Vet.Med.J.,Giza. Vol.52, No.2. (2004) 213 -230.

MICROBIOLOGICAL EVALUATION AND MYCOTOXIN RESIDUES IN SOME FROZEN CAMEL'S MEAT PRODUCTS

JEHAN M. OUF
Animal Health Research Institute, Dokki, Giza

Received: 6. 3. 2004
Accepted:21.4.2004

SUMMARY

Forty frozen camel's meat products samples (10 each of burger, kofta, minced meat and sausage) were collected from different supermarkets in Cairo and Giza governorates. The samples were subjected to bacteriological evaluation. Counts of aerobes, Enterobacteriaceae, coliforms, fecal coliforms, thermophilic aerobic spore formers, mould and yeast were examined. Mycotoxin residues were also determined. The incidence rate of E. coli, Salmonella, Staphylococcus aureus and Bacillus cereus in examined burger was found to be (30%, 0%, 40% and 20%). In kofta the incidence was (30%, 20%, 50% and 30%). On the other side it was (20%, 0%, 20% and 10%) in minced meat while in sausage it was (40%, 0%, 30% and 30%) respectively. Shigella failed to be detected in all examined camel's meat products. Aflatoxins and Ochratoxins could be detected within variable levels in all examined samples.

INTRODUCTION

Meat products are ideal sources of protein when perfectly produced, most B. complex, vitamins and a number of minerals in addition to its palatability and tenderness which are major nutritional attributes.

The camel makes optimal utilization of the meager vegetation and water resources better than any other domestic animal species (El Iraqi, 1996), their maintenance energy requirement has been found to be approximately two thirds of the requirement of beef cattle (NRC, 1985). Camel's meat is used for human consumption in several countries. Camel can be raised economically for

meat production in the desert ecosystem. The dressing percentage of camel ranges from 55 to 65%. The camel carcass consists of approximately 53-77% meat, 4-8% fat and 16-38% bone (Khanna, 1999). He added that an average carcass weighing 210kg would yield 10kg fat and 160kg meat. The protein yield would be sufficient to provide entire protein requirement for 35 adults for a day.

Owing to the excessive continuous consumers demand for meat products, expansion of the processed-meat industries and appearance of several camel meat products in Egyptian supermarkets become extremely necessary.

Camel meat is preferred among the Egyptian publics with poor income. It is suitable for some popular meat industries as Basterma and Kofta in addition to the appearance of other camel meat products in supermarkets which may constitute a public health hazard due to presence of spoilage bacteria responsible for unfavorable changes or pathogenic bacteria leading to food infection or intoxication. Little basic researches have been done in this respect; therefore the purpose of this work is to evaluate some of these meat products microbiologically beside its residues of mycotoxins.

MATERIALS AND METHODS

A- Collection of samples

A total number of 40 samples, 10 each of frozen burger, kofta, minced meat and sausage were collected from different supermarkets in Cairo and Giza. Each sample (about 500g) was transferred separately in a plastic bag to the laboratory in an ice bag to be examined.

B- Bacteriological examination:

The collected samples were prepared according to the technique recommended by (ICMSF, 1978). The prepared samples were subjected to the following examination:

1-Determination of Aerobic plate and Enterobacteriaceae counts ICMSF, (1978).
Drop plate technique was adopted onto standard plate count agar and violet red bile glucose agar respectively. Incubation was done at 37°C for 24 hours.

2-Determination of coliforms and fecal coliforms (MPN/g) .The multiple three-tubes fermentation technique recommended by FAO, (1992) was applied using lauryl sulphate tryptose tubes supplemented with inverted Durhamís tubes. Incubation was done at 37°C for 24-48 hours. Loopful of lauryl sulphate tubes were inoculated into *E. coli* broth and incubated at 44.5°C for 24-48 hours.

3-Determination of Staphylococcus aureus count was adopted by the technique recommended by FAO (1992) using Baird Parker medium. Incubation was done at 37°C for 24-48 hours.

4-Determination of thermophilic aerobic spore formers count using the technique cited after

Elmossalami (1994). Plating was done on Polymyxin pyruvate egg yolk mannitol bromothymol blue agar (PEMBA). The plates were incubated at 44°C for 24 hours.

5- Determination of total mould and yeast counts according to Koneman et al. (1994), using Sabauraudís dextrose agar supplemented with chloramphenicol 0.05mg/ml. Incubation was applied at 25°C for 5 days.

Isolation of pathogens:

1. Isolation of Escherichia coli according to FAO (1992) using Eosin methylene blue (EMB) media incubated at 37°C for 24 hours.
2. Isolation of Salmonella and Shigella according to Harvey and Price (1981) using tetrathionate broth as preenrichment media at 37°C and Rappaport's Vassiliadis as enrichment media at 43°C. Rambach media was used for plating at 37°C for 24 hours.
3. Isolation of Staphylococcus aureus was carried out accoring to the technique recommended by FAO (1992) using Baird Parker media incubated at 37°C for 24-48 hours.
4. Isolation of Bacillus cereus according to Holbrook and Aderson (1980) using Polymyxin pyruvate egg yolk mannitol bromothymol blue agar (PEMBA). Inoculated plates were incubated t 37°C for 24 hours.
5. Isolation and identification of yeasts were performed acording to the methods recommended by Lader and Kreger (1976) and Kreger (1984).
6. Isolation and identification of moulds was performed according to Raper et al. (1965), Raper and Them (1968), Samson et al. (1976), Damsch et al. (1980) and Samson et al. (1981).

Detection and determination of Mycotoxins residues according to the technique recommended by AOAC (2000) using thin layer chromatography method. The analytical procedures can be categorized into 4 steps as follows:

1- Extraction of the toxins from the camel meat samples
2- Clean up (purification of the extract using column chromatography)
3- Development of chromatogram
4- Qualitative and quantitative estimation of the toxin residues by using mycotoxins standards (Aflatoxins B1, B2, G1, G2, M1, M2 and ochratoxin A obtained from Sigma chemical company St. Louis, MO. USA).

The calculation of the concentration of mycotoxins in the sample was made by using the following formula:

Aflatoxins concentration µg/kg= SYV / XW

where:

S= µl of mycotoxin standard equal to unknown.

Y=concentration of mycotoxin standard in µg/ml.

V= µl of final dilution of sample extract.

X= µl of sample extract giving a spot intensity equal to S.

W= mass (weight) of sample represented by the

final extract in gram.

RESULTS AND DISCUSSION

The consumption of camel's meat products in Egypt showed an observable increase especially in the late years. This might be due to the need for more sources of animal proteins and also due to announce BSE (Mad caw disease) in different countries. The total numbers of slaughtered camels in Egypt in 2003 was 90805 camels (General Organization for Veterinary Services, 2003). Nowadays more attention is paid to the Arabian camels as multipurpose animals.

The statistics of bacteriological investigation of camelís meat products (burger, kofta, minced meat and sausage) table (1) revealed that the mean values of total aerobic counts (cfu/g) were $1.3x10^6 \pm 2.5x10^5$, $1.2x10^6 \pm 2.5x10^5$, $3x10^6 \pm 10^6$ and $1.3x10^6 \pm 3.4x10^5$ respectively. Microbiological investigations of camel's meat products are rare. However, many authors reported the microbiological quality of meat types other than camelís meat; therefore, we have to compare the other results. Nearly similar results in burger were reported by Hefnawy (1980) $2.8x10^6$ and Ibrahim (1981) $2.9x10^6$, while higher results were reported by Gill et al. (1997) log 3.8-8.5 and Mohamed (1997) log 6.9. In sausage the results recorded by Elnawawi and Nouman (1981) were $3.6x10^6$ and Mousa et al. (1993) $2.6x10^6$, while higher results were reported by Elsaid (1993) $9x10^6$, Tudela et al. (1996) log 8.37, El-Khateib (1997) $1.1x10^6$ - 10^6 and Mohamed (1997) log 7. Lower results in minced meat reported by Samaha et al. (1992) $6.4x10^5$ and goes parallel with that of Depourq and Pouche (1991) 10^6 and Ouf (1997) $1.9x10^6$.

Concerning the Egyptian Standard Specification for meat products (1991/1688, 1991/1973, 1991/1694 and 1991/1972) it was evident that 100% of examined burger samples exceeded the maximum recommended total aerobic count (10^5). For minced meat 50% exceeded the permissible limit for APC. In sausage or kofta it was found that 40% of the examined samples exceeded the limit (10^6).

The relatively high bacterial count might be attributed to the poor hygiene during processing, transport or storage procedures which resulted in unacceptable meat products (Sharma et al., 1996). The three most common hazardous areas in meat processing plants were identified as employee hygiene, cross contamination and control of heating/storage temperature (Kukay et al., 1996).

Continuous adhesion of microorganisms to inorganic material such as utensils or tables is very important in biocontamination of the products resulted in biofilm production and continuous contamination (Katsaras, 1998).

On the other hand Kosic et al. (1991) stated that the raw material directly influenced the bacterial

count in hamburger. Also uncontrolled thawing temperature can result in significant increases in bacterial population intended for manufactured hamburger.

Concerning the Enterobacteriaceae the mean counts of burger, kofta minced meat, and sausage were $1.9x10^4$ $\pm 2.6x10^3$, $1.8x10^4$ $\pm$ $5.9x10^3$ $3.6x10^3$ $\pm 5.5x10^2$ and $6.7x10^3$ $\pm 6.4x10^2$ respectively.

The results agree with those reported by Hassan (1986) $3.4x10^4$, Mohamed (1997) log 4.5 and Ouf (2001) $3.6x10^4$. Higher results were recorded by Yassien (1988) $5.6x10^5$ in burger, while in minced meat higher records were reported by Refaie and Nashed (1989) $4.3x10^5$ and Ouf (1997) $7.5x10^4$. Higher records were reported by Elsaid (1993) $3x10^5$ and El-Khateib (1997) 10^2-10^7 in case of sausage.

Enterobacteriaceae is one of the main bacteria causing hygienic problems in food industry (Finzi and Costa 1979). In 1980, ICMSF stated that polluted water is a common vehicle for transmission of pathogenic microorganisms, especially the enteric bacteria to man. Water remaining after cleaning operations is intolerable because it permits caking, sticking to surfaces, chemical changes and growth of microorganisms.

Concerning coliforms MPN/g it was found to be $4.6x10^2\pm$ $1.7x10^2$, $7x10^2\pm1.6x10^2$, $5.1x10^2$ $\pm1.6x10^2$ and $3x10^2\pm1.3x10^2$ in burger, kofta, minced meat and sausage respectively.

Similar records were reported by Hefnawy (1980) $4.4x10^2$ and Gill et al. (1997) log <0.5 to 3.6. Higher values were obtained by Yassien (1988) $3.6x10^4$, while Fathi et al. (1992) found 10^4 and Ouf (2001) $1.4x10^3$ in burger. In sausage higher records were reported by Yassien (1988) $2.7x10^4$, Fathi et al. (1992)$7.6x10^3$ and Mousa et al. (1993) $4.6x10^3$. It was found that 40% of burger and 20% of sausage exceed the recommended limits for coliforms by ESS (1991) 10^3.

Fecal coliforms counts per gram ranged from 7.3 to 75, 7.3 to 28, 7.3 to 36 and 7.3 to 28 in burger, kofta, minced meat and sausage respectively.

Addition of spices to minced meat greatly increased its APC and coliforms MPN, showing that untreated spices are a potential source of contamination (Hefnawy and Youssef, 1985). In this respect Eldaly (1986) stated that most spices samples were contaminated by bacteria of fecal origin indicating unsanitary production and handling.

The mean values of *S.aureus* counts were $6.3x10^2\pm3.5x10^2$, $8.2x10^2\pm 4.2x10^2$, $1.7x10^2\pm52$ and $3.6x10^2$ $\pm2.3x10^2$ in burger, kofta, minced meat and sausage samples respectively. Elnawawi and Nouman (1981) detected *S. aureus* in count of more than 102/g in fresh sausage. High-

er results were reported by Tolba (1986) in hamburger and sausage in counts of $4.2x10^3$ and $7.4x10^4$ respectively and El-Leithy and Rashad (1989) in minced meat ($5.3x10^3$).

Concerning the thermophilic aerobic spore formers, the mean counts were $8.5x10^2 \pm 3x10^2$, $2.1x10^2 \pm 38$, $1.7x10^3 \pm 5.2x10^2$ and $1.9x10^3 \pm 6.6x10^2$ in burger, kofta, minced meat and sausage respectively. Marino et al. (1995) stated that comminuted meat products containing vegetables or spices tended to have high microbial counts. Such findings agree with the findings of De Boer et al. (1985) who stated that most spices contained very high number of bacteria and thus might contribute to the spoilage of food products and food poisoning. Baxter and Halzapfel (1982) stated that total number of aerobic spore formers in spices varied from several hundreds to several millions/g depending on the source. The spices were the most heavily contaminated ingredient of British fresh sausage (up to 10^7/g) and the contaminants of spices were mainly aerobic spore forming bacteria. The most highly contaminated spice was the black pepper and 50% out of 26 kinds of spices exceeds 10^4 spore forming bacteria/g (Ito et al., 1985).

Slightly higher thermophilic aerobic spore formers counts were reported by Ouf (2001) in beef burger $2.6x10^3$, nearly similar results were reported in minced meat $3.3x10^3$, while slightly lower in sausage 8x102 (Ouf, 2001).

Simova (1986) stated that the quantity of proteolytic microorganisms ranged from <10 to $4x10^6$, the most active strains belonged to genus Bacillus.

In the examined four camel meat products the average counts of mould ranged between $1.4x10^2 \pm 3x10^2$ and $8.3x10^2 \pm 2.4x10^2$, while in yeast slight higher records ranging between $5.6x10^2 \pm 1.6x10^2$ and $2.3x10^3 \pm 9.2x10^3$ were reported in the examined four camel's meat products.

The incidence percent of food poisoning pathogens was shown in table (2)

E. coli, *S. aureus* and *Bacillus cereus* could be isolated at various percentages. The highest percent was for *E. coli* in sausage (40%). Burger or kofta showed 30% while in minced meat the percentage was 20%. Higher percentages for *E. coli* in hamburger were reported by Hassan (1986) 40%, Abd El-Aziz (1987) 70%, Fathi et al. (1994) 77.78% and Youssef et al. (1999) 88%, while lower percentage were reported by Tolba (1986) 25% and Ibrahim et al. (1995) 15%. In minced meat Vorster et al. (1994) and Youssef et al. (1999) reported higher percentages 74.5% and 28% respectively. Youssef et al. (1999) reported higher percent of *E.coli* (60%) in sausage. Nearly similar results were reported by Zaki (1990) 40-48%and Mousa et al. (1993) 45% while Fathi et al. (1992), Yassien et al. (1998) and Ouf (2001) reported equal lower percentages of *E.coli* (25%).

Some *E. coli* are pathogenic and some may have a far more enhanced ability to colonize the human intestines than most others, Enterohaemorhagic *E. coli* can cause bloody diarrhoea and haemolytic uraemic syndrome. The intestines of animals may be reservoir of this organism for human infection (Bettelhiem, 1996).

Humans and animals are the primary reservoirs for *S. aureus*. This organism can be found in the nose, throat, on the hair and skin of 50% of healthy individuals (Price and Tom, 1998).

The highest percent for *S. aureus* was reported in kofta (50%) followed by hamburger 40% while the percentages were 30% and 20% in sausage and minced meat respectively. Higher percentages were reported in hamburger by Tolba (1986) 52% Abd El-Aziz (1987) 50% and Youssef et al. (1999) 84%. In sausage nearly similar results were reported by Ottaviani and Bacchiocchi (1992) 27.4% and El Khateib (1997) 29% while higher percentages were reported by Abd El-Aziz (1987) 80%, Mousa et al. (1993) 43% and Youssef et al. (1999) 52%. In minced meat nearly similar results were reported by Vorster et al. (1994) 23.4%. These high percentages of *S. aureus* may be attributed to excessive hand manipulation and poor personal hygiene.

Aerobic spore forming bacilli are extremely resistant to heat desiccation, ultra violet light and chemical treatment by forming true endospores (Ketchum, 1988). The most important thermostable enzyme is protease enzyme, which is produced by spore forming thermophilic bacteria and responsible for spoilage during food manufacturing (Chopra and Marthur, 1993).

Bacillus cereus could be isolated from hamburger (20%), minced meat (10%) and by equal percentages in each of sausage and kofta (30%). Higher percentages were reported by Hefnawy et al. (1984) 28% and Youssef et al.(1999) 80% in hamburger and 92% in sausage while in sausage Ali (1987), Saleh et al. (1993) and Youssef et al. (1999) reported 56%, 60% and 92% respectively. Lower records reported by Shinagawa et al. (1984) 12% in sausage. Hefnawy et al. (1984) reported 18%, Ali (1987) 74.3%, Saleh et al. (1993) 89% and Youssef et al. (1999) 88% *B.cereus* in minced meat

Twenty percent of kofta was positive for Salmonella and could not be detected in burger, sausage and minced meat. Presence of Salmonella indicated substandard hygiene during processing, storage and retailing risk to consumers (Murugkar et al., 1993). Singh et al. (1996) could not detect Salmonella in any of the examined meat products. Shigella failed to be detected in any of the examined samples.

Abd El-Rahman and El-Khatieb (1993) stated that yeast is ubiquitous in nature and may be

found as a part of the normal flora of the meat products due to contamination and neglected hygienic measures adopted during preparation and handling of the meat products.

The isolated yeast was identified into Candida (*C. kreusi, C. albicans,*
C. utilis, C. curvata, C. gulliermondi, C. scotlii, C. metinii and *C. tropicalis*), Rhodotorula (Rh. glutinis and Rh. pullida), Tarulopsis glabarta, Sacchromyces cervisae, Trichosporon and Hansenula. The major isolated species were *C. kreusi, C. albicans, C. utilis* and Trichosporon in varying percentages (table 3).

Candida is normal flora of digestive and urogenital tract of human.
C. albicans cause vaginal yeast infection, thrush in the mouth, also invades the lungs, kidneys, heart or carried in the blood where it causes severe toxic reaction (James, 2000).

Trichosporon species may lead to occasional opportunistic invasion of mucous membranes or skin while Sacchromyces species was the main responsible agent for occasional cases of thrush and vaginitis (Finegold and Martin, 1982).

Moulds were recorded to constitute a public health hazard due to mycotoxin production such as Aflatoxin, Ochratoxin, Patulin and Zearalenone (Leistner and Eckardt, 1981; Mirocha, 1983; Mansour et al., 1994 and Mansour et al., 1996). In developing countries, it appears that there is a direct correlation between dietary aflatoxin intake and the incidence of liver cancer (Groopman et al., 1988). It also impaired the immune system (Filtenborg, 1992).

Isolated and identified mould genera and species (table 3) were *Aspergillus niger, A. nidulans, A. flavus, A. parasilicus, A. ochraceous, Mucor sp., Fusarium, Cladosporium, Penicillium sp.* and Alternaria. The predominant moulds were A.niger (100%, 80%, 0% and 60%) and *Penicillium sp.* (20%, 20%, 20% and 40%) in burger, kofta, minced meat and sausage respectively.

The black aspergilli are probably more common than any other group within the genus. They are worldwide in distribution and occur in and upon the greatest variety of substrata, including grains vegetables and other protein substrata. They are abundant in soils from tropical and subtropical areas (Raper and Fennell, 1977).

Dematiaceous hyphomycetes were common on slaughtered camels, cattle and surroundings in Cairo abattoir (Mansour et al., 1990)

Aflatoxins and ochratoxin A are hepatotoxic, nephrotoxic, carcinogenic, immunotoxic and teratogenic (Enriquez, 2000 and Petzinger and Ziegler, 2000).
Aflatoxin B1 is the most potent carcinogen of the aflatoxins and the most of the available toxico-

Table (1): Statistical analytical results of the different bacterial counts in some camel's meat products

Microbial counts	Camel's meat products											
	Burger			Kofta			Minced meat			Sausage		
	min	max	mean ± S.E	min	max	mean ± S.E	min	max	mean ± S.E	min	max	mean ± S.E
Aerobic plate	$3.8x10^5$	$3x10^6$	$1.3x10^6$ ± $2.45x10^5$	$1.2x10^5$	$2.2x10^6$	$1.2x10^6$ ±$2.5x10^5$	$1.4x10^5$	$8x10^6$	$3x10^6$ ±10^6	$2x10^5$	$3x10^6$	$1.3x10^6$ ±$3.4x10^5$
Enterobacteriaceae	10^4	$3x10^4$	$1.9x10^4$ ± $2.6x10^3$	$4x10^3$	$6.1x10^4$	$1.8x10^4$ ±$5.9x10^3$	$1.8x10^3$	$8x10^3$	$3.6x10^3$ ±$5.5x10^2$	$3.8x10^3$	10^4	$6.7x10^3$ ±$6.4x10^2$
Coliforms MPN	28	$1.1x10^3$	$4.6x10^2$ ±$1.7x10^2$	28	$1.1x10^3$	$7x10^2$ ±$1.6x10^2$	11	$1.1x10^3$	$5.1x10^2$ ±$1.6x10^2$	29	$1.1x10^3$	$3x10^2$ ±$1.3x10^2$
Fecal coliforms MPN	7.3	75	26 ±8.5	7.3	28	13.3 ±2.1	7.3	36	15.9 ±3.5	7.3	28	13.8 ±2.6
Staph. aureus	$<10^2$	$3.6x10^3$	$6.3x10^2$ ±$3.5x10^2$	$<10^2$	$3.6x10^3$	$8.2x10^2$ ±$4.2x10^2$	$<10^2$	$6x10^2$	$1.7x10^2$ ±52	$<10^2$	$2.4x10^3$	$3.6x10^2$ ±$2.3x10^2$
Thermophilic ASF	10^2	$3x10^3$	$8.5x10^2$ ±$3x10^2$	10^2	$4x10^2$	$2.1x10^2$ ±38	$2.1x10^2$	$5x10^3$	$1.7x10^3$ ±$5.2x10^2$	10^2	$5.4x10^3$	$1.9x10^3$ ±$6.6x10^2$
Moulds	10^2	$7x10^2$	$3.7x10^2$ ±59.7	$<10^2$	$2.4x10^3$	$8.3x10^2$ ±$2.4x10^2$	$<10^2$	$2.4x10^3$	$1.4x10^2$ ±$3x10^2$	$<10^2$	$2x10^3$	$2.7x10^2$ ±$1.8x10^2$
Yeasts	$<10^2$	$7.8x10^3$	$2.3x10^3$ ±$9.2x10^2$	$<10^2$	$4x10^3$	$1.6x10^3$ ±$4.8x10^2$	$<10^2$	$1.6x10^3$	$6.6x10^2$ ±$2x10^2$	$<10^2$	$1.5x10^3$	$5.6x10^2$ ±$1.6x10^2$

Table (2): Enteropathogenic microorganisms in the examined camel's meat products

Isolated pathogens	Camel's meat products							
	Burger (n=10)		Kofta (n=10)		Minced meat (n=10)		Sausage (n=10)	
	No.	%	No.	%	No.	%	No.	%
Escherichia coli	3	30	3	30	2	20	4	40
Salmonella typhimurium kentackia	0	0	2 1 1	20 10 10	0	0	0	0
Shigella	0	0	0	0	0	0	0	0
Staph. aureus	4	40	5	50	2	20	3	30
Bacillus cereus	2	20	3	30	1	10	3	30

Table (3): Fungal contamination of examined camel's meat products

Isolates	Burger		Kofta		Minced meat		Sausage	
	No.	%	No.	%	No.	%	No.	%
Yeasts								
Candida kreusi	4	40	6	60	2	20	4	40
Candida albicans	4	40	2	20	2	20	2	20
Candida utilis	2	20	2	20	2	20	2	20
Candida curvata	–	–	2	20	–	–	–	–
Candida gulliermondi	–	–	2	20	2	20	–	–
Candidia scotlii	2	20	–	–	–	–	–	–
Candidia matinii	4	40	–	–	–	–	–	–
Candidia tropicolis	2	20	–	–	–	–	–	–
Rhodotorula glutinis	2	20	2	20	–	–	–	–
Rhodotorula Pallida	2	20	–	–	–	–	2	20
Torulopsis glabarta	2	20	2	20	–	–	–	–
Sacchromyces cervisae	–	–	–	–	2	20	2	20
Trichosporon	2	20	4	40	4	40	2	20
Hansenula	2	20	–	–	–	–	–	–
Moulds								
A. niger	10	100	8	80	–	–	6	60
A. nidulans	2	20	–	–	–	–	4	40
A. flavus	–	–	–	–	4	40	–	–
A. parasiticus	–	–	–	–	2	20	–	–
A. ochraceous	–	–	–	–	–	–	2	20
Mucor spp.	–	–	2	20	–	–	–	–
Fusarium spp.	–	–	–	–	2	20	–	–
Cladosporium spp.	–	–	2	20	–	–	2	20
Penicillium spp.	2	20	2	20	2	20	4	40
Alternaria spp.	–	–	–	–	2	20	–	–

Table (4): Mycotoxins residues (ppb) in the examined camel's meat products samples

Mycotoxins residues	Burger			Kofta			Minced meat			Sausage		
	No. of +ve sample	%	Value (ppb)	No. of +ve sample	%	Value (ppb)	No. of +ve sample	%	Value (ppb)	No. of +ve sample	%	Value (ppb)
Aflatoxin B_1	1	10	16.67	2	20	6.25 11.11	1	10	3.33	2	20	5.56 5.93
Aflatoxin G_1	1	10	3.70	1	10	4.44	---	---	---	---	---	---
Aflatoxin M_1	---	---	---	1	10	4.17	---	---	---	1	10	6.67
Ochratoxin A	2	20	3.33 10.00	1	10	12.5	---	---	---	1	10	4.17

ppb: part per billion

logical data relate to aflatoxin B_1 (WHO, 2002).

Aflatoxins B_1 (table 4) detected in (10%, 20%, 10% and 20%), G_1 (10%, 10%, 0% and 0%), M_1 (0%, 10%, 0% and 10%) while ochratoxin A (20%, 10%,0% and 10%) in burger, kofta, minced meat and sausage respectively. Comparing the aflatoxins contamination in camel's meal products to limit established in USA (20ppb), it was found that all samples did not exceed this limit, while one sample of burger, two samples each of kofta and sausage exceeded the limit (5ppb) recommended in Bulgaria, Cuba, Finland, Hongkong, Norway, Russia and Sweden. On the other hand all the samples exceeded the limit (0ppb) as compared the limits in Poland, Romania and Singapore (FAO, 1997). Waltking (2000) stated that aflatoxins B_1 and M_1 were difficult to be destroyed at the range of temperature usually employed in the processing or cooking food, while roasting process resulted in aflatoxins reduction at range of 22.9-47. 34 %.

Comparing the ochratoxin contamination levels in camel's meat products to limit recorded by Czech Republic and Greece (20ppb), it was found that no samples exceeded this limit, while one sample each of burger and kofta exceeded the maximum levels of ochratoxin (5ppb) set by France and Romania. In addition to all samples except minced meat exceeded the limit (2ppb) set by Switzerland (FAO, 1997). Continuous exposure with low level of aflatoxin to growing host may enhance its susceptibility to infection and tumorgenesis (Raisuddin et al., 1993).

Inhibition of the most common strains of Aspergilli and Penicillia which produce mycotoxins in meat products by using some extractives as Eugenol, Isoeugenol and Monolaurin (fatty acid) was applied by Mansour et al. (1996).

Chu (1992) stated that the best control of tissue residues from aflatoxins and ochratoxins is to prevent the intake of contaminated food through the proper pre-harvest, post harvest storage and transportation of agricultural products as well as the standard limits, national or international must be fulfilled during the analysis of food and feedstuffs not only for indirect prevention of any mycotoxin residues carry over in animals for human consumption, but also to provide healthier diet for these animals to avoid economic losses.

REFERENCES

Abd El Aziz, A.T. (1987): Microbial load of some meat products as influenced by the hygienic status of product plant. M. V. Sci. Thesis, Fac. Vet. Med., Cairo Univ.

Abd El-Rahman, H.A. and T.S. El-Khatieb (1993): Significance occurrence of mould and yeast in frozen ground beef. Archiv fur Lebensmittel Hygiene 44, 112.

Ali, G.M. (1987): Incidence of B. cereus in meat products. M.V.Sc. Thesis, Fac. Vet. Med. Assiut Univ.

AOAC (2000): "Natural toxins". Official methods of analysis of AOAC International, Whrwitz, W. (Ed.) 17th Ed. Association of official Analytical Chemistis. Chapter 49, p.1-64 Gaithersburg. Maryland 20877-2417 USA.

Baxter, R. and W. Holzapfel (1982): A microbial investigation of selected spices, herbs and additives in South Africa. J. Food Sci., 47: 570.

Bettelheim, K. A. (1996): Enterohaemorrhagic Escherichia coli: A new problem, on old group organisms. Australian Veterinary Journal, 73: 20.

Chu, FS (1992): Recent progress on analytical techniques for mycotoxins in feed stuffs J. Animal Sci., 70:3950.

Chopra, A.K. and D.K. Marthur (1993): Factor affecting protease production by B. stearothermophilus Rm-67. J. Food Protect., 46: 1020.

Damsch, K.H.; W. Gams and T.H. Anderson (1980): Compendium of soil fungi. Academic Press London.

De-Boer, E. W. M. Spiegelenberg and F. W. Janssen (1985): Microbiology of spices and herbs. Antonie Van Leeuwenhoek, 51: 435.

Depourcq, G. and L. Poucke (1991): Evaluation of the microbiological quality of minced meat. Food policy trends in Europe, Nutrition, Technology, Analysis and Safety.ISB NO 7476-0075-9 pp. 200.

El Iraqi S.M. (1996): Camel News Letter. The camel applied research and development network. First meeting of the general Assembly Damascus, 10-11 Jan. 1996 The Arab center for studies of arid zones and dry land, Syria.

Eldaly, E. (1986): A microbiological investigation of some common spices collected from Egypt and West Germany. Zagazig Vet. J., 13: 70.

El-Khateib, T.S. (1997): Microbiological status of Egyptian salted meat (Basterma) and fresh sausage. J. Food Safety, 17: 141.

Elmossalami, M.K. (1994): Vorkommen, Speziesdifferenzierung und Enterotoxin-bildungsvermogen von aeroben sporenbildnern in verschiedenen Fleischerzeugnissen. Vet. Diss. FU, Berlin.

Elnawawi, F.A. and T.M. Nouman (1981): Investigations into the microbiological quality of fresh raw sausage. Fleischwirtschaft, 61: 6.

Elsaid, E.S.A. (1993): Studies on sausage marketed in Sharkia. Ph.D. Thesis, Fac. Vet. Med., Zagazig Univ.

Enriquez,B. (2000): Mycotoxins contaminants of animal and human foods. Ann. Phrm. Fr., 58(6): 464.

ESS (1991):No. 1688 for frozen beef burger. Egyptian Organization for Standardization.

ESS (1991):No. 1694 for minced meat Egyptian Organization for Standardization.

ESS (1991):No. 1972 for frozen sausage Egyptian Organization for Standardization.

ESS (1991):No. 1973 for kofta Egyptian Organization for Standardization.

FAO (1992): Food and Agriculture organization of united nation manual of food quality control 1. Microbiological analysis, Staphylococcus count, pp. 131.

FAO (1997): Worldwide regulations for mycotoxins 1995 A compendium, 64: 7.

Fathi, S. M.; M. R. A. Rashwan and S. I. El-Syiad (1992): Determination of coliforms and Escherichia coli in some meat products using most probable number technique. Assiut Vet. Med. J., 28: 180.

Fathi, S.; T. El-Kateib; S. Mostafa, and K. Hassanin (1994): Salmonella and Enteropathogenic Escherichia

coli in some locally manufactured meat products. Assiut Vet. Med. J., 31: 190

Filtenborg, O. (1992): Mycology and mycotoxins 3rd World Congress Food Borne Infections and Intoxication, Berlin, Germany, page 613.

Finegold, S.M. and W.J. Martin (1982): Diagnostic Microbiology 6th Ed.The C.V. Mosby Co. Toronto, London.

Finzi, M. and C. Costa (1979): Microbiological contamination in food processing plant. Preventive measures. Rivista della Societa Italiana die Scienza Dell,s Alimentazione, 8, 258.

General Organization for Veterinary Services (2003): Report of the General Organization for Veterinary Service, Ministry of Agriculture and Irrigation, Giza, Egypt.

Gill, C. O.; K. Rahn; K. Sloan and L. M. McMullen (1997): Assessment of the hygienic performance of hamburger patty production processes. International J. Food Microbiology, 36: 1711.

Groopman, J.D.; L.G. Cain and T.W. Kensler (1988): Aflatoxin exposure in human populations: measurements and relation to cancer.CRC Critical Review in Toxicology 19: 113.

Harvey, R.W. and T.H. Price (1981): Comparison of selenite F, Muller Kauffmann tetrathionate and Rappaport medium for Salmonella isolation from chicken giblets and other pre-enrichment in buffered peptone water. J. Hyg. Camb. 87: 219.

Hassan, A.I. (1986): Microbiological quality of ready-to-eat meat meals in air catering. M.V.Sc. Thesis, Fac. Vet. Med., Cairo Univ.

Hefnawy Y and H. Youssef (1985): Microbiological evaluation of some selected spices. Assuit Vet. Med. J. 13: 145.

Hefnawy, Y. (1980): Studies on the sanitary improvement of processed meat (hamburger) manufactured in Egypt. Ph.D. Thesis, Fac. Vet. Med., Assiut Univ.

Holbrook, R. and J.M. Anderson (1980): An improved selective and diagnostic medium for the isolation and enumeration of B. cereus in foods. Canadian J. of Microbiol., 26: 753.

Ibrahim, A.M.; N. Yassien and M. K. Elmossalami (1995): Rapid monitoring of E. coli on meat products using new fluorocult dehydrated culture media. Benha Vet. Med. J., 6: 1995.

Ibrahim, A.M. (1981): Sanitary condition of locally produced hamburger. M.V.Sc. Thesis, Fac. Vet. Med., Cairo Univ.

ICMSF (1978): Microorganisms in foods, Vol. I, Their significance and methods of enumeration, 2nd Ed. Univ. of Toronto Press, Toronto and Buffalo, Canada.

ICMSF (1980): Microorganisms in food III: Microbial ecology of foods Vol. 2. Academic Press, London, New York

Ito, H.; H. Watanabe; S. Bagiawali; L.J. Muhamed and N. Tamura (1985): Distribution of microorganisms in spices and their decontamination by gamma irradiation (Food Irradiation Processing). IAEA, Vienna, 171.

James, M.C. (2000): Modern Food Microbiology 6th Ed., Toronto Publishing, New York Chapter 21, page 144.

Katsaras, K. (1998): The adhesion of Salmonella typhimurium, L. monocytogenes Escherichia coli O157:H7 to high-grade steel surfaces as seen under the scanning electron microscope. Fleischwirtschaft, 78 (2), 119.

Ketchum, P.A. (1988): Microbiological concepts and applications John Wicly and Sons, New York, Chichester, Brisbane, Toronto, Singapore, pp. 329.

Khanna, N.D.(1999): Sustainable camel production and improvement in the rural sector of India dry land Malviya Nagar, Jaipur (Rajasthan), India.

Koneman,E.W.; S.D. Allen; M.W. Janda; P.C. Schreckenberger, and C.W. Winn (1994): Diagnostic Microbiology 6th Ed. J.B. Lippincott, Philadelphia.

Kosic, M.; D. Ivanovic; E. Oljacic, V. Jovelic and L. Timcenko-Kostic (1991): The influence of raw material on bacteriological contamination of hamburger. Nauka-U-Praksi, 21: 377.

Kreger Van Rij (1984): The yeasts a taxonomic study 3rd Ed. Elsevier, Amesterdam.

Kukay, C. C.; L. H. Halcomb, J. N. Sofos; J. B. Morgan; J. D. Tatum; R. P. Clayton and G. C. Smith (1996): Application of HACCP by small-scale and medium-scale meat processors. Dairy, Food and Environmental Sanitation; 16: 74.

Lader, J. and Kreger Van Rij (1976): The yeasts a taxonomic study North Holland Publishing company Amesterdam.

Leistner,L. and Eckardt,C. (1981): Schimmelpilze und Mykotoxine in fleish und fleisherzeugnisse in Mykotoxine in Lebensmittel.J. Reiss Stuttgart Gutsav Fisher Vorlag., 297.

Mansour N., M. Hamdy, N. Yassien and M.K. Refai (1990): Dematiceous hyphomycetes in slaughtered camels, cattle and surroundings at Cairo abattoir. Assit Vet. J. 24: 145.

Mansour N., N. Yassien and A. Elschrif (1994): Mycoflora of imported frozen beef Vet. Med. J. Giza 42: 89.

Mansour N., A. Yousef and J.G. Kim (1996): Inhibition of surface growth of toxinogenic and non toxinogenic Aspergilli and Penicillia by Eugenol, Isoeugenol and Monolaurin. Journal of Food Safety 16: 219.

Marino, M.; G. Duratti; S. D'Aubert and G. Comi (1995): Microbiological quality of comminuted meats from various animals. Ingegneria Alimentare Le Conserve Animali, 11: 21.

Mirocha, J. (1983): Fusarium toxins. Pro. 1st Symp. Mycotoxin, National Res. Center, Cairo, Egypt. Pp 71.

Mohammed, M. (1997): Quality studies on the market frozen meat products. Thesis M. Vet. Sci., Cairo Univ.

Mousa, M. M.; H. A. Awad, N. M. Yassien and H. I. Gouda (1993): Microbial quality of some meat products. Vet. Med. J. Giza, 41: 59.

Murugkar, H. V.; A. T. Sherikar; A. M. Paturkar and B. G. Tarwate (1993): Studies on the microbiological quality of meat products with special reference to the bacterial flora of public health implications. J. Applied Animal Research, 4: 91.

NRC (1985): Nutrient Requirments of beef cattle 6th Ed., National Academic Press Washington, D.C.

Oitaviani, D. and I. Bacchiocchi (1992): HACCP evaluation of hazards of Staphylococcus aureus contamination and evaluation of critical control points in fresh sausage processing. Industrie Alimentari, 31: 1164.

Ouf, Jehan M. (1997): Sanitary status of packed minced meat. M.V.Sc. Thesis Fac. Vet. Med. Cairo Univ., Egypt.

Ouf, Jehan M. (2001): Microorganisms of sanitary importance in some meat products and their additives. Ph. D. Thesis Fac. Vet. Med. Cairo Univ., Egypt.

Petzinger,E. and K. Ziegler, (2000): Ochratoxin A from toxicological perspective. J. Vet. Pharmacol. Ther., 23 (2): 91.

Price, R.J. and P. Tom (1998): Compendium of fish and fish product processes. Hazard and Controls, 1st Ed. NOAA, National Sea College Programm Department of commerce, USA, pp 19. I Proc. Panel Bombay, 1972, IAEA, Vienna, 389.

Raisuddin, S.; K.P. Singh; S. Zaidi; B. Poul and P. Ray (1993): Immunosuppressive effects of aflatoxin in growing rats Mycopathologia 124: 189.

Raper, K.B. and C. Thom (1968): A manual of Penicillia Hafner Publishing Company. New York

Raper, K.B.; D.I. Fennel and A.K. Austwick (1965): The genus Aspergillus, Williams and Wilkins company Baltimore.

Raper, K.B. and D.I. Fennell (1977): The genus Aspergillus. Rober E. Krieger Publishing Comp. Huntington New York.

Refaie, R. S. and S. M. Nashed (1989): Bacteriological studies on Enterobacteriaceae in some meat products. Assiut Vet. Med. J., 23: 45.

Saleh, Y. E.; M. Z. El-Fouly; M. S. Khalil and M. A. Abo-State (1993): Incidence and characterization of Bacillus cereus isolated from Egyptian foods. Qatar University Science Journal, 13: 75.

Samaha, I.; M.M. Moussa; E. Eldaly and E. Saleh (1992): Microbiological Survey of frozen ground beef. Egypt J. Appl. Sci. 7, 26.

Samson, R.A.; A. Stolk and R. Hadlok (1976): Revision on the subsection fasiculata of genus Penicillium and some allied species, Study in Mycology II Centraalbareau voor schimmelcultures, Baarn, The Netherlands.

Samson,R.A.; E.S. Holtstia and E.A.H. Van Oorschot (1981): Introduction to food fungi, Centraalbareau voor schimmelcultures, Baarn, The Netherlands.

Sharma, D.; V. D. Sharma and A. Kumar (1996): Microbial quality of commercial pork products. Indian J. Animal Science, 66: 211.

Simova, B. (1986): Qualitative determination of proteolytic microorganisms in food stuffs. Khigzdraveopaz, 29: 55.

Singh,B.R. ; K.N. Kapoor; Kumar, Ashok; R.X. Agarwaland and K.N. Bhilegaonkar (1996): Prevalence of enteropathogens of zoonotic significance in meat, milk and their products. J. Food Science and Technology, India, 33: 251.

Tolba, K.S. (1986): Antibiotic resistant microorganisms in some meat products. M.V.Sc. Thesis, Fac. Vet. Med., Cairo Univ.

Tudela, L. R. Millan; E. Sanjuan; Penedo; M. Castelo; A. Cardona and A. Saleazar (1996): Characteristics of Las Cuatros Villas' brand white sausage. II Stability parameters (pH, ^{a}w), distribution of total nitrogen and microbial groups. Alimentaria, 271: 57.

Vorster, S. M.; R. P. Greebe and G. L. Nortje (1994): Incidence of Staphylococcus aureus and Escherichia coli in ground beef, broilers and processed meats in Pretoria, South Africa. J. Food Prot., 57: 305.

Waltking, A (2000): Fate of aflatoxin during roasting and storage of contaminated agricultural commodities in feeds, meat and milk Chapter 12, 19th Ed., page 1122.

WHO "Technical Report Series" (2002) Evaluation of certain mycotoxins in food fifty sixth report of the joint FAO / WHO Expert Committee on food additive Geneva.

Yassien, N. A. (1988): Sanitary improvements of locally manufactured meat products. Ph.D., Thesis, Fac. Vet. Med., Cairo University.

Yassien, N. A. Ibrahim and M.K. Elmossalami (1998):

Fluorescence assay for rapid detection of E. coli in meat products. Fleischwirtschaft, 78:505.

Youssef,H ; A. Nasser; K. Hassanein and M. Abd-Alla (1999): Predominance of some food poisoning microorganisms in meat products. Egyptian Society for cattle diseases 5th Sci. Cong., 28-30 Nov. 1999 Assiut Egypt

Zaki, E. (1990): Escherichia coli in meat products with special references to enteropathogenic strains. M. V. Sc. Thesis, Fac. Vet. Med., Cairo Univ