EVALUATION OF MYCOLOGICAL STATUS AND DETICTION OF ITS TOXINS IN BASTERMA AND LUNCHEON IN ASSUIT CITY

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ABSTRACT

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A total of 60 samples of luncheon and basterma (30 from each) were gathered randomly from different supermarkets in Assuit Govermorate. They analyzed for determinating of the total fungi and yeast count using direct plate method on dichloran ros-bengal agar medium as well as identification of the isolated fungi. Mycotoxins production were detected using Thin Layer Chromatographic technique. The results revealed that total mould count / gm of examined samples of luncheon and basterma were1.86 X 10^2 and 1.29 X 10^2 respectively, The total yeast count / gm was 1.8 X 10^1 in luncheon and 1.1 X10^1 in basterma. Aspergillus was the most prevalent genus contaminating 96.7% and 53.3 % of luncheon and basterma samples respectively and comprising 30.9 % and 23.6% of the total fungi in both types of samples respectively, the predominant species of Aspergillus in luncheon were *A.flavus* (56.7%), *A.Fumigatus* (23.3), *A.oryzae* (20%), and *A.niger* (20%). While those recovered from basterma were *A.Flavus* (10%) *A.niger* (36.7%) and *A.tamari* (6.6%). Penicillum occupied the second prevalent genus, it was encountered in (40%) and (33.3%) of samples of luncheon and basterma respeclively and matching (8.3%) and (13.6%) of total fungi on two types of samples respectively, the predominant species of Penicillum recovered from luncheon were *P.oxalicum* (23.3%), *P.janthinellum* (10%) and *P.glabrum* (6.6%), and those recovered from basterma were P.oxalicum (16.7%), *P.expanus* (10%) and *P.brevicompatum* (6.6%). Fusarium was the third frequent genus Contaminating (23.3%) of both luncheon and basterma and constituting (4.9%) and (7.9%) of total fungi on luncheon and basterma respectively, one spp. of Fusarium could be detected from luncheon, it was *F. verticillioides* (23.3%), and two spp. from basterma (*F.nygamai*6.7%) and (*F.verticillioides*13.3%). The remaining fungi was *Rhizopus* spp. which contaminate13.3 % and 6.7% of luncheon and basterma respectively and comprising 2.9% and 2.1%of the total fungi of two types of samples respectively. In this study 4 types of mycontoxins were isolated from 26.7% of luncheon and from 13.3% of basterma in which Aflaloxin B1, Ochratoxin *A*, *Stregmatocyein* and *Zaeralenone* were detected in 13.3%, 3.3%, 6.7% and 3.3% of luncheon respectively. The public health hazard associated with its consumption are discussed.

تقييم الحاله الفطريه وتحديد مدي افرازها للسموم في البسطرمة واللانشون في مدينه اسيوط

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لقد تم جمع ٦٠ عينة من اللانشون والبسطرمة بواقع ٣٠ عينة من كل نوع جمعت عشوائيا من محلات السوبر ماركت المختلفة بمحافظة اسيوط ، وتم تحليل هذه العينات لمعرفة العدد الكلي للفطريات والخمائر وذلك باستخدام طريقة الزرع علي الوسط الغذائي داي كلوران روز بنجال وكذلك التعرف علي الفطريات المعزولة. ولقد تم معرفة السموم المفـرزة باستخدام طريقة (Thin Layer Chromatographic). أظهرت النتائج ان العدد الكلي للفطريات لكل جرام في كـلا من اللانشون والبسطرمة 1.86×10^2 ، 1.29×10^2 علي التوالي وكان العدد الكلي للخمائر لكل جرام في اللانشون 1.8×10^1 وفي البسطرمة 1.1×10^1 وكان فطر الأسبرجلس هو الأكثر إنتشارا فكانت نسبته 96.7 % ، 53.3% في اللانشون والبسطرمة علي التوالي وكان يمثل 30.9 % ، 23.6 % بالنسبة للعدد الكلي للفطريات المعزولـة مـن نوعي العينات علي التوالي وكانت الأنواع السائدة لهذا الفطر في اللانشون هي أسبرجلس فلافس 56.7 % ، اسبرجلس فيوميجاتس 23.3 % ، أسبرجلس أوريزا 20% وأسبرجلس نيجر 20% بينما الأنواع التي أكتشفت في البسطرمة كانت اسبرجلس فلافس 10% ، اسبرجلس نيجر 36.7% وأسبرجلس تماري 6.6%. ويعتبر فطر البنـسيليم وهـو الثـاني إنتشارا موجود بنسبة 40% ، 33.3% في عينات اللانشون والبسطرمة علي التوالي وكان يمثـل 8.3% ، 13.6% بالنسبة للعدد الكلي للفطريات المعزولة من نوعي العينات علي التوالي وكانت الأنواع السائدة لهذا الفطر في اللانـشون هي بنسيليم أوكزاليكم 23.3% ، بنسيليم جانثينليم 10% وبنسيليم جلاسيريم 6.6% بينما الانواع التـي اكتـشفت فـي البسطرمة كانت بنسيليم أوكزاليكم 16.7% ، بنسيليم إكـسبانيس 10% وبنـسيليم بريفـي كومبـاكتم 6.6 %. فطـر الفيوزيريم هو الثالث إنتشارا حيث كان موجود بنسبة 23.3% في كلا من عينات اللانشون والبسطرمة وكـان يمثـل 4.9% ، 7.9% بالنسبة للعدد الكلي للفطريات المعزولة من اللانشون والبسطرمة علي التوالي. ولقد وجد نوع واحـد من الفيوزيريم في عينات اللانشون وهو فيوزيريم سيلويدس 23.3% 23.3% ونوعان فى عينات البـسطرمة وهمـا فيوزيريم نيجامى 7.6%، فيوزيريم فيرتى سيلويدس 13.3% وكان فطر الريزوبس موجود بنسبة 13.3% ، 6.7% في عينات اللانشون والبسطرمة علي التوالي وهذا يمثل 2.9% ، 2.1% من العدد الكلي للفطريات المعزولـة. فـي هـذه الدراسة تم عزل ٤ أنواع من السموم الفطرية بنسبة 26.7% في اللانشون ، 13.3% في البسطرمة وكانت هذه السموم هي أفلاتوكس ,B ، أوكراتوكس A ، ستريجما توسينين ، زيرالينون بواقع 13.3% ، 3.3% ، 6.7% ، 3.6 % في اللانشون علي التوالي بينما وجدت هذه السموم بنسبه 3.3% لكلا منها في عينات البسطرمة .ولقد تم مناقـشة النتـائج واهمية الفطريات والخمائر التى تم عزلها للحفاظ على الصحة العامة.

Key words: Mycological status, Basterma, Luncheon.

INTRODUCTION

Meat products are the most palatable and fast food meat. They are considered the best alternative for the fresh meat due to their low price, easily preparation and palatability (Frazer and Westhoff, 1988).

Luncheon meat usually consists of finely chopped meat and fat, with or without some added cereal and using,cured with salt and nitrite and heat processed (Ranken, 1984), while basterma was prepared from fresh salted meat coated with spice pasta and stored at room temperature (Refai *et al.*, 2003).

Althrough meat products are available sources of protein but they are also an important potential sources of serious diseases if they contaminated by different moulds which are widely distributed in nature (Mossel, 1982; Foster *et al.*, 1983).

Mycotoxins comprise a structurally diverise family of fungal toxins,many of which have been strongly implicated as chemical progenitors of toxicity in man and animal (Ramos *et al.*, 1996).

Futher more, afltoxins are relatively stable compounds,not destroyed by processing and even be concentrated (Carvajal *et al.,* 2003; Honikel, 2003).

The presence of toxinogenic moulds in a meat product does not automatically mean the presence of mycotoxins, especially if growth has not occurred, but rather that a potential for mycotoxin contamination exists. On the other hand,the absence of toxinogenic moulds doesn't guarantee that the meat products are free of mycotoxins, since the toxins may persist long after the moulds have disappeared (Ismail *et al.,* 1994).

Fungal contamination is considered as one of the important spoilage agent of meat and meat products, occurring during slaughtering of animals,transportation,processing of meat products,and using of contaminated equipment,or other additives and spices (Misra, 1983; Abd el- Rahman, 1987).

However, the spices of mycotoxins in human food my be directly from fungal contamination or indirectly through contamination of feed stuffs consumed by the animal (Hussien *et al.,* 1997).

Mould contamination not only causes deterioration of food and feed but also can adversely affected the healthy of humans and animals since they are capable of producing toxic metabolic known as mycotoxins causing cases of food poisoning, liver cancer in human (Mossel, 1982 and Foster *et al.,* 1983).

Under adversety of moisture, PH, temperature conditions economic losses and various degrees of food decomposition were taken place,they can cause lipolytic and proteolytic spoilage (Besancon *et al.,* 1992; Jakobsen and Narvhus, 1996).

Since fungi influence, the biochemical character and flavour of the product and its appearance is commercially undesirable and often result in down grading of the product (Bouton and Grappin 1995; Beuvier *et al.,* 1997).

However, mould and yeast have no role in mould spoilage or toxin production if the garlic content in the pasta in basterma hs not less 35% from the total content (El-Khateib *et al.,* 1987).

The main objective of this study is to study the inadence of the incidence of mould and yeast in meant products (luncheon and basterma).

MATERIALS and METHODS

Collection of samples:
Sixty samples of luncheon and basterma (30 for each) were collected from different supermarkets in Assiut city. The samples were placed in a sterile plastic bags and transferred to laboratory and kept at 4C until fungal analysis.

Enumeration and isolation of fungi:
The direct plating technique using Dichloran – Ros – Bengal media
(Pitt and Hocking, 1985) was employed for isolation of fungi from luncheon and basterma.

Determination of mycotoxins produced by fungal isolates applied in the flowing steps:

1- Fungal isolates:
Seven days old culture of each isolate on PDA (Potato dextrose agar) slope was used to abtain a spore suspension in 0.2% (v/v) aqueous tween 80 (Smith and Onions, 1983).

2-Cultivation of fungal isolates and extraction of mycoloxins:
According to El-Kady and Moubasher, 1982.

3- Purification of the crude extracts:
The extract was purified by column chromatography, which described by Josefsson and Moller, 1977.

4- Thin-Layer Chromatographic determination of mycotoxins:
For qualitative analysis of mycotoxine, Thin Layer Chromatographic (TLC) technique was applied (AOAC 1975, El-Kady and Moubasher, 1982; Dorner 1998).

5- Statistical analytical results was carried by standard errier of propotion (Z).

RESULTS

Table 1: Incidence of isolated fungi in examined luncheon and basterma samples:

Fungal spp.	Luncheon		Basterma	
	No. of +ve samples	Percentage	No.of+ve samples	Percentage
Aspergillus	29	96.7	16	53.3
A. flavus	17	56.7	3	10
A. fumigatus	7	23.3	-	-
A. oryzae	6	20	-	-
A. niger	6	20	11	36.7
A.Tamarri	-	-	2	6.6
Fusarium	7	23.3	7	23.3
F. verticillioides	7	23.3	4	13.3
A.nygamai	-	-	2	6.7
Penicillium	12	40	10	33.3
P. glabrum	2	6.6	-	-
P. oxalicum	7	23.3	2	6.6
P. janthinellum	3	10	-	-
P.expansum	-	-	3	10
P. brevicompactum	-	-	5	16.7
Rhizopus spp.	4	13.3	2	6.7
Yeast spp.	7	23.3	18	60

Table 2: Total count of isolated fungi in examined luncheon and basterma samples:

Fungal spp.	Luncheon		Basterma		Z
	No. of +ve samples	Percentage	No.of+ve samples	Percentage	
Aspergillus	63	30.9	33	23.6	0.28*
A. flavus	29	14.2	5	3.6	
A. fumigatus	10	4.9	-	-	
A. oryzae	10	4.9	-	-	
A. niger	14	6.9	26	18.6	
A.Tamarri	-	-	2	1.4	
Fusarium	10	4.9	11	7.9	0.12*
F. verticillioides	10	4.9	8	5.7	
A.nygamai	-	-	3	2.1	
Penicillium	17	8.3	19	13.6	0.21*
P. glabrum	3	1.5	-	-	
P. oxalicum	10	4.9	3	2.1	
P. janthinellum	4	1.96	-	-	
P.expansum	-	-	6	4.3	
P. brevicompactum	-	-	10	7.1	
Rhizopus spp.	6	2.9	3	2.1	0.03*
Yeast spp.	18	8.8	11	7.9	0.22*
Total	186		129		

* No significant difference.
Z: standard errier of propotion

Table 3: Detection of mycotoxins produced by fungi isolated from Luncheon and Basterma using (TLC) technique:

Types of samples	No. of +ve isolates	No. of tve isolates producing toxin	Fungal spp.	Detected toxin
Luncheon	17	4	*Aspergillus flavus*	Aflatoxin B_1
Luncheon	7	2	*Aspergillus fumigatus*	Stregmatocystein
Luncheon	6	0.0	*Aspergillus oryzae*	- ve
Luncheon	6	0.0	*Aspergillus niger*	- ve
Luncheon	7	1	*Fusarium verticilliodes*	Zearalenone
Luncheon	2	0.0	*Penicillum glabrum*	- ve
Luncheon	7	1	*Penicillum oxalicam*	Ochratoxin A
Luncheon	3	0.0	*Penicillum janthinellum*	- ve
Luncheon	4	0.0	*Rhizopous* spp.	- ve
Basterma	3	1	*Aspergillus flavus*	Aflatoxin B_1
Basterma	11	0.0	*Aspergillus niger*	- ve
Basterma	2	1	*Aspergillus tamari*	Stregmalocystin
Basterma	2	0.0	*Fusarium nygamai*	- ve
Basterma	4	1	*Fusarium verticillioides*	Zearalenone
Basterma	2	0.0	*Penicillum brevicompatum*	- ve
Basterma	3	0.0	*Penicillum expansum*	- ve
Basterma	5	1	*Penicillum oxalicum*	Ochratoxin A
Basterma	2	0.0	*Rhizopous* spp.	- ve

DISCUSSION

Earlier studies reporting environment as a source of food contaminant moulds (Kure *et al.*, 2001; Mizakova *et al.*, 2002; Battilani *et al.*, 2007; Sorensen *et al.*, 2008). In this study the results revealed that all examined samples (100%) were contaminated with moulds.

Results given in Tables (1&2) revealed that total mould count / gm of examined samples of luncheon and basterma were 1.86 x 10^2 and 1.29 x 10^2 respectively. The count in luncheon samples were lower than that reported by Abdel-Rahman *et al.* (1995) (9.2 x 10^3), Roushdy *et al.* (1996) (1.5 x 10^6), Hussien *et al.* (1997) (2.7 x 10^5), Sayed *et al.* (2000) (2.68 x 10^2); El-Tabiy (2006) (2.4 x 10^3). The higher total mould count / gm of basterma were reported by Abdel-Rahman *et al.* (1995) (1.4 x 10^4), Hussien *et al.* (1997) (9.2 x 10^4) and Refai *et al.* (2003), (the count varied from 10 (2) to 10 (5).

Results in Tables (2) indicated that there was no significance difference in count between luncheon and basterma.

Altough the total mould count of any food article is not indicataive of its safety for consumption yet it is of supreme importance in judging the hygienic condition under which it has been produced, handled and stored (Martin and Lowery, 1992). The variation in quantitative estimation of mould counts might be attributed to improper sanitation during slaugher, preparation, manufacturing, additives specially using spices of low quality or during transportation, storage and marketing of the products (Abobaker, 1986; Refai *et al.*, 1990; Roushdy *et al.*, 1996).

The mould count in both products samples may be attributed to the widespread distribution of mould in nuture. Fungi are normal inhibitant of wool of the animal, also have ability to be adopted at wide range of temperatures (Nasser *et al.*, 1998). The most common fungal genera in both luncheon and

basterma (Tables 1&2) were Aspergillus then Penicillium. This observation was relatively agree with Wu *et al.* (1974); Abdel-Rahman *et al.* (1984); Beuchat (1987); Lotfi *et al.* (1987), Sayed *et al.* (2000); Mohamed and Hussien (2004); Aideia (2005); El-Tabiy (2006), while Roushdy *et al.* (1996) and Hussein *et al.* (1997) reported that penicillium was the common fungal genera followed by Aspergillus in different meat products.

Tables (1& 2) revealed that Aspergillus was the most prevalent genus contaminating 96.7% and 53.3% of luncheon and basterma respectively and comprising 30.9% and 23.6% of the total fungi of the same samples respectively, while Azza *et al.* (1997) detected Aspergillus in 32.6% of luncheon samples and in 31.1% of basterma.

From Table (1, 2) The predominant species of Aspergillus recovered from luncheon samples were *A. flavus* (56.7 %), *A. Fumigatus* (23.3%), *A.oryzae* (20%) and *A. niger* (20%), while species of Aspergillus recovered from samples of basterma were *A. flavus* (10%), *A. niger* (36.7%) and *A. tamari* (6.6%). The results obtained by Hussien *et al.* (1997) that *A. niger* was 12.5 % in luncheon and 10.9% in basterma, while Sayed *et al.* (2000) reported that *A. flavus* was moderately occurred in luncheon.

A.fumigatus has a marginal xerophile nature ranges from 12°c to 55°c Ayerst, (1966), he also reported that *A.niger* is more prevalent in warmer climates in field satuation and stored foods Al-Doory (1980) revealed that Aspergillus spp. were incriminated in pulmonary aspergillosis, skin infection, sinusitis and otitis for food handlers.

Also Tables (1, 2) showed that *Penicillum* occupied the second prevalent genus. It was encountered in 40% and 33.3% of the samples of luncheon and basterma respectively and matching 8.3% and 13.6% of the total fungi on two types of samples respectively, Hussien *et al.* (1997) could detect penicillium in 26.4% of luncheon and in 42.7% of basterma, Dereje *et al.* (2010) indicated that most of the *P. nalgiovense* have the ability to produce toxins on the products and can become potential food safety hazards.

The predominant species of *Penicillum* recovered from luncheon samples were *P.oxalicum* (23.3%), *P.janthinellum* (10%) and *P.glabrum* (6.6%), and those recovered from basterma samples were *P.oxalicum* (16.7%), *P.expanus* (10%) and *P. brevicompactum* (6.6%). Some investigators could detect another spp. of penicillium in luncheon Abdel-Rahman and El-Bassiony, (1984) found *P. verrucosum var cyclopium* in 94.5%, Sayed *et al.* (2000) isolated *P.viridicatum* from 20%.

Penicillosis are diseases induced by pathogenic strains of Penicillium in human involving the upper respiratory tract and lungs, carcinogenic effects are also caused by mycotoxins produced by many Penicillium species (Mossel, 1982).

Fusarium was the third frequent genus contaminating 23.3% of both luncheon and basterma and constituting 4.9% and 7.9% of total fungi on luncheon and basterma respectively, one spp. of *Fusarium* was detected in luncheon samples it was *F. verticillioides* (23.3%), and two spp. were detected in basterma samples, they were *F. nygamai* (6.7%) and *F. verticillioides* (13.3%). (Tables 1&2).

The remaining fungi was *Rhizopus* spp. which contaminat 13.3% and 6.7% of the samples of luncheon and basterma comprising 2.9%and 2.1%of the total fungi, respectively, (Tables 3&4). Most of these fungi had been isolated previously, but with different frequencies from meat products, Hefnawy (1980); Hegazi *et al.* (1992); Zaki *et al.* (1995); Nagat, (1997).

Yeasts derived from fungal analysis of luncheon samples revealed 7(23.3%) which comprised 8.8% in luncheon samples (Table 1) and revealed 18 (60%) in basterma samples which comprised 7.8% of the total fungi (Table 2). While the total yeast/gm in luncheon and basterma were 1.8X10 and 1.1X10 respectively.

The growth of microbes, such as bacteria, yeasts and moulds deteriorate the safety and

quality of food products and cause significant economic loss (Fittenborg *et al.*, 1996; Pitt and Hocking, 1999; Samson *et al.*, 2004), also growth of fungal particles can be facilitated by chains of production processes that each and every process in the chain should be considered to determine where to act (FAO, 2008).

A.flavus is the most important natural source of aflatoxins in the world's food supplies of which are B_1 , B_2 , G_1 and G_2 . The risk of B_1 and B_2 aflatoxins starts when they ingested by a lactating animal and a proportion is hydoxylated to M_1 and M_2 aflatoxin derivitives of lower toxicity but their significant due to the wide spread consumption of mycotoxicated milk by infants (Frobish *et al.*, 1986). Also Aflatoxins produced by *A.flavus* exposed man and animals to acute and chronic toxicity distincted in four forms: liver damage, liver cirrhosis, induction of tumours and teratognic effects (Frisvad and Samson, 1991).

As shown in Table (3) in this study 4 types of mycotoxins were detected of which aflatoxin B_1 was detected in four samples luncheon and one sample of basterma, that 23.5% and 33.3% of isolated *A.flavus* could produce this toxin in both luncheon and basterma samples respectively. AFB1, is highly toxic compound and its occurrence poses a threat to the health of consumers specially young children (Pierides *et al.*, 2000). In addition to aflatoxin Stregmatocyste in toxin was found in two samples of luncheon which produced by 28.5% of isolated *A. fumigatus*, also this toxin was found in one sample of basterma produced by 50% of isolated *A. tamari*.

OchratoxinA was detected in two samples, one in luncheon and the other in basterma in which 14.3% and 20% of *P.oxalicum* could produce this toxin in luncheon and basterma respectively, also zearalenon toxin was detected in one sample of luncheon and one sample of basterma in which 14.3% and 25% of *F.verticillioides* could produce this toxin in luncheon and basterma respectively.

Other species of fungi could not produce mycotoxin.

These data showed that mycotoxin was isolated from 26.7% of luncheon and from 13.3% of basterma in which Aflatoxin B_1, Ochratoxin A, Stregmatocystein and Zaeralenone were detected in 13.3%, 3.3%, 6.7% and 3.3% of luncheon samples respectively and were detected in 3.3% in all samples of basterma. (Ismail and Zaky, 1999) could detect aflatoxin B_1 in 14% of luncheon samples which is nearly simelar to our results.

In conclusion, It could be concluded that luncheon and basterma are liable to be contaminated with several fungal species as they are normal inhibtant of air and adapt themselves at a wide range of environmental conditions. strict hygienic measures must be applied during manufacturing. Application of HACCP system (Hazard Analysis Critical Control Point) along the line of production must be paralled with the end product inspection.

REFERENCES

Abdel-Rahman, H.A.; youssef, H. and Hefanwy, Y. (1995): Mycological quality of meat products in Egypt. Assiut Vet. Med. J. 12: 153.

Abdel-Rahman, H.A. (1987): Mycological Studies on some seected spices with special refrences to aflatoxion producing Aspergillus flavus species. Assiut Vet. Med. J. 19(37): 93-100.

Abdel-Rahman, H.A.; Youssef, H. and Hefanwy, Y. (1984): Mycological quality of meat products in Egypt. Assiut Vet. Med. J., 14(27): 131-134.

Abobaker, M. (1986): Estimation of mould and yeasts in imported frozen meat and chicken. ph. D. Thesis, Fac. Vet. Med. Alex. Univ.

Aiedia, A.M. (1995): Quality investigation into room kept traditional meat products in Egypt. PH. D. Thesis in hygiene and control of meat Fac. Vet. Med. Cairo University.

Al-Doory, Y. (1980): Laboratory Medical Mycology. Lee Febiger Philadelphia Kimpton Publishers, London.

Amal, A. Mohamed and Nemmat, A. Hussein (2004): Proteolytic and lipolytic activity of fungi isolated from luncheon meat and poultry in Assiut City. Assiut Vet. Med. J. Vol. 50: 100-113.

AOAC (1975): Methods of Analysis of the Association Official Analytical Chemists. 12th ed. Horwitz W., Sanzel A. and Reynolds, H. (Eds.). George Banta Comp. Inc. Washington DC, USA 462-482.

Ayerst, G. (1966): The effects of moisture and temperature on growth and spore germination in some Fungi. J. Stored Prod. Res. 5: 669-687.

Azza, A. El-Tabiy (2006): Mycological study on some processed Meat products exposed from sale in markets. Assiut Vet. Med. J. Vol. 52 No. 110:121-131.

Azza, H.; Zeinab, N.; Abd-El-Aziz, A.S. and Tolba, K.S. (1997): Mycological Aspects of cheese and Meat products with their relation to Aflatoxins. Beni-suef Vet. Med. Res. Vol. Vii No.1, January 19: 276–282.

Battilani, P.; Pietri, V.A.; Giormi, P.; Formenti, S.; Bertuzzi, T.; Tescani, T.; Virgili, R. and Koza Kiewicz, Z. (2007): Penicillium population indry – cured ham manufacturing plants J. of Food Protecion 70: 975-980.

Besancon, X.; Smet, C.; Chabalier, C.; Rivemale, M.; Revebal, J.P.; Ratomahenine, R. and Galzy, P. (1992): Study of surface yeast flora of Roquefort cheese, International Journal of food Microbiologu, 17-9-18.

Beuchat, L.R. (1987): Food and Beverage Mycology. 2nd Ed. An Avi Book, published by Van Nostrand, New york.

Beuvier, E.; Berthaud, K.; Cgarra, S.; Dasen, A.; Pochet, S.; Buscihon, S. and Duboz, G. (1997): Ripening and quality of swiss-type cheese made from raw, pasteurized or microfiltered milk. International Diary Journal 7: 311-323.

Bouton, Y. and Grappin, R. (1995): Comarasion de la qualite de fromages a pate pressee cuite fabriques a partir de lait cru ou microfiltre hait 75: 31-44.

Carvajal, M.; Bolanos, A.; Rojo, F. and Mendez, I. (2003): Aflatoxin M_1 in pasteurized and ultra Pasteurized milk with different fat content in Maxico. Journal Food protection. 66: 1885-1892.

Dereje, T.; Asefaa, Cathrine, F.; Kureb, Ragnhild, O.; Gjerdec, Mahmoud, K.; Omerd, Solveig Langsrudb; Truls Nesbakkene and Ida Skaara. (2010): Fungal growth pattern, sources and facrors of mould contamination in a dry – cured meat production Facility. International J. of Food Microbiolog 140: 131-135.

Dorner, J.W. (1998): Chromatographic analysis of mycotoxins. In: Chromatographic analysis of environmental and food toxicants. Shibamoto T. (Ed.), Marcel Dekker Inc. New York. 113.

El-Kady, I.A. and Moubasher, M.H. (1982): Toxigenicity and toxins of stachybotrys isolates from wheat straw samples in Egypt. Exper. Mycol. 6: 25-30.

El-Khateib, T.; Schmidt, U. and Leistner, L. (1987): Microbiological stability of Turkish basterma. Fleishwirlchaft, 67(1), 101-105.

FAO (2008): Risk-based Food inspection manual In. FAO. Rome Filtenborg, O., Frisvad. J.C., Thrane, U., 1996. Mould in food spoilage. International Journalof Food Microbiology 33, 85-102.

Foster, G.M.; Nelson, F.E.; Speck, M.h.; Doetsch, R.N. and Olson, J.C. (1983): Diary Microbiology Ridgview Publ. Co. California.

Filtenborg, O.; Frisvad, J.C. and Thrane, U. (1996): Moulds in food spoilage. International J. of food Microbiology 33: 85-102.

Frazier, W.C. and Westhoff, D.C. (1988): Food Microbiology. 3rd Ed., Mc Graw-Hill Book, New york.

Frisaved, J.C. and Samson, R.A. (1991): Mycotoxins produced by species of Penicillium and Aspergillus occurring in cereals. In cereal Grain: Mycotoxin, Fungi and quality in Drying and storage, ed. J. chelkowski. Amsterdam: Elseveir, pp. 441-476.

Frobish, R.A.; Bradley, B.D.; Wagner, D.D.; Long-Bradley, P.E. and Hairston, H. (1986): Aflatoxin residues in milk of diary cows after ingestion of naturally contaminated grain. J. Food prot . 49: 78-785.

Hefnawy, Y.A.M. (1980): Studies on the sanitary improvement of processed meat (humburger) manufacture in Egypt PH.D. Thesis, Meat Hygiene, Food Hygiene Dept., Fac. Vet. Med. Assiut Univ. Assiut, Egypt.

Hegazi, S.M.; Ferial el-Far; Edreis, A.M. and Aziz, N.H. (1992): Studies of Fungal and aflatoxins contamination of meat, meat products and Food additives. Vet. Med. J.Giza, 40: 31-36.

Honikel, K.O. (2003): Man-made residues and environmental contaminants in meal. The 2nd International Cong. Of Food Hyg. And Human Health. Fac. Vet. Med. Assiut Univ. pp. 54-63.

Hussein, A.; Niaz, Z.; Abd-El-Aziz, A.S. and Tolba, K.S. (1997): Mycological aspects of cheese and meat products with their relation to aflatoxins. Beni-Suef Vet. Med. Res. VII, 1: 276-281.

Ismail, K.; Saad, M. and Abdel-Naser, Z. (1994): Mycotoxin producing potential of some isolated of Aspergillus flavus and Eurotium groups from the meat products, Microbiological Research. 149, 297-307.

Ismail, M.A. and Zaky, Z.M.M. (1999): Evaluation of the Mycological status of luncheon meat with special reference to aflatoxigenic mould and aflatoxhn residues. Mycopathologia 146(3): 147-154.

Jakobsen, M. and Narvhus, J. (1996): Yeasts and their possible beneficial and negative effect on the quality of diary products. International Diary Journal, 6: 755-768.

Josefsson, B.G. and Moller, T.E. (1977): Screening method for the detection of aflatoxins, ochratoxin patulin, strigmatocystin and zearalenone in cereals. J. /assoc. Off. Anal. Chem. 60: 1369-1371.

Kure, C.F.; Wasteson, Y.; Brendehaug, J. and Skaar, I. (2001): Mould contaminants on Jarlsberg and Norvegia cheese blocks from four factories. International J. of Food. Microbiology 70: 21-27.

Leistner, L. and Gorris, L.G. (1995): Food preservation by hurdle technology. Trends food sci. Technol. 6: 41-46.

Lotfi, A.; Abdel-Rahman, H.; Hefnawi, Y. and Youssef, H. (1987): Studies on the mycological status of sausages in upper Egypt. Fleischwirtschaft, 63 (4): 595-596.

Martin, S. and Lowery, B. (1992): The influence of environmental conditions on the mould growth and toxin Mykolikosen. Eink Kuse Einfuhrung. Tierenahrung 11: 22-38.

Misra, N. (1983): New Recors of fungi from the bark of cinnamon in storage. Science and Culture, 49(5): 133-135.

Mizakova, A.; Pipova, M. and Turek, P. (2002): The occurrence of moulds in fermented raw meat products. Czech J. of food Science 20: 89-94.

Mossel, D.A.A. (1982): Microbiology and food 3rd Ed. Univ. of Utrecht the Netherland.

Nagat, A.S. (1997): incidence of mycotoxins and mycotoxin – producing moulds in some Egyptian diary products. 4th Sci. cong., Egyptian Society For cattle diseases 7-9 Dec. p 74-80.

Nasser, Laila, A.; El-shanawy, A.A. and Barakat, A. (1998): Ecological and physiological studies of fingi associated with camel hair. 8th congress Fac. Vol. Med. Assiut University, Egypt, pp. 243-254.

Pierides, M.; Nezami, H.; Peltonen, K.; Salminen, S. and Ahokas, J. (2000): Ability of diary strains of lactic acid bacteria to bind Aflatoxins M_1 in a food model. J. Food Port. 63: 645-650.

Pitt, J.I. and Hocking, A.D. (1985): Fungi and food spoilage 2nd ed. Aspen publisher, Inc, Maryland.

Ramos, A.J.; Gremmesl, J.F. and Hernandez, E. (1996): prevention of toxic effects of mycotoxins by means of non-nutritive adsorbent compounds. J. Food Protection, 59(6): 631-614.

Ranken, M.D. (1984): Meat and meat products. In Food Industries Manual, 21st Ed. Chapter 1, pp.18. Leonard Hill, USA.

Refai, MK.; Niazi, ZM.; Aziz, NH. and Khafaga, NE. (2003): Incidence of aflatoxion B, in the Egyptia meat basterma and control by gamma irradiation. 377: 382.

Refai, M.; Mansour, N.; Naggar, A. and Abel Aziz, A. (1990): Fungalflora in Egyptian modern abattoirs. Vet. Med. J. 38: 588.

Roushdy, S.; Ibrahim, A.; Aldanaf, N.; Hammad, H. and Moustafa, R. (1996): Mycotoxin Residues in meat and meat products. Vet. Med. J. Giza, 44: 181.

Samson, R.A.; Frisvad, J.C. and Hoekstra, E.S. (2004): Introduction to Food and Airborne Fungi. Centraalbureau Voor Schimmelcultures, Utrecht.

Sayed, A.M.; Mahmoud, A.L. and Abd-El-Allaa, A.A. (2000): Mycoflora and natural occurrence of mycotoxins in lives of imported bulls and poultry and some meat products. Assiut Vet. Med. J. 43(86): 188-199.

Smith, D. and Onions, A.H.S. (1983): The preservation and maintenance of living fungi. Kew. U.K., CAB, International Mycological Institute.

Sorensen, L.M.; Jacobsen, T.; Nielsen, P.V.; Frisvad, J.C. and Koch, A.G. (2008): Mycobiota in the processing areas of two different meat products. International J. of Food Microbiology 124: 58-64.

Wu, Q.; Jezkova, A.; Yuan, Z.; Pavlikova, L.; Dohnal, V. and Kuca, K. (2009): Biological degradation of aflatoxins Informa health cure, Durg Metabolism Revrew. Vol 4 No 1: 1-7.