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PROTEOLYTIC AND LIPOLYTIC ACTIVITY OF FUNGI ISOLATED FROM LUNCHEON MEAT AND POULTRY IN ASSIUT CITY

(With 3 Tables)

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النشاط الفطرى المحلل للبروتين والدهون للفطريات المعزولة من لانشون اللحوم والدجاج فى مدينة أسيوط

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لتقييم الحالة الميكولوجية للانشون (الدجاج واللحوم) تم جمع ٤٠ عينة عشوائية من مدينة أسيوط (٢٠ عينة لكل نوع) وقد تم العد باستخدام طريقة الزرع على الوسط الغذائى داى كلوران روز بنجال آجار والتحضين عند درجة٢٨°م لمدة تتراوح من ٥-٧ أيام وقد أظهرت النتائج أن كل العينات المستخدمة كانت عالية التلوث بالفطريات حيث تم التعرف على عدد ٣٥ فصيلة تابعة لــ ١٤ جنس وكان أكثرها شيوعا فصيلة الاسبريجلس نيجر, فلافس وبارازيتكس التابعة لجنس الاسبريجلس ثم تلاها فى الظهور فصيلة البنسليوم كروزوجينم, كلوروفيلم التابع لجنس البنسليوم ثم فصيلة الترناريا اولترناتا و الميوكور سيدبنسيلويدس بينما كان الاسبرجلس فيوميجيتس و ميليس وتمارى والبنسليوم سترينيم أقلها شيوعا. وقد تم اختبار ٥٤ عزلة تابعة لــ ٢٦ فصيلة للتعرف على مقدرتها على افراز انزيمى الليباز والبروتييز وقد أظهرت النتائج أن النسبة كانت ٨١,٥ % , ٧٢,٢% من العترات المستخدمة لها القدرة على إفراز الإنزيمين على التوالى. وقد تمت مناقشة الأهمية الصحية والاقتصادية للفطريات والطرق المتبعة لمنع تلوث المنتج.

SUMMARY

Fourty samples of luncheon meat and poultry (20 samples for each) were collected from different supermarkets at Assiut City for mycological investigation. The plating technique using dichloran ros-bengal agar medium which incubated at 28°C was used for enumeration and isolation of fungi. The results indicated that all samples were highly contaminated with moulds. Some 35 species belonging to 14 genera were isolated. The most frequently encountered fungi were *Aspergillus* *niger, A. flavus, A. parasiticus. Penicillium chrysogenum, P.corylophilum, Alternaria alternata* and *Mucor ciricinelloides. A. fumigatus, A. melleus, A. tamarii, P. citrinum, P.italicum* and *Scopuloriopsis brevicaulis* were less common. A total of 54 isolates, belonging to 26 species were tested for their abilities to produce lipase and protease enzymes. Of these isolates 81.5% and 72.2% could produce lipase and protease enzymes, respectively. The public health significance of isolated fungi was discussed.

Key word:*Proteolytic and lypolytic activity of fungi isolted from luncheon*

INTRODUCTION

Meat and poultry products are valuable sources of protein but they are also an important potential source of serious disease if contaminated by different moulds which widely distributed in nature. These fungi are extremely considered as a major factor in the spoilage of meat products leading to great economic losses and constitute a major public health hazard by production of a wide variety of mycotoxins causing food poisoning and have carcinogenic effect in human (Mossel, 1982 and Foster,*et al,* 1983).

Luncheon may be contaminated by fungi either before and /or during processing, transportation and storage (El-Gendy and Morth, 1980 and Stoloff, 1984). Mould can cause deterioration of meat and meat products through production of proteolytic and lipolytic enzymes leading to discolouration, poor appearance , off-odour and off flavours (Koburger and Marth 1984, Besanco *et al.*,1992 and Jakobsen and Narvhus 1996).

Protease enzyme is produced by keratinolytic and non keratinolytic fungi but most active species were dermatophytes particularly species of Chrysosporium (Abdel-Gawad, 1997).

Lipase enzymes are generally quite stable and may retain activity in food for long periods even at low temperature..(Smith and Alford, 1984).

Many investigations concerned with studying lipase and proteolytic activities of many fungi (Barakat and Abdel-Sater, 1999; Aalbaek *et al.*, 2002; Abbas, *et al.*, 2002; Cabaleiro *et al.*, 2002; Germano *et al.*,2003 and Singh, 2003).

The purpose of this investigation was designed to study

1- The distribution and occurrence of fungi contaminating 40 luncheon samples (20 luncheon meat and 20 luncheon poultry)
2- Screening of the fungal isolates strains for their capabilities for production of protease and lipase enzyme.

MATERIAL and METHODS

-Collection of samples:

Fourty samples of luncheon meat and poultry (20 for each) were collected from different supermarkets in Assiut City. The samples were placed in a sterile plastic bags and transferred to the laboratory and kept at 4°C until fungal analysis.

Enumeration and isolation of fungi:

The direct plating technique (Pitt and Hocking, 1985) was employed for isolation of fungi from luncheon meat and poultry. Twelve pieces of luncheon of each sample (1x1 cm) were put on the surface of three plates of dichloran rose-bengal agar medium as reported by King *et al.*, (1979).

The plates were incubated at 28°C for 7 days and the growing fungi were counted, isolated and calculated per 12 pieces for each sample. Identification of fungi were based on macro and microscopic feature according to Raper and Fennel (1965), Pitt (1979); Domsch *et al.*,(1980); Kozakiewicz (1989); Moubasher (1993); Samson *et al.*,(1995) and Pitt and Hocking (1997).

-Screening for enzyme production:

A total of 54 fungal isolates representing 26 species and 11 genera isolated from luncheon meat and poultry were tested for their ability of producing lipase and protease enzymes.

-Lipase production:

The isolates were inoculated into deep slant of the basal medium as reported by Ullman and Blasins (1974). Positive results were recorded according to Hankin and Anagnostakis (1975). The lypolytic activity indicated by opaque zones surrounding microbial growth consisted of calcium salts of fatty acids.

-Protease production:

Proteolytic activity of selected moulds was detected using the medium reported by Ong and Gaucher (1973). The degree of enzyme activity was referred as weak, medium or high

RESULTS and DISCUSSION

The results revealed that all examined luncheon samples (100%) were contaminated with moulds, where the total count was 373 and 214/240 pieces of luncheon meat and poultry respectively (Table 1). A total of thirty five species belonging to 13 and 10 genera were isolated. The mean, standard deviation, minimum and maximum numbers of isolates of most common fungi from luncheon meat and poultry are presented in Table (2). The most prevalent genera in the two types of luncheon (Table 1) were *Aspergillus* and *Penicillium* followed by Mucor. These observations were not relatively agree with those indicated by Hamdy *et al.,* (1993) and Hassan and Raghab (1996). *Penicillium, Aspergillus* and *Geotrichum* were found to be commonly isolated from different meat products (Abdel-Rahman *et al.,*1984; Roushdy *et al.,*1996; and Hussein *et al.,*1997).

Aspergillus (12 species) was the most prevalent genus contaminating 85% and 100% of the samples of luncheon meat and poultry and comprising 38.5% and 56.9% of the total fungi respectively. Among its species *A.niger, A.parasiticus* and *A.vlavus* were the most common. Other members of Aspergillus could be isolated but in lower frequency such as *A.carbonarius, A.candidus, A.Terrcus* and *A.japanicus* (Table 1). These findings were nearly similar to the results that recorded by several researchers. About 70%-84% of total luncheon samples examined were found contaminated by *Aspergillus flavus* in Assiut (Zohri, 1990; Aziz and Youssef, 1991; Farghaly, 1993; Zaki *et al.,*1995 and Hassan and Ragheb, 1996). Nahed (1999) recorded that 81.09% of luncheon were contaminated with Aspergillus, where 37.16 out of them was *A.niger.*

Penicillum occupied the second prevalent genus. It was encountered in 80 and 70% of the sample matching 23.9% and 18.8% of the total fungi on two types of luncheon respectively (Table 1). These results are in harmony with that recorded by several researchers. Abdel-Rahman and El-Bassiony (1984) detected *Penicillium* spp. especially *P.verrucosum var cyclopium* in luncheon in 94.5%, while Reiss (1986) detected *Penicillum* sp. in meat products, Zohri (1990) detected *Penicillum* of 20 species and 2 species of mucor from luncheon samples. Hassanien (1996) and Roushdy *et al.* (1996) found that Aspergillus, Penicillum were the most common species in luncheon. Ismail and Zaki (1999) found *P.variabile* and *P.janczewskii* in high percentage in luncheon meat. Alternaria (2 species) was the third frequent genus contaminating 35% and 50 % of total samples constituting 5% and 7% of total fungi on luncheon meat and poultry, respectively. Mucor (2 species) was also common and recovered from 50% and 30% of the samples constituting 10.3% and 7.5% of total fungi on the two types of luncheon. *M.circinelloides* was the most common while *M.rascemosus* was less frequent. The remaining fungi were less frequently encountered (Table 1).

Most of these fungi had been isolated previously, but with different frequencies from meat products (Hitokoto *et al.*, 1972; Abdel-Rahman *et al.*,1984; Zdenka and Pepeljnjak, 1986; El-Khateib and Abdel-Rahman 1989; El-Maraghy and Zohri, 1995, 1996; Ismail and Zaki, 1999.

Capabilities of fungi for enzyme production:

A total of 54 isolates, belonging to 26 species were tested for their ability to produce lipase and protease enzymes. Of these isolates 44 and 39 only were able to produce lipase and protease enzymes, respectively (Table 3).

Lipase production:

Of the 44 positive isolates, 15 showed high activity, while 23 revealed moderate lipase activity. The other 6 isolates had weak activity. These isolates belonged to five species, *Alternaria alternata* (1 isolate), *A. flavus* (1), *A. niger* (1), *A. parasiticusi* (2) and *Paecilomyces variotii.*

Protease production:

The protease enzyme was detected by 39 isolates of which 10 were highly producers (*Alternaria alternata,* (1 isolate); *A.chlamydospora,* (1); *Aspergillus alutaceus,*(2); *A.aureolortus,* (1); *Mucor circinelloides,* (2); *Paecilomyces variotii,* (1); *Rhizoctonia solani,* 1 and *Rhizopus* stolonifer, (1). On the other hand, 10 isolates of four species, *Alternaria alternata* (2), *Aspergillus flavus* (4), *A.parasiticus* (3) and *Geotrichum candidum* (1), were moderate producer activity. The remaining 19 isolates showed low activity.

Many researches concerned with the ability of fungi to produce lipase and protease enzymes. Abdel-Rahman and Saad (1989) ; Banwart (1989) found that fungi isolated from meat and meat products e.g. *Penicillium, Mucor, Cladosporium, Fusarium, Aspergillus, Geotrichum, Alternaria* and *Rhizopus* had lipolytic and proteolytic activity.

Megella *et al.* (1990) found that some isolates of *Penicillum chrysogenum, Aspergillus flavus* and other species exhibited high proteolytic activity.

Abdel Sater and Ismail (1993) showed that 72.5% of 69 isolates had the ability to produce caseinase enzyme. They observed that the isolates of *Aspergillus alutaceus, Chastomium globosum, Cladosporium sphaerospermum, Emericella nidulins var lata* and *Penicillum chrysogenum* produced caseinase enzyme in strong degree. Lipase and protease enzymes were produced by several isolates of fungi in variable degrees (Trigueros *et al.*,1995; Vanderzant and Moore, 1995; Yadar *et al.*, 1998; Barakat and Abdel-Sater, 1999; Abbas *et al.*, 2002; Cabaleiro *et al.*, 2002; Papaglanni and Moo-Young, 2002; Aalbaek *et al.*,2002 and Germano *et al.*, 2003).

In conclusions, a large number of moulds species including mycotoxic fungi were isolated from both luncheon meat and poultry, such fungal contamination make the products unpalatable and unsafe for consumption (Munimbazi and Bullerman, 1996).

The results indicated improper plant sanitation and neglected hygienic measures during production packing or storage. Also it was observed that most isolates tested had variable levels of proteolytic and lipolytic activities.

To avoid such contamination, educational programs and training courses should be recommended to the meat handlers and workers. The meat additives should be conditioned and checked periodically for the presence of moulds. Sanitary rules should be adopted and periodical cleaning and disinfecting of transport vehicles and meat cold-stores.

REFERENCES

Aalbaek, T.; Reeslev, M.; Jensen, B.; Eriksen, S. H. (2002): Acid protease and formation of multiple forms of glucoamylase in batch and continuous cultures of *Aspwergillus niger*. Enzyme and Microbiol Technolgy, 30: 410-415.

Abbas, H.; Hiol, A.; Deyris, V.; Comeau, L. (2002): Isolation and characterization of an extracellular lipase from Mucor sp. Strain isolated from palm fruit: Enzyme and Microbiol Technology 31: 986-975.

Abdel-Gawad, K. M. (1997): Mycological and some physiological studies of keratinophilic and other mould associated with sheep wool. Microbiol Res., 152:181-188.

Abd-El-Rahman, A. H. and Saad, S. M. (1989): Studies on the proteolytic activity of some prevalent mould species in relation meat hygiene. Zagazig Vet. J. 17, 2: 228-236.

Abd-El-Rahman, H. A. and El-Bassiony, T. (1984): Psychrotrophic moulds in some food products. First Scientific Congress, Vet. Med. Assiut Univ.

Abdel-Rahman, H.; Yossef, H. and Hefnawey, Y. (1984): Mycological quality of meat products in Egypt. Assiut Vet. Med. J. 12, 24: 153-159.

Abdel-Sater, M. A. and Ismail, M. A. (1993): Ecological and enzymatic studies on fungi associated with Biscuits in Egypt. International Biodeterioration and Biodegradation 31: 277-292.

Aziz, N. H. and Youssef, Y. A. (1991): Occurrence of aflatoxin and aflatoxin-producing mould in fresh and processed meat in Egypt. Food Additives and contaminates. 8 (3): 321-331.

Banwart, G. J. (1989): Basic Food Microbiology 2nd Ed. An Avi book published by Van Nostrand Rein hold New York.

Barakat, A.and Abdel-Sater, M. M. (1999): Preliminary characterization and lipolytic activity of mould associated with raw butter. Bull. Fac. Sci. Assiut Univ. 28 : 109-122.

Besanco, X.; Smet, C.; Chabalier, C. J. R. V. Mal, M. Reverbel, J. P.; Ratomaheniza, R. and Galzy, P. (1992): Study of surface yeast flora of Roquefort cheese. International Journal of Food Microbiology. 17: 9-18.

Cabaleiro, O.R.; Couto, S. R.; Sanroman, A.; Longo, M. A. (2002): Comparison between the protease production ability of ligninolytic fungi cultivated in solid state media. Process Biochemistry :1017-1023.

Domsch, K. H.; Gams, W. and Anderson, T. H. (1980): Compendium of Soil Fungi : London Academic press, 859 pp.

El-Gendy, S.M. and Marth, E. H. (1980): Proteolytic and lipolytic activities of some toxigenic and non toxigenic Aspergilli and Penicillia. J. Food Protect. 43, 5:354-355.

El-Kady, I. A. and Zohri, A. N. (2000): Mycoflora and mycotoxin of hamburger in Egypt. First Symposim on Food Safety October 9-11 Kingdom Saudi Arabi-Ministry of Higher Education. King Faisal Univ.

El-Khateib, T. and Abdel-Rahman, H. A. (1989): Mould and Yeast hazard in frozen ground beef. Assiut Vet. Med. J. 21:123-128.

El-Maraghy, S. M. and Zohri, A. A. (1995): Mycoflora and mycotoxins of corned beef. Qatar Univ. Sci.J. 15 (1): 101-108.

El-Marghy, S. and Zohri, A. N. (1996): Mycroflora and mycotoxins of sausage collected from three Governorates in Egypt. ABHATh-ALYARMOUK (Pure Sci and Eng.) Vol. No. 2 pp. 35-49.

Farghaly, R. M. M. (1993): Occurrence and significance important of toxic Aspergilli in meat and meat products. Ph. D. thesis. Fac. Vet. Med. Suez. Canal Univ. Egypt.

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

Germano, S.; Pandey, A.; Clarice, A.; Osaku, Saul N.; Rocha, Cu O.S. R. Soccd (2003): Characterization and stability of proteases from Penicillum sp. Produced by solid-state fermentation. Enzyme and Microbiol. Technology 32: 246-251.

Hamdy, M. M.; Mansour, Nada, K.; Awad, Hoda, A.A.E. and Biomy, Maha, M. M. (1993): A study on isolated moulds with special reference to *Aspergillus spp.* from surface of fresh and cold stored meat. Vet. Med. J. Giza 41, 2:115-120.

Hankin, I. Anagnostakis, S. L. (1975): The use of solid media for detection of enzyme production by fungi. Mycologia 67:597-607.

Hassan, A. A. and Raghab, R. R. (1996): Identification of some fungi and mycotoxins in sausage. Vet. Med. J. Giza 44, 2A: 215-220.

Hassanien, Fatin, S. (1996): Mycological aspect of some marketed meat products. Zag. Vet. J., 24, 1:60-64.

Hitokoto, H.; Morozuni, S.; Wanke, T. and Zen Yoji, H. (1972): Studies of fungal contamination of food-stuffs in Japan: Fungal flora and incidence of toxin producing fungi in minced meat marketed in Tokyo. Annual Report of Tokyo Metropolitan research laboratory by public health 24:41-46.

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

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

Jakobsen, M. and Narvhus, J. (1996): Yeast and their possible beneicial and negative effects on the quality of dairy products. International Dairy J. 6: 755-768.

King, A. D.; Hocking, A. D. and Pitt, J. I. (1979): Dichloran rose bengal medium for enumeration and isolation of molds from foods. Appl. Environ. Microbiol. 37: 959-964.

Koburger, J. A. and Marth, Ed. (1984): Yeast and Mould in Compendium of Methods for the Microbiological Examination of Food (Speck, M. L. Ed). American Public Health Association. Washington, D.C.

Kozakiewicz, Z. (1989): Aspergillus species on stored products. Mycological papers; 161: 1-188, C.A.B. International Mycological Institute Ferry Lane, Kew, Surrey, UK.

Megalla, S. E.; Nassar, A. Y. Moharram, A. M.; Abdel Gawad, K. M. and Mahmoud, E. A.L. (1990): Some physiological studies on fungi isolated from poultry feed stuffs. J.Basic Microbiol. 30, 3: 165-180.

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

Moubasher, A. H. (1993): Soil fungi in Qatar other Arab Countries. The Scientific and Applied Research centre, University of Qatar, Doha, Qatar, 566 pp.

Munimbazi, C. and Bullerman, L. B. (1996): Moulds and mycotoxin in foods from Burandi. J. Food. Prot. 59:864.

Nahed, M. N. (1999): Mycological status of meat and some meat products. Ph. D. thesis. Meat hygiene Fac. Vet. Med. Assiut Univ.

Ong, P. S. and Gaucher, G. M. (1973): Protease production by thermophilic fungi. Can. J. Microbiol., 19:129-133.

Papagianni, M. and Moo-Young, M. (2002): Protease secretion in gliucoamylase producer *Aspergillus niger* cultures: Fungal morphology and inoculum effects. Process. Biochemistry 37, 1271-1278.

Pitt, J. I. (1979): The genus *Penicillium* and its teleomorphic states *Eupenicillium* and *Talaromyces.* London: Academic Press, 634 pp.

Pitt, J. I. and Hocking, A. D. (1985): Fungi and food spoilage. Pp.413, Sedney, Academic Press.

Pitt, J. I. and Hocking, A. D. (1997): Fungi and food spoilage Balackie Academic and Professional, London, UK 593 pp.

Raper, K. B. and Fennel, D. I. (1965): The genus *Aspergillus* . R. E. Kriger Publishing Company. Huntrngton, NY, USA.

Reiss, J. (1986): Shimmelpilze springer Verlog Brlin, Heidelberg, New York and Tokyo.

Roushdy, S.; Ibrahim, S.; Aldanaf, Hammad, H. and Moustafa, R. (1996): Mycotoxin residues in meat and meat products. Vet. Med. J. Giza, 44 (2): 181-187.

Samson, R. A.; Hockstra, E. S.; Frisvad, J. S. and Flltenborg, O. (1995): Introduction to food-borne fungi (Fourth edition) Centraalburedu voor schimmelcultures Baarn Delft.

Singh, C. J. (2003): Optimization of an extracellular protease of chrysosporium keratinophilum and its potential in bioremediation of keratinic wastes: Mycopathologia 156 (3): 151-156.

Smith, J. L. and Alford, J. A. (1984): Lipolytic microorganisms in compendium of methods for the microbiological examination of foods. American Publ. Health Association, Washington, D.C.

Stoidff, L. (1984): Toxigenic fungi in Compendium of methods for the Microbiological examination of foods (Speck, H. L. ed.). American Public Health Association. Washington D.C.

Trigueros, G.; Garcia, M. L.; Casas, C.; Ordonez, J. A. and Selegas, M. D. (1995): Proteolytic and lypolytic activities of mould strain isolated from spanish dry fermented sausages. Zeitschrift. Fur-Lebensmittel Untersuchung and Forschung 201, 3: 298-302.

Ullman, V. and Blasins, G. (1974): A sample medium for the detection of different lipolytic activity of microorganisms. Zentrabl. Bakteriol. Hyg. II Abt. A., 229: 264-267.

Vanderzant, W. C. and Moore (1995): The influence of certain factors on the bacterial counts and proteolytic activities of several psychrophilic organisms. J. Dairy Sci., 38:743.

Yadar, R. R.; Saxena, R. K.; Gupta, R. and Davidson, S. (1998): Lipase production by Aspergillus and Pencillum species: Folia Microbiol. 43 (4) 373-378.

Zaki, Z. M.; Ismail, M. A. and Refai, R. S. (1995): Aspergillus flavus and aflatoxins residue in luncheon meat. Assiut Vet. Med. J. 33,66:144-147.

Zedenka, C. and Pepeljnjak,S. (1986): Distribution and finding of toxigenic kinds of mould in smoked meat products. Vet. Arh. 56: 75-82.

Zohri, A. A. (1990): Mycoflora and mycotoxins of some meat products. Ph. D. Thesis. Botany Dept. Fac. Sci. Assiut Univ.

Table 1: Fungi isolated from 40 luncheon samples meat and poultry (20 samples each).

Genera & species	Luncheon meat			Luncheon poultry		
	TC	TC %	NCI &OR	TC	TC%	NIC&OR
Alternaria	19	5.1	7 M	15	7	10 M
A. Alternata **(Fries) Keissier**	18	4.8	7 M	15	7	10 M
A.chlamydospora **Muchacca**	1	0.3	1 L	-	-	-
Aspergillus	142	38.5	17 H	122	56.9	20 H
A.alutaceus **Berkely & Curtis**	2	0.54	2 L	1	0.5	1 L
A.aureolatus **Munt. (Vet & Bata)**	1	0.3	1 L	6	2.8	3 L
A.candidus	4	1.1	4 L	-	-	-
A.carbonarius **Bainier & Thom**	16	4.3	5 L	-	-	-
A.flavus **Link**	41	11	12 H	17	17.8	11 H
A.fumigatus **Fresenius**	1	0.3	1 L	-	-	-
A.japanicus **Saito**	-	-	-	6	2.8	3 L
A.melleus **Yukawa**	2	0.54	1 L	-	-	-
A.niger **Van Tieghem**	53	14.5	14 H	66	30.8	17 H
A.parasiticus **Speare**	20	5.4	9 M	20	9.4	9 M
A.tamarii **Kita**	2	0.54	1 L	-	-	-
A.terreus **Thom**	-	-	-	6	2.8	4 L
Cladosporium cladesporiodes **(Fresenius) de Vries**	13	3.5	4 L	-	-	-
Cunninghamella elegans **Lendner**	8	2.2	2 L	3	1.4	2 L
Drchslera spicifera **Nelson**	-	-	-	4	1.9	1 L
Emericella nidulans **(Eidam) Vuillemin**	2	0.54	1 L	4	1.9	1 L
Epicoccun nigrum **Link**	2	0.54	2 L	-	-	-
Fusarium solani **(Martius) Saccardo**	3	0.8	1 L	4	1.9	3 L
Geotrichum candidum **Link**	27	7.3	4 L	-	-	-
Mucor	38	13.25	11 H	16	7.5	6 M
Mucor circinelloid **Van Tieghem**	31	10.25	10 M	16	7.5	6 M
M.racemosus **Fresenius**	7	3	1 L	-	-	-

Table 1:

Genera & species	Luncheon meat			Luncheon poultry		
	TC	TC %	NCT&OR	TC	TC%	NIT&OR
Penicillum	88	23.9	16 H	40	18.8	14 H
P. brevicompactum **Dierckx**	2	0.54	1 L	24	11.2	8 M
P. chrysogenum **Thom**	50	13.4	11 H	-	-	-
P. citrinum **Thom**	1	0.3	1 L	-	-	-
P. corylophilum **Dierckx**	20	5.4	4 L	7	3.3	4 L
P. duclauxii **Delacroix**	-	-	-	4	1.9	3 L
P. islandicum **Sopp**	3	0.8	1 L	-	-	-
P. itali **Wehmer**	1	0.54	1 L	-	-	-
P. variable **Sopp**	-	-	-	4	1.9	2 L
Pen. Sp.	11	2.96	1 L	1	0.5	1 L
Rhizoctonia solani **Kühn**	11	2.96	4 L	5	2.3	4 L
Rhizopus stolonifer **(Ehrenberg) Vuillemin**	19	5.1	6 M	1	0.5	1 L
Scopulariopsis breviculis **Saccardo (Bainier)**	1	0.3	1 L	-	-	-
Total count	373			214		
No. of genera 14	13			10		
No of species 35	30			20		

TC = Total count calculated per 240 segments

TC% = Total count percentage calculated per total count of fungi

NCI = Number of cases of isolation out of 20 samples examined

OR = Occurrence Remoras

L = Low 1-5 cases

M = Moderate 6-10 cases

H = High 11-20 cases

Table (2): Minimum (Min), maximum (Max), mean and standard deviation (SD) of the common fungi from both luncheon meat and poultry.

Species	Luncheon meat				Luncheon poultry			
	Min.	Max	Mean	SD	Min	Max	Mean	SD
Alternaria alternata	00.	6.00	0.90	1.8561	00.	3.00	0.75	0.966
Aspergillus	00.	20.00	7.10	5.9463	2.00	14.00	6.10	3.3701
A. flavus	00.	12.00	2.05	3.1368	00.	4.00	0.85	1.0894
A.niger	00.	6.00	1.70	1.8382	00.	9.00	3.30	2.5152
A.parasiticus	00.	6.00	1.00	1.5218	00.	5.00	1.00	1.5560
M.circinelloides	00.	9.00	1.85	2.6213	00.	6.00	0.80	1.5424
Penicillium	00.	19.00	4.40	4.8384	00.	6.00	2.00	2.0520
P.corylophilum	00.	9.00	1.00	2.4279	00.	3.00	0.35	0.8127
Total	4.00	41.00	20.95	9.3159	4.00	34.00	15.15	7.7478

Table 3: Capabilities of producing lipase & or protease by common fungal species isolated from luncheon meat and poultry.

Organisms	NIT	Lipase				Protease			
		P	W	M	H	P	W	M	H
Alternaria alternata	4	4	1	1	2	4	1	2	1
A.chlamydospora	1	-	-	-	-	-	-	-	1
Aspergillus alutaceus	2	2	-	-	2	2	-	-	2
A.aureolatas	1	1	-	1	-	1	-	-	1
A.carbonorius	1	1	-	1	-	-	-	-	-
A.flavus	6	5	1	4	-	6	2	4	-
A.fumigatus	1	1	-	-	1	-	-	-	-
A.japanicus	3	1	-	1	-	2	2	-	-
A.niger	3	3	1	2	-	3	3	-	-
A.parasiticus	5	4	2	2	-	5	2	3	-
A.terreus	2	2	-	2	-	1	1	-	-
Cunnigh.elegans	1	1	-	-	1	-	-	-	-
Emericella nidul	2	1	-	-	1	1	1	-	-
Drechster aspicif	1	1	-	1	-	-	-	-	-
Geotrichum cand	2	1	-	1	-	2	1	1	-
Mucor circinelloid	3	3	-	2	1	3	1	-	2
Pen. Variotii	1	1	1	-	-	1	-	-	1
Pen.brevicomp	3	3	-	1	2	-	-	-	-
P.chrysogen	2	2	-	1	1	1	1	-	-
P.citrinum	1	1	-	-	1	-	-	-	-
P.coryloph	2	2	-	1	1	2	2	-	-
P.duclwxii	1	-	-	-	-	-	-	-	-
P.island	1	-	-	-	-	-	-	-	-
P.variabile	1	1	-	-	1	-	-	-	-
Rhizoct.soloni	2	1	-	1	-	2	1	-	-
Rhizop. Stolon	2	2	-	1	1	2	1	-	1
Total isolates	**54**	**44**	**6**	**23**	**15**	**39**	**19**	**10**	**10**
% Total isolates		**81.5**	**11.1**	**42.6**	**27.8**	**72.2**	**35.1**	**18.5**	**18.5**

NIT = Number of the isolates tested

P = positive isolates

W = weak producer

M = Moderate producer

H = High producer