ENTEROBACTERIACEA IN EDIBLE OFFAL

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A B S T R A C T

The aim of this study is to determine the contamination level of cattle and camel offal with *Enterobacteriaceae* either qualitatively or quantitatively. A total of 120 random lung, liver and heart samples (40 of each) were collected equally from cattle and camel from El Menoufya Governorate. The obtained results indicated that the mean values of total *Enterobacteriaceae* count / g of lung , liver and heart samples were 8.53×104± 1.41×104 , 3.96×104± 0.75×104 and 9.17×103± 2.08×103 for cattle and 5.26×104± 1.03×104 , 8.84×103± 2.17×103 and 4.59×103± 0.66×103 for camel , respectively, while the mean values of the coliform count /g of lung , liver and heart samples1.72×104± 0.39×104, 7.44×103± 1.86×103 and 3.25×103± 0.67×103 , of cattle. & 9.51×103± 2.31×103, 4.27×103± 0.89×103 and 8.38×102± 1.93×103 in case of camel, respectively. The differences associated with the examined offal samples as a result of total *Enterobacteriaceae* and coliform counts were highly significant ($P < 0.01$). On the other hand, *Salmonella, E.coli, Citrobacter, Enterobacter, Klebsiella, Serratia* and *Proteus* species were isolated from the examined offal samples with varying percentages. The significance of the isolated *Enterobacteriacae* and the various sources of contamination as well as the suggestive hygienic measures for the production of clean and safe offal were discussed.

Key Words: *Enterobacteriaceae,* Edible offal, *Salmonella,* E. *coli*

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1. INTRODUCTION

Animal edible offal such as liver, heart and lung has great importance as foods for Egyptians. Microbial contamination of the carcass and internal organs is of high significance for quality and shelf life of meat and offal. Contamination takes place either externally from soil, water, equipments, and utensils, handling by workers and during transportation or internally from diseased animals. Environmental conditions may affect the composition of microbial flora (type and number) and rate of microbial growth and subsequent spoilage that may occur [1]. *Escherichia coli* is an emerging agent among pathogens that cause diarrhea that continues to be one of the most common causes of morbidity and mortality among infants and children in developing countries [2]. While, *Salmonella* infections are frequent cause of foodborne out breaks and affect several million people worldwide each year [3].

Therefore, the objective of the current study was to determine the level of *Enterobacteriaceae* contamination of cattle and camel offal at abattoir level and to identify their pathogenic strains.

2. MATERIALS AND METHODS

2.1. Collection of samples.

A total of one hundred and twenty random samples of edible animal offals represented

by liver, heart and lung were collected from cattle and camel. Accurately, 20 samples of each organ from each species of animals were collected randomly from different slaughter houses of El - Menoufya Governorate. All collected samples were put into ice box and transferred immediately to the laboratory without undue delay for evaluation of their bacteriological aspect.

2.2. Preparation of offal samples according to [4]:

Twenty five grams of the examined organ samples were transferred to aseptic blender jar and 225 ml of 0.1 % sterile buffered peptone water were aseptically added to the content of jar. Each sample was then homogenized in the blender at 2000 r.p.m for 2 minutes to provide a homogenate, from which tenth - fold serial dilutions were prepared.

The prepared samples were subjected to the following examination:

2.3. Determination of Enterobacteriaceae count ISO (2004):

Purplish – red colonies surrounded by a red zone of precipitated bile acid on Violet Red Bile Glucose agar plates counted and recorded as total Enterobacteiaceae count per gm .

2.4. Determination of coliform count [4]:

All tubes of MacConkey broth showing acid and gas production within 48 hours were recorded as positive, and then the MPN of Coliform bacteria was calculated from MPN, 3 tubes dilution index and recorded as MPN/gm.

2.5. Screening of Escherichia coli:

The technique recommended by [4] was carried out using MacConkey broth and Eosin Methylene Blue agar plates. The metallic green colonies on Eosin Methylene Blue agar plates were picked up and identified biochemically and serologically. The isolates were serologically identified according to [5] by using rapid diagnostic *E.coli* antisera sets (DIFCO Laboratories, Detroit Michigan 48232-7058, USA).

2.6. Screening of Salmonellae:

The method described by ISO 6579 (2002). Rappaport Vassiliadis broth tubes were used as enrichment broth and incubated at 41° C for 24 hours. While Xylose Lysine Desoxycholate (XLD) agar plates were used as plating media, typical colonies appeared black center and a lightly transparent zone of reddish color. Pure cultures were serologically identified according to Kauffman White scheme [6] by using rapid diagnostic Salmonella antisera sets (Denka Seiken Company, Ltd, Japan).

2.7. *Members belonging to Enterobacteriaceae were further identified according to* [7].

3. RESULTS

3.1 The total Enterobacteriacae count.

The obtained results in table (1) indicated that the total *Enterobacteriacae* count in the examined cattle offal samples was ranged from 7.4×10^3 to 2.5×10^6 with an average value of $8.53 \times10^4 \pm 1.41\times10^4$ for lung samples , 4.8×10^3 to 1.3×10^6 with an average value of $3.96 \times10^4 \pm 0.75 \times 10^4$ cfu/g for liver samples and 9.7×10^2 to 4.0×10^5 with an average value of cfu/g $9.17 \times10^3 \pm 2.08 \times10^3$ for heart samples , respectively. In case of camel offal samples the total *Enterobacteriacae* count was ranged from 3.6×10^3 to 1.0×10^6 with an average value of $5.26 \times10^4 \pm 1.03\times10^4$ for lung samples, 9.0×10^2 to 4.7×10^5 with an average value of $8.84 \times10^3 \pm 2.17 \times 10^3$ cfu/g for liver samples and 5.0×10^2 to 8.2×10^4 with an average value of cfu/g $4.59\times10^3 \pm 0.66 \times10^3$ for heart samples, respectively. Highly significant differences were detected among different species of animals and between organs in this study at ($P < 0.05$).

Table 1. Statistical analysis of Enterobacteriaceae counts/g in the examined samples of edible cattle and camel offal (n=20).

	Cattle			Camel		
Offal	Min	Max	Mean ± S.E*	Min	Max	Mean ± S.E*
Lung	7.4×10^3	2.5×10^6	$8.53\times10^4\pm1.41\times10^4$ **	3.6×10^3	1.0×10^6	$5.26\times10^4\pm 1.03\times10^4$**
Liver	4.8×10^3	1.3×10^6	$3.96\times10^4\pm 0.75\times10^4$**	9.0×10^2	4.7×10^5	$8.84\times10^3\pm 2.17\times10^3$**
Heart	9.7×10^2	4.0×10^5	$9.17\times10^3\pm 2.08\times10^3$**	5.0×10^2	8.2×10^4	$4.59\times10^3\pm 0.66\times10^3$**

**High significant differences (P<0.01).

3.2 The Most probable number of coliforms.

The summarized result given in table (2) showed that the Most probable number of coliforms in the examined cattle offal samples was ranged from 2.6×10^3 to 3.1×10^5 with an average value of $1.72\times10^4 \pm 0.39\times10^4$ for lung samples , 1.5×10^3 to 6.8×10^4 with an average value of $7.44\times10^3\pm 1.86\times 10^3$ cfu/g for liver samples and 4.0×10^2 to 2.2×10^4 with an average value of cfu/g $3.25\times10^3 \pm 0.67\times10^3$ for heart samples , respectively. While camel offal samples the Most probable number of coliforms was ranged from 9.7×10^2 to 1.1×10^5 with an average value of $9.51\times10^3 \pm 2.31\times10^3$ for lung samples , 6.0×10^2 to 3.5×10^4 with an average value of $4.27\times10^3 \pm 0.89\times 10^3$ cfu/g for liver samples and 1.0×10^2 to 9.3×10^3 with an average value of cfu/g $8.38\times10^2 \pm 1.93\times10^3$ for heart samples , respectively. Highly significant differences were detected among different species of animals and between organs in this study at ($P < 0.05$).

3.3 *The Incidence of enteric bacteria.*

Results outlined in table (3) and table (4) revealed that the incidence of *Citrobacter diversus* and *Citrobacter freundii* in examined lung, liver and heart of cattle were (15% & 15%) , (0% & 25%) and (10% & 10%), respectively. In case of camel lung, liver and heart samples were (10% & 5%), (0% & 20%) and (15% & 5%) respectively. The incidence of *Enterobacter. aerogenes, Enterobacter cloacae* and *Enterobacter hafniae* in examined lung , liver and heart of cattle were (40% , 20% & 15%) , (15% ,35% & 10%) and (5% , 5% & 0%) respectively. In case of camel lung, liver and heart samples, the incidence of *Enterobacter aerogenes* , *Enterobacter cloacae* was (30% & 15%), (5% & 15%) and (30% & 10%), respectively. Moreover, *Klebsiella pneumonae* and *Klebriella ozaenae* in examined lung , liver and heart samples of cattle were (50% & 15%) , (0% & 20%) and (10% & 5%), respectively. In case of camel lung, liver and heart samples incidence of *Klebsiella pneumonae and Klebriella ozaenae* was (40% & 10%) ,(0%, 20%) and (5% & 0%), respectively. Also, the incidence of *Proteus mirabilis* , *Proteus rettgeri* and *Proteus vulgaris* in examined lung , liver and heart samples of cattle were (60% , 25% & 40%) , (20% , 0% & 0%) and(35% , 55% & 25%), respectively. In case of camel lung, liver and heart samples incidence of *Proteus mirabilis* and *Proteus vulgaris* was (45% & 20%) , (25% & 15%) and (45% & 15%), respectively. As well as the incidence of *Serratia liquefaciens and Serratia marcescens* in examined lung , liver and heart samples of cattle were (25% & 5%) ,(10% & 10%) and(0% & 0%), respectively. In case of camel lung, liver and heart samples incidence of *Serratia liquefaciens* was 15%, 0% and 5%.

Table 2. Statistical analysis of coliform counts/g in the examined samples of edible cattle and camel offal (n=20).

Offal	Cattle			Camel		
	Min	Max	Mean ± S.E*	Min	Max	Mean ± S.E*
Lung	2.6×10^3	3.1×10^5	$1.72\times10^4\pm0.39\times10^4$**	9.7×10^2	1.1×10^5	$9.51\times10^3\pm2.31\times10^3$**
Liver	1.5×10^3	6.8×10^4	$7.44\times10^3\pm1.86\times10^3$**	6.0×10^2	3.5×10^4	$4.27\times10^3\pm0.89\times10^3$**
Heart	4.0×10^2	2.2×10^4	$3.25\times10^3\pm0.67\times10^3$**	1.0×10^2	9.3×10^3	$8.38\times10^2\pm1.93\times10^3$**

**High significant differences (P<0.01).

Table 3. Incidence of Enteric bacteria isolated from the examined samples of edible cattle offal (n=20).

Isolated bacteria	Lung		Liver		Heart	
	No.	%	No.	%	No.	%
Citrobacter diversus	3	15	3	15	-	-
Citrobacter freundii	5	25	2	10	2	10
Enterobacter aerogenes	8	40	4	20	3	15
Enterobacter cloacae	3	15	7	35	2	10
Enterobacter hafniae	1	5	1	5	-	-
Klebsiella ozaenae	4	20	2	10	1	5
Klebsiella pneumoniae	10	50	3	15	-	-
Proteus mirabilis	12	60	5	25	8	40
Proteus rettgeri	4	20	-	-	-	-
Proteus vulgaris	7	35	11	55	5	25
Serratia liquefaciens	5	25	1	5	2	10
Serratia marcescens	2	10	-	-	-	-

Table 4. Incidence of Enteric bacteria isolated from the examined samples of edible camel offal (n=20).

Isolated bacteria	Lung		Liver		Heart	
	No.	%	No.	%	No.	%
Citrobacter diversus	2	10	1	5	-	-
Citrobacter freundii	4	20	3	15	1	5
Enterobacter aerogenes	6	30	3	15	1	5
Enterobacter cloacae	3	15	6	30	2	10
Klebsiella ozaenae	4	20	1	5	-	-
Klebsiella pneumoniae	8	40	2	10	-	-
Proteus mirabilis	9	45	4	20	5	25
Proteus vulgaris	3	15	9	45	3	15
Serratia liquefaciens	3	15	-	-	1	5

3.4 The incidence of E. coli. Table (5) recorded that a total of 12 isolates

of *E. coli* 10%) were isolated from cattle and camel offal samples in a number and percentage of 8 (13.33 %) and 4 (6.67%) respectively. *E. coli* strains isolated from examined cattle offal samples were 4 (20%) from lung samples, 3 (15 %) in liver samples and 1 (5%) in heart samples. On the other hand *E. coli* strains isolated from examined camel offal samples were 2 (10%) in lung samples, 2 (10%) in liver samples and 0 (0%) in heart samples**.** The serotyping of *E. coli* isolated from the examined cattle offal samples were reported in tables (6). The serotypes of *E. coli* were *E. coli* O26 : K60(B6) 4(50%) , *E. coli O55* : K59(B5) 1(12.5%) , *E. coli* O127: K63(B8) 2(25%) and Untypable *E. coli* 1(12.5%).While in camel samples serotyping of *E. coli* isolated were reported in tables (7).The serotypes of *E. coli* were *E.coli* O26 : K60(B6) 2(50%) , *E.coli* O111 : K58(B9) 1(25%) and *E.coli* O119: K69(B19) 1(25%).

3.5 The incidence of Salmonella.

As listed in table (8) Salmonella isolated from the examined offal samples of cattle and camel was 5 (8.33%) and 5 (8.33%) respectively. Salmonella strains isolated from examined cattle offal samples were 2 (10%) from lung samples, 3 (15%) in liver samples and 0(%) in heart samples. On the other hand Salmonella strains isolated from examined camel offal samples were 2 (10%) in lung samples, 4 (20%) in liver samples and 0(0%) in heart samples**.**

The Salmonella species. isolated from the examined cattle offal samples were reported in tables (9) , They were *S. enteritidis* 2 (10%) present only in liver samples , 2 strains of *S. typhimurium* isolates from lung and liver samples each organ samples have 1 (5 %) , and *S. dublin* isolated only from lung samples 1(5%). While Salmonella species isolated from camel offal samples were listed in table (10) were *S. enteritidis* 2 strains isolates from lung and liver samples each organ samples have 1 (5 %) , *S. typhimurium* 1(5 %) isolated only from lung samples , *S. heidlberg* 1(5 %) isolated only from liver samples and *S. leopoldville* 2 (%10) isolated from liver samples of camel.

Table 5. Incidence of *E.coli* isolated from the examined samples of edible cattle and camel offal (n=20).

Offal	Cattle		Camel		Total (40)	
	No.	%	No.	%	No.	%
Lung	4	20	2	10	6	15
Liver	3	15	2	10	5	12.5
Heart	1	5	-	-	1	5
Total (60)	8	13.33	4	6.67	12	10

Table 6. Serotyping of *E.coli* isolated from the examined samples of edible cattle offal (n=20).

E.coli Strains	Lung		Liver		Heart		Strain Characteristics
	No.	%	No.	%	No.	%	
$O_{26}:K_{60}(B_6)$	1	5	2	10	1	5	EHEC
$O_{55}:K_{59}(B_5)$	1	5	-	-	-	-	EPEC
$O_{127}:K_{63}(B_8)$	1	5	1	5	-	-	ETEC
Untypable	-	-	1	5	-	-	---------
Total	3	15	4	20	1	5	

ETEC: Enterotoxigenic *E. Coli*, EPEC: Enteropathogenic *E. Coli*, EHEC: Enterohaemorrhagic *E. coli*

Table 7. Serotyping of *E.coli* isolated from the examined samples of edible camel offal (n=20).

	Lung		Liver		Heart		Strain Characteristics
E.coli Strains	No.	%	No.	%	No.	%	
$O_{26}: K_{60}(B_6)$	1	5	1	5	-	-	EHEC
$O_{111}: K_{58}(B_9)$	-	-	1	5	-	-	EHEC
$O_{119}: K_{69}(B_{19})$	1	5	-	-	-	-	EPEC
Total	2	10	2	10	-	-	

ETEC: Enterotoxigenic *E. coli* , EPEC: Enteropathogenic *E. Coli*, EHEC: Enterohaemorrhagic *E. coli*

Table 8. Incidence of Salmonella organisms isolated from the examined samples of edible cattle and camel offal (n=20).

	Cattle		Camel		Total (40)	
Offal	No.	%	No.	%	No.	%
Lung	2	10	2	10	4	10
Liver	3	15	4	20	7	17.5
Heart	-	-	-	-	-	-
Total (60)	5	8.33	6	10	11	9.16

Table 9. Serotyping of Salmonella organisms isolated from the examined samples of edible cattle offal (n=20).

Serotypes	Lung		Liver		Antigenic Structure	
	No.	%	No.	%	O	H
S. enteritidis	-	-	2	10	1,9,12	g,m : 1,7
S. typhimurium	1	5	1	5	1,4,5,12	i : 1,2
S. dublin	1	5	-	-	1,9,12	g,p : -
Total	2	10	3	15		

Table 10. Serotyping of Salmonella organisms isolated from the examined samples of edible camel offal (n=20).

	Lung		Liver		Antigenic Structure	
Serotypes	No.	%	No.	%	O	H
S. enteritidis	1	5	1	5	1,9,12	g,m : 1,7
S. leopoldville	-	-	2	10	6 , 7	b : z 6
S. heidlberg	-	-	1	5	4 , 5 , 12	1 , 2 r:
S. typhimurium	1	5	-	-	1,4,5,12	i : 1,2
Total	2	10	4	20		

4. DISCUSSION

In case of the total *Enterobacteriacae* count

nearly similar results were obtained by [8] who found that *Enterobacteriacae* count obtained from heart and liver was 2×10^3 and 4×10^4, respectively. And [9] who found that *Enterobacteriacae* count cattle and camel liver $4.28 \times 10^4 \pm 0.71 \times 10^4$ and $2.05 \times 10^4 \pm 0.44 \times 10^4$, respectively**.** However, lower findings were reported by [10] who found that *Enterobacteriacae* count 3.4×10^3 cfu/g in abattoir samples [11] who found that *Enterobacteriacae* count in examined beef liver was 2.2×10^3. But higher finding obtained by [12] who found that *Enterobacteriacae* count in camel liver were 7.6×10^5 cfu/g [13] that recorded *Enterobacteriacae* count of liver and lung was 6.1×10^6 and 1.5×10^7 , respectively**,** [14] who reported that mean Enterobacteriacea count was $8.4 \times 10^5 \pm 6 \times 10^5$, $8.3 \times 10^5 \pm 3 \times 10^5$, $6.3 \times 10^5 \pm 2 \times 10^5$ for liver samples of cattle , camel , respectively and [15] who reported that mean *Enterobacteriacea* count was $2.4\times10^6\pm6\times10^5$ in liver samples, $3.8\times10^6\pm9.5\times10^5$ in heart and $3.5\times10^6\pm9\times10^5$ in lung samples.

Determination of *Enterobacteriace* count indicates the enteric contamination and declares the hygienic quality of raw food [16], and the high Enterobacteriace count reported may explain the fact that the GIT is common habitat of *Enterobacteriacae* organisms and is considered the main source of contamination with these organisms to edible offal during slaughtering, dressing, evisceration, handling and transportation to butcher shops [17]. While in case of Total coliform count nearly similar results were obtained by [9] who reported that total coliform count in cattle liver samples was $1.33 \times 10^4 \pm 0.29 \times 10^4$ and in camel liver samples was $5.86 \times 10^3 \pm 0.73 \times 10^3$ /g. However lower finding were reported by [18] they recorded results of coliform count in camel liver samples was 2×10^3 **[**19**]** who reported that average of coliforms count (MPN) was 2.6×10^3 cfu/g in liver samples [13] who reported that coliform count was 4.5×10^2 and 3.2×10^2 in liver and lung, respectively [11] who reported that average of coliforms count of examined beef liver was 2.37×10^3. But higher figures were recoded by [20] who reported that MPN was2.4×10^5 cfu/g in beef liver and [15] who reported that $9.7\times10^5 \pm3.3\times10^5$ in liver samples, $2.4\times10^6\pm1.1\times10^6$ in heart samples and $4.2\times10^6\pm2.3\times10^6$ in lung samples. The source of coliform contamination to edible offals began during skinning from the hide and hair of animal by knives and workers also during evisceration due to puncture of internal organs or from air, worker utensils or clothes , water used for carcass and offal wash [21, 22, 23].

The incidence of *E.coli* in this study was nearly similar to that reported by [25] who reported that *E. coli* (9.80%) isolated from lungs samples of camels and [26] who reported that incidence of E. coli in fresh bovine lung tissue samples was 20%. While lower findings reported by **[**27] who found that the frequency of isolated *E.coli* was 8.6% and [28] who found that *Escherichia coli* isolated in a percentage of (18.22%) of the examined lung samples. Higher findings reported by [18] who found that *Escherichia coli* isolated from camel liver samples was 15.2%, [29] they isolated *E.coli* (40%) from samples of cattle liver, [30] isolated *E. coli* (26.66%) from lungs of slaughtered camels and [15] who Isolated *E. coli* was 40 % in 25 examined liver samples, 20 % out of 25 examined heart samples and 20 % out of 25 examined lung samples. From the previous results, we observed that *E.coli* obtained from cattle offal samples were double the isolates (number and percentage) obtained from camel offal samples. We observed that *E.coli* isolated from cattle lung samples of was more than isolated from liver and heart samples that explained that lung samples were contaminated than liver and heart samples. While in case of camel *E.coli* isolated from lung samples of was more than isolated from liver and heart samples. While the incidence of *Salmonella* was nearly similar to that reported by [31] who isolated *Salmonella* at a percentage of 16.6% livers of cattle. While lower findings reported by [27] who failed to isolate *Salmonella* [32]

who failed to isolate Salmonella from hearts collected from 200 normal calves, [25] who isolated *Salmonella* species in 2.94 %. From lungs samples of camels and [33] who isolated Salmonella 8.57%, from bovine liver. Higher findings reported by [34] who isolated *Salmonellae* from 32% of samples at evisceration and from 82% of samples after inspection from livers of cattle , [35, 36, 37, 38, 39, 26 and 15] who isolated *Salmonellae* at percentage of 40 % from 25 examined liver samples , in heart were 12 % and in lung recorded 8 %. Presence of *S. heidlberg and S. leopoldville* from camel samples suggesting that they may be come from camels imported from Sudan as this strain of Salmonella prevails in Middle Africa as recorded by [58, 49]. From the previous results, we observed that *Salmonellae* obtained from camel offal samples were more than obtained from cattle samples. We observed that *Salmonellae* isolated from liver samples were more than that isolated from lung and heart samples of camel samples, heart samples of cattle were negative for Salmonellae. While *Salmonellae* isolated from liver samples of cattle were more than obtained from lung and heart samples, heart samples of cattle were negative for *Salmonellae*. The leading source of contamination of carcasses by Salmonella is the evisceration step at the slaughterhouse [40].

Salmonella typhimurium and *Salmonella enteritidis* are the most frequently isolated serovars from food borne outbreaks throughout the world [41]. Moreover, infected animals may excrete Salmonella in their faeces, especially during stress contaminating the environment and transmit the infection to other animals, which may become carriers. The carrier animals bear the salmonellae in their mesenteric lymph node, liver, spleen and gall bladder [42]. Members of family *Enterobacteriaceae* are major causes of opportunistic infection including septicemia, pneumonia, meningitis and urinary tract infections. Examples of genera that cause opportunistic infections are *Citrobacter, Enterobacter, Escherichia, Hafnia, Morganella, Providencia and Serratia* [24].

As a conclusion, the mean total *Enterobacteriacae*a count in cattle lung, liver and heart samples were more than those of camel. Also mean Coliform count in cattle lung, liver and heart samples were more than those of camel. It was observed that lung of both cattle and camel has the largest mean of *Enterobacteriacae*a and Coliform count compared with liver and heart samples of both cattle and camel this suggests that contamination of lung occurred more frequently than liver and heart. In addition, *E.coli* more frequently isolated from cattle than camel samples. *Salmonella* more frequently isolated from camel than cattle samples.

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كلية معتمدة 2013

الميكروبات المعوية فى أحشاء الذبائح الصالحة للاستهلاك

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الملخص العربي

أجريت هذه الدراسة للتعرف علي مدي تواجد الميكروبات المعوية المختلفة فى عينات الأحشاء الداخلية للماشية و الجمال المذبوحة بمجازر المنوفية حيث تم جمع عدد 120عينة من الرئة و الكبد و القلب للماشية و الجمال حيث أجريت الفحوص البكتريولوجية عليها لتحديد العدد الكلي للميكروبات المعوية و الميكروبات القولونية وكذلك محاولة عزل الأيشريشيا كولاي والسالمونيلا وقد أظهرت النتائج أن متوسط العدد الكلى للميكروبات المعوية لعينات الرئة و الكبد و القلب علي التوالى $10\times8.53\pm10^4\times1.41$، $10^4\times3.96$ ± $10^4\times0.75$ و$10^3\times9.17\pm10^3\times2.08$ / جم للماشية و $10^4\times5.26\pm10^4\times1.03$، $10^3\times8.84\pm10^3\times2.17$و$10^3\times4.59\pm10^3\times0.66$/ جم فى عينات الجمال علي التوالى. على الجانب الآخر، كان متوسط العدد الكلى لميكروبات القولون لعينات الرئة و الكبد و القلب علي التوالى $10\times1.72\pm10^4\times0.39$،$10^4\times7.44$، $10\times1.86\pm10^3\times3.25$و$10\times0.67\pm10^3\times51.9$/جم للماشية. و$10\times2.31\pm10^3\times4.27$، $10\times0.89\pm10^3\times8.38$و $10\times1.93\pm10^2\times1.93$/ جم فى عينات الجمال على التوالى . كذلك تم عزل ميكروب السالمونيلا والايشريشيا كولاي والستروباكتر والانتروباكتر والكليبسيلا والبروتيس والسيريتيا بنسب مختلفة وتصنيفهم باستخدام الطرق السيرولوجية. هذا وقد تم مناقشة الأهمية الصحية للميكروبات التي تم عزلها ومدي تأثيرها علي الصحة العامة والمصادر التي تسبب التلوث بهذه الميكروبات وأيضا وكذلك المقترحات التي تؤدي الي تحسين الحالة الصحية لذبائح الغنم والماشية والجمال.

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