilia, Cladosporum, Emericella, Eurotium, Fusarium,Giotrichum, Moniliella, Mucor, Penicillium, Rhizopus, Syncephalastrum* and *Trichoderma* (Tables 3, 4 and 5). The greater number of species was held to genus Aspergillus, 10 species were recovered namely: *A. candidus, A. flavus, A. fumigatus, A. niger, A. ochraceus, A. oryza, A. parasiticus, A. terrus, A. versicolor* and *A. wentii*. Eight species of *Penicillium* were recovered namely: *P. brevicompactum, P. camemberti, P. citrinum, P. chrysogenum, P. echinulatum, P. glabrum, P. nalgiovense* and *P. veracious*. Five species were isolated from genus Fusarium namely: *F. Avenaceum, F. Oxysporum, F. Solani, F. Sporotrichiodis* and *F. subglutinans*. Four species from *Mucor* were isolated namely: *Mucor circinelloides, Mucor hiemalis, Mucor plumbeus* and *Mucor racemosus*. Three species were isolated from genus *Eurotium* namely: *Eurotium amesteolodami, Eurotium chevalieri* and *Eurotium herbariorum*. Two species from *Cladosporum* were isolated namely: *Cladosporum sphaerospermum* and *Cladosporum cladosporoids*. One species was found in different plant and spices samples from the other genera of fungi. The most prevalent fungi isolated from all examined samples were: *A. niger, A. flavus, P. veracious* and *A. ochraceus*. Domsch *et al.*, 1981 and Aziz *et al.*, 1998 stated that, the contamination of foodstuffs with fungal species was a result of natural extraneous contamination by dust following storage in humid conditions. Fungi fall into two ecological categories: field and storage fungi. Field fungi were observed to invade developing or mature seed while it is on the plant, the major field fungi genera are: *Alternaria, Fusarium* and *Cladosporum*. On the other hand, storage moulds are those encountered on plants at moisture conditions routinely found in stored products, these fungi are principally species of *Aspergillus* and *Penicillium*.

The dominance of *Aspergillus* and *Penicillium* spp. in all examined samples was in accordance with the results obtained by Takatori *et al.*, 1977, Ayres *et al.*, 1980 and Aziz *et al.*, 1998 who stated that *Aspergillus* and *Penicillium* spp. were the main component of different types of spices and medicinal plants which are common in food industry. They found a high degree of contamination in all samples. Misra 1981, Roy *et al.*, 1988 and Aziz *et al.*, 1998 isolated *A. flavus, A. niger, A. fumigatus, A. ochraceus, A. candidus, Alternaria and Rhizopus* from the seeds of cinnamon, fennel, black pepper and cumin, all of which are commonly used in drug industry. *A. flavus* and *A. niger* were the most frequent *Aspergillus* species yielded in all examined medicinal plant samples in this investigation (71.56% and 77.06% respectively) (Table 3). This was in accordance with the results of Roy and

Chourasia 1990 and Aziz *et al.*, 1998 who stated that these two types of fungi were the main contaminant of different herbal drug samples. Tilio and peppermint had the highest fungal load while fennel had the lowest count (Table 2), this may be due to the presence of certain types of volatile oils in fennel which inhibit the fungal growth and also due to bad handling and storage of tilio and peppermint which enhance the growth of contaminated fungi.

Although the results in Tables 2, 3 ,4 and 5 show the presence of mycotoxins producing moulds in medicinal plants and spices, data in Table 6 indicate that only one mixed spices sample was found to be contaminated with aflatoxin B_1 and G_2 with a level of 3.78 and 7.92 ppb, respectively and no mycotoxins were detected in the rest of the examined samples. This result indicates that medicinal plants are not ideal substrate for mycotoxins formation due to their essential oils which has an inhibitory effect against mycotoxins production. This agrees with Abou-Arab *et al.*, 1999 who failed to detect mycotoxins in medicinal plants and spices samples. Also, Abdel Hamid et al., (1985) found that medical herbs and analogous as well as spices inhibited Aflatoxins and Ochratoxin A production, while some samples were positive for citrinin and/or zearalenone (for the presence of *Penicillium* spp. and *Fusarium* spp.).

Table (2): Average number of total fungal count in the examined samples:

Type of examined sample	Number of examined samples	rebmuN egaravA (cfu)
Anise	9	$30x10^2$
Black pepper	9	$16x10^2$
Caraway	9	$14x10^2$
chamomil	6	$49x10^3$
Cinamon	9	$23x10^2$
Cumin	9	$27x10^2$
Fennel	9	29x10
Ginger	9	$83x10^2$
Mixed spices	9	$27x10^3$
Thyme	9	$11x10^3$
Peppermint	9	$10x10^4$
Rosemary	6	$50x10^2$
Tilio	8	$13x10^5$

Cfu = Colony forming unit

Eppley (1968) found that, mycotoxin producing moulds are quite ubiquitous and frequently contaminate food and agricultural commodities. However, the presence of toxigenic moulds in food does not automatically mean the presence of mycotoxins and vice versa. Several researchers reported that, no Aflatoxins were present in different crude herbal drugs even though these samples were highly contaminated with *Aspergillus* spp. (Abou-Arab *et al.*, 1999). On the other hand, Salem and Slim (1994) recorded low concentrations of Aflatoxins in few samples of herbs and medicinal plants.

Table (3): Average number and percentage of isolated species from 110 samples:

Species	No. of positive samples	% of positive samples
Alternaria alternata	13	11.82
Asp. candidus	9	8.18
Asp. flavus	78	70.91
Asp. fumigatus	7	6.36
Asp. niger	84	76.36
Asp. ochraceus	21	19.09
Asp. oryza	11	10.00
Asp. parasiticus	1	0.91
Asp. terrus	2	1.82
Asp. versicolor	4	3.64
Asp. wentii	1	0.91
Byssochlamys nivae	2	1.82
Chrysonilia sitophila	1	0.91
Cladosporum sphaerospermum	15	13.64
Cladosporum cladosporoids	1	0.91
Emericella nidulans	5	4.55
Eurotium amesteolodami	3	2.73
Eurotium chevalieri	2	1.82
Eurotium herbariorum	6	5.45
Fus. avenaceum	1	0.91
Fus. oxysporum	2	1.82
Fus. solani	2	1.82
Fus. sporotrichiodis	1	0.91
Fus. subglutinans	1	0.91
Giotrichum candidum	1	0.91
Moniliella stolk	2	1.82
Mucor circinelloides	1	0.91
Mucor hiemalis	4	3.64
Mucor plumbeus	10	9.09
Mucor racemosus	14	12.73
Pen. brevicompactum	5	4.55
Pen. camemberti	3	2.73
Pen. citrinum	1	0.91
Pen. chrysogenum	5	4.55
Pen. echinulatum	4	3.64
Pen. glabrum	1	0.91
Pen. nalgiovense	3	2.73
Pen. verrucosum	60	54.55
Rhizopus oryza	47	42.73
Syncephalastrum racemosum	1	0.91
Trichoderma harzianum	2	1.82

Table (4): Percentage of samples (medicinal plants) contaminated with different fungal species:

Species	An.	Car.	Cham.	Cinn	Pepp	Tilio
Alternaria alternata	33 33	44 44	16 67	-	11.11	-
A candidus	-	22.22	-	-	-	16 67
A flavus	66 67	77.78	83 33	22 22	44 44	75 00
A fumigatus	-	-	-	66.67	-	-
A. niger	77.78	88.89	66.67	33.33	88 89	75 00
A. ochraceus	33 33	11 11	33 33	-	-	-
A. oryza	-	11.11	33.33	11.11	11.11	25.00
A. parasiticus	-	-	-	-	-	-
A terrus	11.11	-	16.67	-	-	-
A versicolor	-	11.11	16 67	-	-	-
A. wentii	11.11	-	-	-	-	-
Byssochlamys nivae	11.11	-	-	-	-	-
Chrysonilia sitophila	-	-	-	-	-	-
Cladosporum sphaerospermum	33.33	-	-	-	11.11	12.50
Cladosporum cladosporoids	-	11 11	-	-	-	-
Emericella nidulans	-	22.22	16.67	11.11	-	-
Eurotium amesteolodami	11 11	-	-	-	-	-
Eurotium chevalieri	11.11	-	16.67	-	-	-
Eurotium herbariorum	-	-	16.67	-	-	-
F. avenaceum	-	-	-	-	-	-
F. oxysporum	11.11	11.11	-	-	-	-
F solani	11.11	-	-	-	-	-
F. sporotrichiodis	11.11	-	-	-	-	-
F subglutinans	-	-	-	-	-	-
Giotrichum candidum	-	11.11	-	-	-	-
Moniliella stolk	-	-	-	11.11	-	-
Mucor circinelloides	-	-	-	-	11.11	-
Mucor hiemalis	11.11	11.11	-	-	11.11	-
Mucor plumbeus	-	22 22	13.67	-	22.22	16.67
Mucor racemosus	11.11	33.33	-	11 11	-	25 00
P. brevicompactum	-	-	-	-	-	-
P. camemberti	-	11 11	-	-	11.11	-
P. citrinum	-	-	-	-	11.11	-
P chrysogenum	-	-	-	-	11 11	16 67
P. echinulatum	-	-	-	-	-	-
P. glabrum	-	-	-	-	-	-
P. nalgiovense	11 11	-	-	-	11.11	-
P. verrucosum	44.44	55 56	50.00	22.22	55 56	62 50
Rhizopus oryza	44 44	22 22	16 67	44 44	55 56	62 50
Syncephalastrum racemosum	-	-	-	-	-	-
Trichoderma harzianum	-	-	-	-	-	-

An.=Anise / Car. = Carawy / Cham. = Chamomil / Cinn. = Cinnamon / Pepp. = Peppermint / A. = *Aspergillus* / F. = *Fusarium* / P. = *Penicillium*./ - = Not detected

Table (5): Percentage of samples (spices) contaminated with different fungal species:

Species	Bl. p	Cum	Fenn	Gin.	M. sp.	Thyme	R. M.
Alternaria alternata	-	22.22	-	-	22.22	-	-
A. candidus	33.33	11.11	-	11.11	-	-	16.67
A. flavus	77.78	100.00	88.89	66.67	88.89	62.50	83.33
A. fumigatus	-	-	11.11	-	-	-	-
A. niger	88.89	88.89	88.89	55.56	77.78	75.00	100.00
A. ochraceus	44.44	33.33	11.11	33.33	11.11	25.00	-
A. oryza	-	-	-	11.11	-	37.50	-
A. parasiticus	-	-	11.11	-	-	-	-
A. terrus	-	-	-	-	-	-	-
A. versicolor	-	-	-	11.11	-	-	16.67
A. wentii	-	-	-	-	-	-	-
Byssochlamys nivae	-	-	-	-	-	12.50	-
Chrysonilia sitophila	-	-	11.11	-	-	-	-
Cladosporum sphaerospermum	22.22	11.11	-	11.11	22.22	37.50	16.67
Cladosporum cladosporoids	-	-	-	-	-	-	-
Emericella nidulans	-	-	-	11.11	-	-	-
Eurotium amesteolodami	-	-	11.11	-	11.11	-	-
Eurotium chevalieri	-	-	-	-	-	-	-
Eurotium herbariorum	-	11.11	-	11.11	11.11	12.50	16.67
F. avenaceum	-	11.11	-	-	-	-	-
F. oxysporum	-	-	-	-	-	-	-
F. solani	11.11	-	-	-	-	-	-
F. sporotrichiodis	-	-	-	-	-	-	-
F. subglutinans	-	-	11.11	-	-	-	-
Giotrichum candidum	-	-	-	-	-	-	-
Moniliella stolk	-	-	-	-	-	12.50	-
Mucor circinelloides	-	-	-	-	-	-	-
Mucor hiemalis	-	-	-	-	-	12.50	-
Mucor plumbeus	-	-	11.11	11.11	-	-	33.33
Mucor racemosus	-	-	22.22	11.11	11.11	12.5	33.33
P. brevicompactum	11.11	11.11	22.22	-	-	12.50	-
P. camemberti	-	-	-	-	-	-	-
P. citrinum	-	-	-	-	-	-	-
P. chrysogenum	-	11.11	-	11.11	-	-	16.67
P. echinulatum	-	-	11.11	-	11.11	12.50	16.67
P. glabrum	-	-	-	-	-	-	16.67
P. nalgiovense	-	-	-	-	-	12.50	-
P. verrucosum	77.78	66.67	66.67	66.67	44.44	50.00	50.00
Rhizopus oryza	44.44	66.67	22.22	44.44	44.44	37.50	50.00
Syncephalastrum racemosum	11.11	-	-	-	-	-	-
Trichoderma harzianum	-	-	22.22	-	-	-	-

Bl. P= Black pepper / Cum. = Cumin / Fenn. = Fennel / Gin. = Ginger / M. sp. = Mixed Spices / R. M. = Rose Mary

Table (6): Average value of mycotoxins present in medicinal plant and spices samples:

denimaxe to epyT elpmas	Number of examined samples	Number of contaminated samples	erutsioM tnetnoc %	Mycotoxins concentration (ppb)					
				Aflatoxin					Ochratoxin A
				B1	B2	G1	G2	Total	
esinA	9	0	7.58	ND	ND	ND	ND	ND	ND
reppep kcalB	9	0	9.04	ND	ND	ND	ND	ND	ND
yawaraC	9	0	7.41	ND	ND	ND	ND	ND	ND
limomahC	6	0	8.50	ND	ND	ND	ND	ND	ND
nomaniC	9	0	8.74	ND	ND	ND	ND	ND	ND
nimuC	9	0	7.47	ND	ND	ND	ND	ND	ND
lenneF	9	0	7.69	ND	ND	ND	ND	ND	ND
regniG	9	0	8.67	ND	ND	ND	ND	ND	ND
secips dexiM	9	1	8.59	3.78	ND	ND	7.92	11.70	ND
Thyme	9	0	8.70	ND	ND	ND	ND	ND	ND
tnimreppeP	9	0	7.87	ND	ND	ND	ND	ND	ND
Rose Mary	6	0	8.19	ND	ND	ND	ND	ND	ND
oiliT	8	0	8.24	ND	ND	ND	ND	ND	ND

ND = Not Detected.

Table (7) shows the effect of microwave treatment on the mycological quality of some of the tested spices and medicinal plants which are used raw as flavoring substances on or in some foods. It is clear that, the exposure of all examined samples to microwaves at medium frequency for 60 seconds increased the quality of them causing marked decrease of the total fungal count about one log. Also exposure of the tested samples for 75 seconds had the same effect. These results agree with that obtained by Bartner and Lucke (1995) who concluded that, microwave treatment has germ reducing effect on medicinal plants. Emam et al., (1995) stated that, exposure of some spices to microwaves for 40-75 min had the same germ reduction effect on moulds without any loss of the flavoring compounds.

Table (7): Pattern of fungal count (cfu) using microwave treatment of spices:

Time / Type	0 sec	15 sec	30 sec	45 sec	60 sec	75 sec
Black pepper	$28x10^2$	$19x10^2$	$35x10^2$	54x10	18x10	14x10
Cinnamon	$26x10^2$	$53x10^2$	53x10	18x10	17x10	19x10
Cumin	25x10	11x10	13x10	12x10	3x10	5x10
Fennel	30x10	40x10	49x10	34x10	9x10	5x10
Ginger	$62x10^2$	$31x10^2$	$40x10^2$	$12x10^2$	24x10	12x10
Thyme	$46x10^2$	$73x10^2$	$108x10^2$	99x10	65x10	19x10
Peppermint	$44x10^2$	$34x10^2$	$23x10^2$	$12x10^2$	44x10	12x10

Data in Table (8) show the effect of boiling of some types of spices and medicinal plants whose extracts are used for infants nutrition (anise, caraway, peppermint and tilio) or used as traditional hot drinks (cinnamon and ginger). Data indicates that, boiling has a complete eliminating effect on moulds content of anise, caraway and peppermint after boiling for 1 min and after 3 min in case of cinnamon and ginger. The resistant strains belonged to the genera: *Aspergillus* (*niger* and *fumigatus*) and *Penicillium (verrucosum).*

Table (8): Effect of heat treatment (boiling) on fungal content (cfu) of some herbs and spices:

Time / Type	0 (min)	1(min)	2(min)	3(min)	4(min)	5(min)
Anise	$40x10^3$	-ve	-ve	-ve	-ve	-ve
Carawy	$12x10^2$	-ve	-ve	-ve	-ve	-ve
Cinnamon	$59x10^2$	$18x10^2$	$4x10^2$	-ve	-ve	-ve
Ginger	$37x10^2$	16x10	3x10	-ve	-ve	-ve
Peppermint	$55x10^2$	-ve	-ve	-ve	-ve	-ve
Tilio	$64x10^2$	-ve	-ve	-ve	-ve	-ve

-ve = Negative.

Data in Table (9) shows the effect of roasting on the mycological load of cumin and black pepper. It is clear from the data that, roasting for 3 min. markedly decreased the fungal content of the examined samples while using the same treatment for 4 and 5 min. completely eliminated the fungi present at the starting count (zero time). The resistant strains belonged to the genera: *Aspergillus* (*niger, flavus* and *fumigatus*) and *Penicillium (verrucosum).*

Data in Tables (8 and 9) agree with those of Robert *et al.*, 1995 who reported that, the abovementioned mould types have thermoresistant affinity and can survive high temperatures.

Table (9): Effect of heat treatment (roasting) on fungal content (cfu) of some spices:

Time / Type	0 (min)	1(min)	2(min)	3(min)	4(min)	5(min)
Black pepper	$32x10^2$	$21x10^2$	$12x10^2$	14x10	-ve	-ve
Cumin	73x10	31x10	28x10	10x10	-ve	-ve

-ve = Negative

CONCLUSION

Contamination of medicinal plants and spices with pathogenic and mycotoxins producing fungi considered as an alarming health hazard though the mycotoxins content of the examined samples in this study is very low in frequency and in concentration. That is because the reverse health effect of the isolated fungal species and also because of the probability of mycotoxins production especially after storage of contaminated medicinal plants and spices in the highly humid stores present in Egypt which belongs to the tropical characteristics in its environmental conditions. Boiling of herbal plants can destroy all the pathogenic fungi and render it fit for consumption. Microwave and roasting treatments of spices and medicinal plants, which are used raw as flavoring substances on or in some foods, are effective and save methods for decontamination of them. Good Agricultural Practices (GAPs) must be followed to prevent the appearance of such problems which are very hard to manipulate and overcome.

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المخاطر الصحية المرتبطة بالبهارات و الأعشاب و النباتات الطبية فـــى الســوق المصرية

١.الفطريات و السموم الفطرية

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المعمل المركزى للأغذية و الأعلاف- مركز البحوث الزراعية

تم فحص ١١٠ عينة من ٧ أنواع مختلفة من التوابل و هى الفلفل الأسود – الكمون – الشـــمر – الجنزبيل – حصالبان – البهار – الزعتر و ٦ أنواع من النباتات الطبية و هى الكراوية – اليانسون – القرفـة – النعناع – التيليو – البابونج لمعرفة المحتوى الفطرى لهم و أيضا المحتوى من السموم الفطرية .

تم جمع العينات من أماكن مختلفة من أسواق محافظة القاهرة – بجمهورية مصر العربية.

و قد وضحت البيانات أن أكثر محتوى فطرى وجد فى التيليو بينما أقل محتوى فطرى وجد فى الشمر. و قـد كانت الأنواع المعزولة من الفطريات المنتجة للسـموم مثـل *A. flavus* المفـرز للأفلاتوكسـينات و *P. verrucosum* , *A. ochraceus* المفرزة للأوكراتوكسين (أ) ، و قد تم عزلهم بنسـبه ٧١,٥٦ % ، ٥٥,٠٥ % ، ١٩,٢٧ % على التوالى .

تم عزل أصناف أخرى من الفطريات ذات تأثير ممرض على صحة الإنسان ، و خاصـــة عـن طريق الإستنشاق و التى تسبب أمراض الحساسية الشديدة مثل *A. niger* بنسـبة ٧٧,٠٦ %. و قـد وجـد الأفلاتوكسين فى عينة بهار واحدة من العينات المختبرة بتركيز ١١,٧ ميكرو جرام / كجم. بينما لم يوجـد الأوكراتوكسين (أ) فى أى من العينات المختبرة .

و قد أظهرت هذه الدراسة التأثير الإيجابى الفعال لمعالجة بعض العينات تحت الفحص من التوابـل و النباتات الطبية بواسطة الغليان و التحميص و الميكروويف لتحسين الحالة الميكروبية لها.