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Studies of mould contaminations of meat in slaughter houses, butcher's shops and in cold stores

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In our laboratory, it is our purpose to study the foodborne fungi which contaminate certain human and animal foodstuffs. REFAI, ELMOSSALAMI and LOOT (1967) found that Aspergillus niger and Penicillium funiculosum have been incriminated in the contamination of 6480 kg of imported smoked herring, most of which were condemned for their unfittness for human consumption. In 1968, REFAI & SADEK found that one species of Penicillium was the predominant mould in most of 23 different foodstuffs examined. From the feeds of poultry, REFAI and EL-BAHAY (1968) have isolated Rhizopus, Aspergillus, Penicillium, Mucor and Paecilomyces species.

The present survey was adopted to study the precise nature of fungus contamination of meat during the technical steps towards its consumption. These steps include slaughtering and its subsequent measures taken in the slaughter houses; transportation of meat to the butcher's shops and preservation of meat in shops and in cold stores before selling or distribution.

Materials and methods

5622 specimens were obtained by means of swabs rubbed on the surfaces of beef, buffalo, camel, mutton, goat and poultry meat in different slaughter houses, in butcher's shops and in cold stores. Swab specimens were also obtained from the surroundings including walls, floors, cutting trays, butcher's clothes and refrigerators in the afromentioned three premises for examination. Water contaminants and airborne mould flora isolated by the elaborate procedures from these premises were not ignored. Swabs from different means of meat transportation as refrigerated cars, motorcycles and wooden cars were also examined for contaminating moulds. The swabs were rubbed on the surface of Sabouraud agar plates, which were then incubated at room temperature. The isolated fungi were identified according to their cultural and microscopical appearances.

Results

3127 mould strains were isolated from 5622 swab specimens taken from meat surfaces, walls and floors in slaughter houses, butcher's shops and cold stores as well as from different means of transportation. Some of these strains were also isolated from air and water in these premises.

About 55 % of the moulds were isolated from meat surfaces. However high percentages of moulds were recorded from the surroundings especially walls, floors and air. (see **table 1).**

The results presented in **table 2** show the types of moulds isolated and their numbers. At the top lies Aspergillus niger, (1313) then Penicillium (841) followed by Mucor (254), Rhizopus (147), Aspergillus fumigatus (125), Streptomyces (113), Pullularia (77), Cephalosporium (71), Alternaria (66), Scopulariopsis (53), Aspergillus flavus (50) and Botrytis (47).

It is clear that Aspergillus niger and Penicillium species were the predominant fungi in all samples. Aspergillus niger alone constituted about 40 % of the isolated fungi, most frequently isolated from the atmosphere of all premises examined, transportation means

Table 1: No. of swab specimens examined and moulds isolated from meat and surroundings

Premises	Meat		Surroundings		Total	
	no. of samples examined	no. of moulds isolated	no. of samples examined	no. of moulds isolated	samples	moulds
slaughter houses	2500	1184	800	529	3300	1713
butcher's shops	287	134	105	70	392	204
cold stores	830	430	340	230	1170	660
transport means	—	—	760	550	760	550
Total	3617	1748	2005	1379	5622	3127

Table 2: No. and types of moulds isolated from meat and surroundings

Moulds	No. of strains isolated from		Total
	meat	surrounding	
Aspergillus niger	680	633	1313
A. fumigatus	68	57	125
A. flavus	32	18	50
Penicillium	467	374	841
Mucor	183	71	254
Rhizopus	70	47	117
Alternaria	46	20	66
Cephalosporium	35	36	71
Scopulariopsis	26	27	53
Botrytis	34	13	47
Pullularia	37	40	77
Streptomyces	70	43	113
Total	1748	1379	3127

and clothes of the butchers, and rarely isolated from water samples. It approximately represented half of the isolated fungi from shops, cold stores and means of transportation and about ⅓ of the isolated fungi from slaughter houses (**table 3**).

The Penicillium species constituted about 28 % of all moulds isolated. They were frequently found in slaughter houses, in cold stores and in transportation means, more predominant in the atmosphere and surroundings than on meat surfaces.

In cold stores only a limited number of moulds were found both on meat and on the surroundings, they mostly comprise Aspergillus niger and Penicillium species and a few number of Rhizopus, Pullularia and Streptomyces. Mucor was isolated only from meat; Streptomyces from air and poultry meat; Rhizopus from floors and mutton meat; Alternaria only from poultry meat and Botrytis only from beef. Aspergillus fumigatus, A. flavus, Cephalosporium and Scopulariopsis were not met with in cold stores; neither on meat surfaces nor in the surroundings.

Table 3: No. and types of moulds from different places

Samples	no and types of moulds												Total
	Asp. niger	Asp. fumigatus	Asp. flavus	Penicillium	Mucor	Rhizopus	Alternaria	Cephalosporium	Scopulariopsis	Botrytis	Pullularia	Streptomyces	
Slaughter houses													
1. Meat	410	66	31	324	128	45	32	31	24	22	16	55	1184
2. Surroundings	193	26	14	151	47	17	16	15	12	10	6	22	529
Butchers' shop													
1. Meat	60	2	1	33	15	5	4	4	2	2	1	5	134
2. Surroundings	42	3	1	15	3	1	1	1	1	—	—	2	70
Cold stores													
1. Meat	210	—	—	110	40	20	10	—	—	10	20	10	430
2. Surroundings	120	—	—	80	—	10	—	—	—	—	10	10	230
Transport means	278	28	3	128	21	19	3	20	14	3	24	9	550
Total	1313	125	50	841	254	117	66	71	53	47	77	113	3127

Table 4: No. and types of moulds isolated from meat

Meat	no of samples examined	no of moulds isolated	moulds											
			Asp. niger	Asp. fumigatus	Asp. flavus	Penicillium	Mucor	Rhizopus	Alternaria	Cephalosporium	Scopulariopsis	Botrytis	Pullularia	Streptomyces
Beef	980	590	240	26	13	162	57	18	16	14	10	10	7	17
Mutton	790	381	125	12	6	103	49	27	6	7	—	17	11	18
Buffalo	743	393	145	21	8	96	47	22	10	7	7	7	4	19
Camel	598	178	58	7	3	55	18	2	4	5	8	—	4	14
Goat	186	96	52	2	2	21	2	1	—	2	1	—	11	2
Poultry	320	110	60	—	—	30	10	—	10	—	—	—	—	—
Total	3617	1748	680	68	32	467	183	70	46	35	26	34	37	70

From **table 4**, it is clearly shown that moulds were equally distributed on the surfaces of different types of meat. However, Aspergillus fumigatus, A. flavus, Rhizopus, Cephalosporium, Scopulariopsis, Botrytis, Pullularia and Streptomyces were not found at all on poultry meat. It must be noted that the examined poultry meat were only present in cold stores, where many of the mentioned fungi were not met with. From the results in the same table, it is quite apparent that Scopulariopsis was not found on mutton meat. Botrytis was not isolated from camel or goat meat.

In **table 5**, it is obvious that moulds were found in a high percentage in the surroundings especially in air, on walls and on floors, these were equal in distribution in slaughter houses and cold stores but slightly less in shops and more frequently distributed in transportation means. On the contrary, water played no role in the contamination of meat. Only 8 strains were isolated from 201 water samples.

Table 5: No. and types of moulds isolated from slaughter houses, shops, cold stores, and transport means

Source of samples	no of moulds isolated	no of samples examined	moulds: Asp. niger	Asp. fumigatus	Asp. flavus	Penicillium	Mucor	Rhizopus	Alternaria	Cephalosporium	Scopulariopsis	Botrytis	Pullularia	Streptomyces
1. Air	242	205	80	9	6	57	8	5	4	4	2	2	12	16
2. Water	201	8	1	1	—	2	—	—	—	—	2	2	—	—
3. Walls	249	192	85	5	5	59	15	5	2	6	4	1	2	3
4. Floors	250	187	84	6	2	59	6	13	4	3	2	2	—	6
5. Utensils	67	41	25	2	—	8	2	—	1	1	—	—	—	2
6. Chothes of the butchers	236	196	80	6	2	61	19	5	6	2	3	3	2	7
7. Transport means	760	550	278	28	3	128	21	19	3	20	14	3	24	9
Total	2005	1379	633	57	18	374	71	47	20	36	27	13	40	43

Discussion and conclusion

From the results obtained, it is clear that air, walls and floors of the slaughter houses are the sources of contamination of meat. This happens through exposure of meat to the open air in slaughter houses. In butcher's shops, it is a custome to hange the excellent meat outside the shop to be attractive. Although meat are covered by clean cloth, they are exposed to the air during saling. Also during handling of meat in slaughter houses by contact to the walls and floors. More fungal spores fall on the surface of meat during transportation to the shops or to the cold stores besides fungi already found in the cars themselves.

In shops, some moulds are removed mechanically via washing with water and some others are again added by exposure to air. In cold stores, the contaminants obey to a selective pattern; those which are able to grow at a low temperature will flourish or at least become viable and germinate when the conditions becomes favourable, and others cannot withstand low temperature and loose their viability.

Summary

3127 mould strains were isolated from 5622 swab specimens taken from meat surfaces, walls and floors in slaughter houses, butcher's shops and cold stores as well as from different means of transportation. Some of these strains were also isolated from air and water in these premises. At the top of the isolated fungi lies Aspergillus niger (1313), then Penicillium species (841), followed by Mucor (254), Rhizopus (147), A. fumigatus (125), Streptomyces (113), Pullularia (77), Cephalosporium (71), Alternaria (66), Scopulariopsis (53), A. flavus (50) and Botrytis (47).

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