FUNGI IN OVINE CARCASSES ENVIRONMENT IN TWO SLAUGHTERHOUSES IN NORTH OF ALGERIA

Dahmani **Asma***[1], Aissi **Miriem**[2], Harhoura **Khaled**[2], Zenia **Safia**[2]
[1]University of Blida1, Institute of Veterinary Sciences, Blida, Algeria.
[2]Laboratory Research «Animal Health and Production», Superior National Veterinary School - B.P. 165, Issad Abbas, El Alia. Algiers, Algeria.
*E-mail address of corresponding author: asmavet42@yahoo.fr

Abstract
Background: *Meat contamination is a major public health problem and cause of lower economic productivity. A large number of yeast and mold have been isolated on the surface of carcasses; the slaughterhouse is a major place for this contamination.*
Aim: *To evaluate the prevalence and the occurrence of these fungi in 4 anatomical sites (neck, shoulder, abdomen and thigh) of ovine carcasses slaughtered in two slaughterhouses in the north of Algeria and to assess some risk factors: slaughter staff (left and right hand), slaughter equipment (knives, axes and rifles), infrastructure (floor, walls, faucets, hooks and air).*
Methods: *280 swabs were used (160 samples from 40 ovine carcasses, 16 swabs from slaughter staff, 48 swabs from slaughter equipment and 56 from infrastructure). Isolated yeasts and mold were identified using microscopic characterization.*
Results: *Showed a high prevalence (67.14%) of fungi with a predominance of yeasts, and revealed the presence of 10 fungal genera, represented by 20 species (14 species of yeast and 6 species of mold) with a strong frequency of Candida (39.89%) for yeast and Penicillin (46.60 %) for mold. A total of 17 species were collected from ovine carcasses while 19 species were found in their surroundings. Rhodotorula, Penicillium, Cladosporium were the genus isolated from slaughter staff, slaughter equipment, infrastructure and from ovine carcasses.*
Conclusion: *These results indicate that the surroundings may constitute significant sources of fungi and suggest that the slaughterhouse constitutes one of the major critical points on the hygienic quality of meat.*

Keywords: carcasses, slaughterhouse, yeasts, mold, contamination.

Received: 14.03.2020 Reviewed: 14.05.2020 Accepted: 22.05.2020

1. INTRODUCTION

The external contamination of meat constitutes a constant problem in most developing countries in the abattoir itself where there are many of potential sources of infection by microorganisms (Lawrie, 1979). The level of surface contamination of carcasses varies depending on the conditions of hygiene and the procedure of slaughter (Widders *et al.,* 1995). During the slaughtering process, the main sources of contamination are the slaughtered animals themselves (leather and dung), equipment (machines and cuttings tools), the work environment (building, air, dust, water), and the staff (workers' hands and lack of personnel hygiene) (Yassien, 1992; Bell & Hathaway, 1996; Bacon *et al.*, 2000). Most of the cases are caused by bacteria, but some are caused by fungi. Fungi are ubiquitous in nature. They commonly contaminate meat and meat products, they are responsible for a major protein of food deterioration in developing countries. Their presence in meat and meat products are regarded as an indicator of the hygienic conditions under which these products are produced and stored (Gracy & Collins, 1992 ; Ismail *et al.,* 1995). Mould may cause spoilage or render the meat hazardous by the production of mycotoxins (Ismail *et al.,* 1995) which may lead to haemorrhages with hepatotoxic, nephrotoxic, neurotoxic, dermatotoxic, carcinogenic or immunosuppression (Cheo, 1991; Hassan *et al.,* 2004), food poisoning and/or spoilage including stickness, whiskers, black spots, green spots or patches, fat decomposition and offensive odour (Hassan *et al.,* 2013). The air,

water, walls and floors of abattoirs are considered the main sources of the fungi which contaminate carcasses (Mansour, 1986; Yassien *et al.*, 1989; Refai *et al.*, 1993; Ismail *et al.*, 1995). In fact, *Aspergillus, Penicillium*, have been isolated frequently from the air and floors of slaughterhouses (Yassien *et al.*, 1989; Refai *et al.*, 1993). Also, *Candida* is the most common yeast in fresh meat (Jay *et al.*, 2005). In Algeria, no studies have been done on the prevalence of the fungal contamination of ovine carcasses in slaughterhouse as well as on various factors favoring their appearance and development. So the aim of the study is to determine the prevalence of this contamination and to evaluate the occurrence of these fungi on ovine carcasses and their surroundings in order to identify the sources of this contamination in two slaughterhouses in north of Algeria.

2. MATERIALS AND METHODS

Sampling (collection of swab samples)

A total of 280 samples were collected from two slaughterhouses in the north of Algeria. That is 160 samples taken from 40 sheep carcasses randomly chosen immediately after evisceration in 4 anatomical sites :neck, shoulder, abdomen and thigh, 16 swabs were obtained from the personnel hands, 48 swabs were collected on slaughter equipment (knives, axes and rifles), and 56 from infrastructure (floor, walls, faucets, hooks and air). These samples were collected during the preparation of the carcasses. Samples were obtained by the swab technique. At each sampling site, a moistened sterile dry cotton wool swab was rubbed vertically, horizontally, and diagonally across the sampling site. Samples were taken by swabbing 100 cm^2 areas from carcasses sites, walls and floors, and 10 cm^2 from the personnel hands, each delimited by a sterile template. For the air spora, the exposed plate method was used, with each plate being exposed to the air of the slaughterhouse for 1 min. After identification, samples were placed in sterile cool bags and were transported to the laboratory for testing. In the laboratory, samples were held in a refrigerator until analysed never more than 24 h.

Mycological analyses

Mycological analysis was realized in the laboratory of parasitology-mycology of the Superior National Veterinary School -Algiers. Swabbings were made by direct scattering of the swab on the surface of Sabouraud Dextrose Agar (SDA) added to chloramphenicol (QUELAB, Laboratories INC and code : QB - 39-3806) and incubated for 3 days at 25°C. The macroscopic examination of the colonies makes it possible to distinguish yeasts from filamentous fungi:

- Yeast colonies usually have a wet, creamy or mucous appearance.
- Mold colonies are dry, powdery, or fluffy and rarely moist or mucous.

Finally, isolated yeasts and filamentous fungi were identified using microscopic characterization.

Identification of mould

It involves taking a colony using a Pasteur pipette previously sterilized and deposit it between slide and coverslip in a drop of lactophenol, then observe under an optical microscope at magnification X 40. Examination under the optical microscope allows to search morphological characters (shape, size of spores, filaments, mycelium).

Identification of yeasts

Yeasts isolated were identified by the gallery Paster (gallery Auxanogramme) (DIMED, code: 15300 Algiers). This identification was performed taking into consideration morphological characteristics, like formation of chlamidoconidium, pseudohyphae and germinal tube development. This gallery is composite due to its various cultural middle and various tests for the precise identification of yeasts.

- Middle Sabouraud/Chloranphenicol at 37 °C: this test allows one to highlight the potential pathogenic character of the yeasts when it develops in a temperature, bordering the corporal temperature.

- Middle Sabouraud/Actidione: this test allows one to highlight colonies sensitive to actidione (Cycloheximide). Colonies having grown on this middle are considered resistant to Actidione (R), colonies not having grown on this middle are considered sentitive to Actidione (S).
- Middle with cream of rice (rice cream): this middle favors the production of chlamidospores characteristics of *Candida albicans* in anaerobic middle.
- Middle with serum for blastese: the serum of ovine is used as middle to favor the production of *Candida*'s typical germinal albicans tube (test of germination).
- Middle in the urea Indole: this test allows one to look for the hydrolysis of the urea. The change of the middle colour of yellow-orange to purpule-red corresponds to the secretion of an urease. The yeast which turns the middle to red in 4 h is *Candida neoformans.*

For the identification of the genre and species of yeasts, the key of identification of yeasts proposed by Drouhet & Dupont (1985) was used.

3. RESULTS AND DISCUSSION

Prevalence of fungi

In our survey, the mycological examination of the ovine carcasses samples and the surrounding showed the presence of yeasts and filamentous fungi, with higher frequency of yeast**.** Indeed, of the 280 samples realized, 188 were positive, that is, 67.14%. Yeasts predominant and were detected in 158 (56.42%) samples: 80 (50%) ovine carcasses samples, 12 (75%) personnel hands samples, 33 (68.75%) slaughter equipment samples, and 33 (58.92%) infrastructure samples. While mold were observed in 79 (28.21%) samples: 42 (26.25%) ovine carcasses samples, 7 (43.75%) personnel hands samples, 14 (29.16 %) slaughter equipment samples, and 16 (28.21%) infrastructure samples (Table 1)**.** Yeasts are mostly saprophytic, while few species are pathogenic. They occur almost every where in the environment as well as skin and in alimentary tract of mammals. In contrast to the yeasts, mold can be seen with the naked eye as fluffy growths on food, colored black, white, or other pigments (Gracy & Collins, 1992). Like yeasts, they are primarily saprophytic organisms, breaking down complex organic materials into simpler substances, thus contributing to the decomposition of meat (Gracy & Collins, 1992). The contamination of meat products with different species of fungi is not only responsible for meat spoilage leading to its condemnation and economic losses, but also may constitute a major public health hazard due to the production of mycotoxins (Pitt, 1984). High prevalence of fungal colonies were detected in samples realized. Such results are nearly similar with those found by Hassan *et al.* (2013), who reported that mould were detected in 88.89% of the examined surface swabs of sheep carcasses at four abattoirs in Egypt. Abo-Hussein *et al.* (2014) found that the prevalence of mold contaminated the examined samples of 100 rabbit carcasses swab was 26%, and the prevalence of yeasts was 44%**.** This contamination indicates bad hygienic measures inside the slaughter halls. Fungi are ubiquitous in nature (Hassan, 1990), and may contaminate meat during slaughtering, dressing and handling in slaughterhouses where the environmental conditions as air, walls, floors, equipments and workers hands, as well as the intestinal contents play an important role in contamination of meat with fungi (Mansour *et al.*, 1990; Refai *et al.*, 1993; Hassan, 2003; El Shafei, 2004). Recent studies showed that animals are a source of contamination for meat, and that slaughter operations play a role in controlling the contamination. Borch & Arinder (2002) found that the fecal matter is a major source of contamination and can reach carcasses through direct deposition, as well as by indirect contact through equipment, workers, installations and air. In another study, Koohmaraie *et al.* (2005) observed that, the fleece of a sheep is a primary vehicle for the introduction of contamination to the slaughterhouse.

Table 1: Prevalence of cultures with fungal, yeast and mold growth.

Sampling sites		Number of samples	Number of samples with fungal development	(%)	Number of samples with yeasts	(%)	Number of samples with mold	(%)
Carcasses	Neck	40	21	52.5	16	40	13	32.5
	Shoulder	40	25	62.5	23	57.5	7	17.5
	Abdomen	40	25	62.5	21	52.5	12	30
	Thigh	40	26	65	20	50	10	25
Total		160	97	60.62	80	50	42	26.25
Personnel hands		16	14	87.5	12	75	7	43.75
Equipment	Knives	40	30	75	29	72.5	12	30
	Rifles	4	2	50	2	50	1	25
	Axes	4	3	75	2	50	1	25
Total		48	35	72	33	68.75	14	29.16
Infrastructure	Walls	4	2	50	0	0	2	50
	Floors	4	3	75	2	50	3	75
	Faucets	4	4	100	4	100	2	50
	Hooks	40	29	72.5	27	67.5	5	12.5
	Air	4	4	100	0	0	4	100
Total		56	42	75	33	58.92	16	28.21
Total		280	188	67.14	158	56.42	79	28.21

While, Bhandare *et al.* (2007) reported that the contamination were due to poor infrastructure such as lack of dressing facility, drainage, differentiation between clean and unclean operations, lack of maintenance, hygiene and sanitation, excessive handling of carcasses and cross contamination. In our study, the fungal contamination may be attributed to lack of hygienic measures during preparation and handling of carcasses, the large number of animals slaughtered at slaughterhouse and the cross contamination between different carcasses (cattle, sheep, goat) inside the abattoir.

Frequency of yeasts and mold identified

10 fungal genera, represented by 20 species were identified (14 species of yeasts and 6 species of mold) with a strong frequency of *Candida* sp. (39.89%), followed by *Torulopsis* sp. (22.22%), *Rhodotorula* sp. (17.67%), *Trichosporon* sp. (15.15%), *Geotrichum candedum* (3.03%) and *Cryptococcus* sp. (2.02%) for yeasts, and *Penicillum* (46.60 %), *Mucor* (28.15%), *Cladosporium* sp. (15.53%) and *Aspergillus* sp. (9.7%) for mold (Table 2). Most of the yeast and mold species that were isolated during our study are known to be among the most frequently found on the surface of fresh meat (Jay *et al.*, 2005). Our results partially agreed with many authors**.** Indeed, Hechelman (1981) found that the most important mold genera isolated from meat were *Aspergillus, Penicillium, Cladosporium, Alternaria, Fusarium, Mucor* and *Rhizopus* in descending percentages. Hassan *et al.* (2013) recorded that the most important mold genera isolated from the examined surface swabs of sheep carcasses were *Aspergillus* (37.78%), *Penicillium* (36.66%), *Sporotricum* (11.11%), *Thamnidium, Rhizopus, Fusarium* (6.67% for each*), Cladosporium* (5%), *Trichoderma* (5%), *Nigrospora and Mucor* (3.33% for each).

Table 2: Frequency of yeasts and mold identified in the samples.

	Genre	%	Species	Number	%
Yeasts	*Candida*	39.89	*Candida guilliermondi*	46	23.23
			Candida tropicalis	25	12.62
			Candida zeylanoide	5	2.52
			Candida krusei	2	1.01
			Candida pseudotrpicalis	1	0.5
	Torulopsis	22.22	*Torulopsis* sp.	31	15.65
			Torulopsis globosa	13	6.56
	Rhodotorula	17.67	*Rhodotorula glutunis*	20	10.10
			Rhodotorula rubra	15	7.57
	Trichosporon	15.15	*Trichosporon cutaneum*	29	14.64
			Trichosporon capitatum	1	0.5
	Geotrichum	3.03	*Geotrichum candedum*	6	3.03
	Cryptococcus	2.02	*Cryptococcus albidus*	3	1.51
			Cryptococcus terreus	1	0.5
Total		100		198	100
Mold	*Penicillum*	46.60	*Penicillum commun*	26	25.24
			Penicillum sp.	22	21.35
	Mucor	28.15	*Mucor*	29	28.15
	Cladosporium	15.53	*Cladosporium* sp.	16	15.53
	Aspergillus	9.7	*Aspergillus niger*	8	7.76
			Aspergillus fumugatus	2	1.94
Total		100		103	**100**

While, *Aspergillus* species isolated from the examinated surface swabs of sheep carcasses were *A. flavus* (15.55 %), followed by *A. niger* (7.78%), *A. fumigatus* (6.66 %), *A. ochraceus* (5%), *A. terreus* (4.44 %) and *A. nidulans* (3.33%). In another study, Abo-Hussein *et al.* (2014) isolated from the surface of rabbit carcasses *Aspergillus (A. flavus, A. fumigatus, A. niger*), *Penicillium*, *Mucor*, *Scopuloriapsis* sp., *Fusarium*, *Alternaria*, *Geotrichum* for mold and *Candida*, *Sacchromyces, Torulopsisa* and *Rhodotorula* for yeast. Ismail *et al.* (1995), collected 34 fungal genera from beef carcasses and their surroundings and found that *Aspergillus*, *Cladosporium* and *Penicillum* were recovered in high incidence. Also, Viljoen *et al.* (1998), identified yeast from poultry carcasses and found that *Candida* sp. were isolated in highest proportion followed by *Debaryomyces* sp., *Cryptococcus* sp., *Rhodotorula* sp., *Yarrowia* and *Saccharomyces* sp.There are a number of mould that have been described as pathogens and can pose risks to human and animal health (Mižáková *et al.*, 2002). 78 species of mould have already been isolated from meat and various meat products. However, only 50 of them are reported to be toxicogenic (Ostrý, 2001). Toxicogenic mould are able to produce toxic metabolites known as mycotoxins witch are carcinogenic, tumorgenic, haemorrhagic, teratogenic, dermatoxic, nephrotoxic and cause hepatic carcinoma in man (Hassan *et al.*, 2004). However, among the genera isolated from meat products two (*Penicillium* sp. and *Aspergillus* sp.) are potentially toxicogenic. Members of the genus *Penicillium* are reported to produce the widest range of mycotoxins (Mižáková *et al.*, 2002). Moreover, *Aspergillus* species may lead to infection through mucous membranes of eyes and nostrils, causing pulmonary aspergillosis, allergy or may cause skin lesions, nasal infection as well as nail and external ear infection. *Aspergillus flavus* and other species as *A. fumigatus, A. niger* and *A. nidulens* can produce mycotoxins in foods. Some species of *Aspergillus* produce aflatoxins while others could produce patulin and ochratoxin**.** The most frequent yeasts genus isolated in our survey was *Candida* sp. The spectrum of *Candida* and other yeast infections is wide. These yeasts have different biologic patterns but share the feature to be mainly opportunistic agents: their pathogenic power is only

expressed when risk factors are present (Develoux & Bretagne, 2005).

Occurrence of yeasts and mold identified in the samples

Results achieved in table (3) reported the occurrence of yeasts identified in the samples. The yeast species isolated from ovine carcasses, personnel hands, slaughter equipment and infrastructure were *Candida guilliermondii, Candida tropicalis, Torulopsis* sp., *Rhodotorula globosa, Rhodotorula rubra, Trichosporon cutaneum*. Species of *Torulopsis globosa* were reported from ovine carcasses, personnel hands and infrastructure, while *Cryptococcus albidus* was isolated from ovine carcasses, slaughter equipment and infrastructure. On the other hand, some fungi were reported rarely: *Candida zeylanoide* from the carcasses and slaughter staff, *Candida krusei* and *Geotrichum candedum* from carcasses and slaughter equipment. In addition, other species was recorded only from ovine carcasses : *Trichosporon capitatum*, while others were reported only from slaughter equipment : *Cryptococcus terreus* and *Candida pseudotropicalis*. For molds, results are presented in table (4). The 3 species that were identified in ovine carcasses, slaughter staff, slaughter equipment and infrastructure were *Penicillum commun, Penicillum* sp. and *Cladosporium* sp. Whereas, some species as *Mucor* and *Aspergillus niger* were reported from carcasses, slaughter equipment and infrastructure. On the other side, *Aspergillus fumugatus* was isolated from only infrastructure (wall and air). The findings of this research showed that personnel hands, material, infrastructure were contaminated by fungi. This contamination can spread fungi to non-contaminated carcasses.The environmental statues in the slaughter halls including air, floors, walls, utensils, hides, washing water and intestinal contents of the slaughtered animals as well as tables, knives, workers are considered as main source of fungal contamination of meat (Hamdy *et al.*, 1990; Mansour *et al.*, 1990; Refai *et al.*, 1993; El Shafei, 2004). Infrastructure is an important source of contamination, floor may transfer contamination to workers' shoes. The workers, in turn, circulate inside the establishment, there by disseminating the contamination. Barros *et al.* (2007) showed that the drains and floors can offer a favorable environment for microbial growth, and an important source of propagation and preservation of microorganisms.Fungal contamination was already reported from carcasses and their surrounding**.** In some studies, *Aspergillus, Penicillium, Cladosporium and Mucor* genera were isolated from the floors and walls of slaughterhouses (Mansour, 1986; Refai *et al.*, 1993). Moreover, Viegas *et al.* (2016) investigated fungi from air, floors and walls samples collected from slaughterhouses, and found that *Cladosporium sp.* was the most frequently isolated in the swine/bovine slaughterhouse air ; and *Penicillium sp*. in the large animal slaughterhouse. Ismail *et al.* (1995) recorded that *Aspergillus, Pencillium* and *Cladosporium* were the commonest fungi isolated in slaughterhouse from beef carcasses and their surroundings and found that some fungi were reported only from beef carcasses, while others were found only from the surroundings. Same results were found by Yassein *et al.* (1989) who reported that *Aspergillus, Penicillum, Cladosporium* sp., were isolated frequently from floors of slaughter halls of camel and cattle. In addition, Rafai *et al.* (1993) reported that *Aspergillus* and *Penicillium* sp. were among the fungi isolated frequently from the floor of modern Egyptian abattoirs. In slaughterhouses, the biological risk is present not only from the direct or indirect contact with animal matter (feces, innards, feathers), but also from the exposure to bioaerosols (Paba *et al.*, 2014). Refai *et al.* (1993) found that the most common fungi in the air of modern Egyptian abattoirs were *A. niger, A. flavus, A. fumigatus, Cladosporium* sp. and *Pencillium* sp. wich were almost in agreement with our results. Also, similar results were found by Mansour *et al.* (1990) who reported *A. niger* and *Cladosporium* sp., and Hamdy *et al.* (1990) who found that the most frequent moulds are *Aspergillus, Penicillium.*

Table 3: Occurrence of yeasts identified in the samples.

	Ovine carcasses				**Total**	Personnel	Equipment			**Total**	Infrastructure					**Total**
	Neck	Shoulder	Abdomen	Thigh			Knive	Axe	Rifle		Hook	Floor	Wall	Air	Faucet	
	N %	N %	N %	N %	**N %**	N %	N %	N %	N %	**N %**	N %	N %	N %	N %	N %	**N %**
Candida guilliermondii	3 15	8 29.62	7 24.13	3 14.28	**21 21.64**	3 15.78	10 28.57		1 33.33	**11 26.82**	11 35.48					**11 26.82**
Candida tropicalis	4 20	2 7.4	2 6.89	4 19.04	**12 12.37**	2 10.52	5 14.28	1 33.33		**6 14.63**	3 9.67				2 25	**5 12.19**
Candida zeylanoide	1 5	1 3.7	1 3.44		**3 3.09**	2 10.52										
Candida krusei		1 3.7			**1 1.03**		1 2.85			**1 2.43**						
Candida pseudotropicalis							1 2.85			**1 2.43**						
Torulopsis sp	3 15	5 18.51	2 6.89	2 9.52	**12 12.37**	3 15.78	6 17.14	1 33.33	1 33.33	**8 19.51**	7 22.58				1 12.5	**8 19.51**
Torulopsis globosa	1 5	1 3.7	3 10.34	3 14.28	**8 8.24**	1 5.26					2 6.45	2 100				**4 9.75**
Rhodotorula glutinis	3 15	2 7.4	5 17.24	4 19.04	**14 14.43**	1 5.26	1 2.85			**1 2.43**	3 9.67				1 12.5	**4 9.75**
Rhodotorula rubra	1 5	2 7.4	3 10.34	2 9.52	**8 8.24**	3 15.78	1 2.85			**1 2.43**	1 3.22				2 25	**3 3.71**
Trichosporon cutaneum	4 20	3 11.11	4 13.79	3 14.28	**14 14.43**	4 21.05	4 11.42	1 33.33	1 33.33	**6 14.63**	3 9.67				2 25	**5 12.19**
Trichosporon capitatum			1 3.44		**1 1,03**											
Cryptococcus albidus			1 3.44		**1 1.03**		1 2.85			**1 2.43**						**1 2.43**
Cryptococcus terreus							1 2.85			**1 2.43**						
Geotrichum candedum		2 7.4			**2 2.06**		4 11.42			**4 9.75**						
Total	20 100	27 100	29 100	21 100	**97 100**	19 100	35 100	3 100	3 100	**41 100**	31 100	2 100			8 100	**41 100**

Table 4: Occurrence of mold identified in the samples.

	Ovine carcasses				**Total**	Personnel	Equipment			**Total**	Infrastructure					**Total**
	Neck	Shoulder	Abdomen	Thigh			Knive	Axe	Rifle		Hook	Floor	Wall	Air	Faucet	
	N %	N %	N %	N %	**N %**	N %	N %	N %	N %	**N %**	N %	N %	N %	N %	N %	**N %**
Mucor	3 20	6 66.66	3 21.42	4 40	**16 33.33**		4 30.76			**4 26.66**	1 16.66	1 25	1 50	4 23.52	2 100	**9 29.03**
Penicillum commun	4 26.66		3 21.42	2 20	**9 18.75**	5 55.55	4 30.76		1 100	**5 33.33**	2 33.33	1 25		4 23.52		**7 22.58**
Penicillum sp.	6 40		3 21.42		**9 18.75**	3 33.33	4 30.76			**4 26.66**	2 33.33	1 25		3 17.64		**6 19.35**
Cladosporium sp.		3 33.33	4 28.57	4 40	**11 22.91**	1 11.11		1 100		**1 6.66**	1 16.66			2 11.76		**3 9.67**
Aspergillus niger	2 13.33		1 7.14		**3 6.25**		1 7.69			**1 6.66**		1 25		3 17.64		**4 19.20**
Aspergillus fumugatus													1 50	1 5.88		**2 6.45**
Total	15 100	9 100	14 100	10 100	**48 100**	9 100	13 100	1 100	1 100	**15 100**	6 100	4 100	2 100	17 100	2 100	**31 100**

The sources of contamination can also be attribuatted to the multiple contacts with contaminated tools and operators hands. The knives and the meat hooks for hanging carcasses used for filleting and cutting were not sanitized at slaughterhouse visited, most of them were left on the floor in the establishment, they were not cleaned prior to use and they were made of wood, whose porous nature allows for water infiltration and the accumulation of organic matter. Previous studies have shown that the cleaning of personal equipment by meat plant workers is often ineffective for removing microorganisms. Indeed, Eustace *et al.* (2007) indicated that faecal organisms are not always removed

during knife cleaning. Also, Gill & McGinni (2004) found that there might be real risks associated with the persistence of possibly hazardous organisms on powered equipment used for dressing carcasses and in equipment used for its maintenance.

4. CONCLUSION

Our results reflect poor conditions of carcasses slaughtering and handling, and inadequate hygienic practices in the two slaughterhouses. These contamination limit the opportunities of meat preservation and therefore their commercial life; as a result, they accentuate economic risks by loss of foodstuffs, and health risks to public health by food borne diseases. Prevention of fungal dissemination in slaughterhouses is of great importance in order to avoid mycotoxin production. Strict maintenance of good practices of slaughter hygiene is of central importance to ensure both public health protection and meat quality.

5. REFERENCES

[1]. Lawrie, R.A. (1979). Meat Science: 3rd Ed., Pregamon Press, Oxford, UK.

[2]. Widders, P.R., Coates, K.J., Warner, S., Beattie, J.C., Morgan, I.R. & Hickey M.W. (1995). Controllig microbial contamination on beef and lamb meat during processing. *Australian Veterinary Journal*, 72, 208-211.

[3]. Yassien, N. (1992). Enteropathogenic *E.coli* in a food serving establishment. *Fleischwirtsch*, 72(5), 757-758.

[4]. Bell, R.G. & Hathaway, S.C. (1996). The hygienic efficiency of conventional and inverted lamb dressing systems. *Journal of Applied Microbiology*, 81, 225- 234.

[5]. Bacon, R. T., Belk, K. E., Sofos, J. N. & Clayton R. P. (2000). Microbial populations on animal hides and beef carcasses at different stages of slaughter in plants employing multi-sequential interventions for decontamination. *Journal of Food Protection*, 63, 1080-1086.

[6]. Ismail, M. A., Abou Elala, A.H., Nassar, A. & Michai D. G. (1995). Fungal contamination of beef carcasses and the environment in a slaughterhouse. *Food Microbiology*, 12, 441-445.

[7]. Cheo, F.S. 1991. Mycotoxins food contamination mechanism, carcinogenic potential and preventative measures. *Mutation Research*, 259 (3), 261

[8]. Hassan, A. A., Ragheb, R.R. & Rahmy, N.A. (2004). Pathological changes in cows spontaneously fed on some mycotoxins. *Egyptian Journal of Comparative Pathology and Clinical Pathalogy*, 17 (1), 282-293.

[9]. Hassan, A. A., Amin, R. A., Lamada, H. M. & El Sherif, M. F. (2013). Fungal Contamination of Sheep Carcasses at Abattoir Level. *Benha Veterinary Medical Journal*. 25(2), 177-186.

[10]. Mansour, N. K. (1986). Zum vorkommen von Schimmelpilzen der Gattung *Cladosporium* Link ex Fries auf Schaffieisch. Vet. Med. Diss., Munchen, West Germany.

[11]. Yassien, N., Mansour, N., E1-Daly, E. & Darwish A. (1989). Contamination of slaughtered camels, cattle and their surroundings with mould in urban abattoir. *Alexandria Journal of Veterinary Science*, 5, 185-193.

[12]. Refai, M., Mansour, N., EI-Naggar A. & Abdel-Aziz, A. (1993). Fungal flora in modern Egyptian abattoirs. *Fleischwirtsch*, 73, 172-174.

[13]. Jay, M.J., Loessner, J.M. & Golden D.A. (2005). Modern food microbiology. Seven edition. Food science text series. Springer Edition, P, 790.

[14]. Drouhet, E. & Dupont, B. (1985). Les champignons levuriformes d'interet médical. Laboram a. Revue d'information. 21, 3-12.

[15]. Pitt, J. I. (1984). The significance of potentially toxigenic fungi in food. *Food Technology In Australia*, 36 (5), 218-219.

[16]. Abo-Hussein, L. M., Saad, S.M., Salem A. M. & El-Shater, M. A. H. (2014). Mycological evaluation of rabbit carcasses. *Benha Veterinary Medical Journal*, 26 (1), 84-93.

[17]. Hassan, A. A. 1990. Fungal contamination of food. M. V. Sc. Thesis. Fac.Vet. Med. Cairo Univ.

[18]. Mansour, N., Hamdy, M., Yassien, N. & Refai, M. (1990). Dematiaceous Hyphomycetes in slaughtered camels, cattle and surroundings at Cairo abattoir. *Assiut Veterinary Medical Journal*, 24, 145-152.

[19]. Hassan, A.A. (2003). Detection of some mycotoxins and mycotoxins producing fungi in both macro and micro-environment of diseased animals.7 th sci, congress. Egyptian. Society for cattle. Diseases.7-9 Des, Assiut, Egypt, Pp, 112-114.

[20]. El Shafei, H.M.E. (2004). Study on mycotic contamination in abattoir. M.V.Sc. Thesis, Fac. Vet. Med, Cairo Univ Beni-Sued Branch, Egypt.

[21]. Borch, E. & Arinder, P. (2002). Bacteriological safety issues in beef and ready-to-eat meat products, as well as control measures. *Meat Science, Savoy*, 62 (3), 381-390.

[22]. Koohmaraie, M., Arthur, T. M., Bosilevac, J. M., Guerini M., Shackelford S. D. & Wheeler T. L.

(2005). Post-harvest interventions to reduce/eliminate pathogens in beef. *Meat Science*, 71, 79-91.
[23]. Bhandare, S. G., Sherikar, A.T., Paturkar, A.M., Waskar, V.S. & Zende, R.J. (2007). A comparison of microbial contamination on sheep/goat carcasses in a modern Indian abattoir and traditional meat shops. *Food Control*, 18, 854-858.
[24]. Hechelman, H. (1981). Ageneral discussion of yeast and molds. Fleischerei. 32 (2), 107-110.
[25]. Viljoen, B. C., Geornaras, I., Lamprecht, A. & Von Holy, A. (1998). Yeast populations associated with processed poultry. *Food Microbiology*, 15, 113-117.
[26]. Mižáková, A., Pipová, M. & Turek, P. (2002). The Occurrence of Moulds in Fermented Raw Meat Products. *Czech Journal of Food Sciences*, 20(3), 89-94.
[27]. Ostrý, V. (2001). Výskyt plísní v mase a masných výrobcích (I). *Vliv na zdraví člověka. Maso*, 12, 20-24.
[28]. Develoux, M. & Bretagne, S. 2005. Candidiasis and yeast infections. *EMC-Maladies Infectieuses*, 2, 119-139.
[29]. Hamdy, M.M., Yassien, N. & Mansour, N. (1990). Mycological investigation of air in camel and cattle slaughter halls. *Fleisch Wirtsch*, 70, 429-430
[30]. Barros, M.D. A.F., Nero, L.A., Monteiro, A. A. & Beloti, V. (2007). Identification of main contamination points by hygiene indicator microorganisms in beef processing plants. *Ciência e. Tecnologia de Alimentos., Campinas*, 27(4), 856-862.
[31]. Viegas, C., Faria, T., dos Santos, M., Carolino, E., Sabino, R., Gomes, A. Q. & Viegas S. (2016). Slaughterhouses Fungal Burden Assessment: A Contribution for the Pursuit of a Better Assessment Strategy. *International Journal of Environmental Research and Public Health*, 13, 297.
[32]. Paba, E., Chiominto, A., Marcelloni, A.M., Proiettol, A.R. & Sisto, R. (2014). Exposure to Airborne Culturable Microorganisms and Endotoxin in Two Italian Poultry Slaughterhouses. *Journal of. Occupation and Environmental Hygiene*, 11, 469-478.
[33]. Eustace, I., Midgley, J., Giarrusso, C., Laurent, C., Jenson I. & Sumner, J. (2007). An alternative process for cleaning knives used on meat slaughter floors. *Journal of Food Microbiology*, 113, 23-27.
[34]. Gill, C.O. & Mc Ginni, J.C. (2004). Microbiological conditions of air knives before and after maintenance at a beef packing plants. *Meat Science*, 68, 333-337.