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Prevalence and Molecular Characterization of *Yersinia species* Isolated from Dogs and Cats

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Yersinia infection is one of the five main bacterial gastrointestinal diseases of humans. Limited information on the presence of *Yersinia* spp. from companion animals, especially dogs and cats were found. Therefore, this study was carried out to investigate the existence of *Yersinia* spp. in companion animals and to evaluate the antimicrobial profile of zoonotic isolates using classical microbiological techniques and multiplex PCR targeting four virulence-associated genes ystA (*Yersinia* stable toxin gene), *ail* (attachment-invasion locus gene), *inv* (invasion gene) and yadA (*Yersinia* adhesion gene). The study included 200 fecal samples from (cats n= 120 and dogs n= 80), and stool specimens (n=50) from contact owners. Twenty-nine (14.5%) out of 200 fecal samples were found to be positive for *Yersinia* species which were identified as *Y. enterocolitica* was (51.7%), *Y. intermedia* (20.6%), moreover, *Y. Frederiksen* (27.5%). For human stool specimens, *Yersinia* species found to 8 (16%), and *Y. enterocolitica* 50 %. The sensitivity rates of *Y. enterocolotica* to the following antibiotics ciprofloxacin, cefepime, imipenem, norfloxacin, amikacin, cefotaxime was 94.7, 84.2%, 78.4%, 78.4%, 68.4% and 57.9%, respectively. In conclusion, *Yersinia* species particularly *Y. enterocolitica* and related species are existing in dogs, cats, and their human contacts in our locality. Recovery of such enteropathogens and identification of the virulent genes provide an information about the public health hazard and zoonotic role played by such pets as a source and reservoirs. Identification of prevalence of such infection may help to construct the ideal treatment and preventive measures.

Keywords: *Yersinia enterocolitica,* Pets, Antibiotic sensitivity, Multiplex PCR.

Introduction:

The genus *Yersinia* is comprised of 11 species, of which 3 have evidently been shown to cause human disease named yersiniosis [1, 2]. *Yersinia enterocolitica (Y. enterolitica)*, an enteropathogenic species is widely distributed in nature and affects both humans and animals [3]. The genus *Yersinia* is related to family *Enterobacteriaceae* and comprises three human and animal pathogens, *Y. enterocolitica*, *Y. pestis*, and *Y. pseudotuberculosis*. The pathogenic strains of *Y. enterocolitica* and *Y. pseudotuberculosis* cause yersiniosis, an acute enteric disease, in animals and humans [4]. It can be divided to six biotypes (1A, 1B, 2, 3, 4, 5) and comprises many serotypes. There are many biotypes and serotypes of *Yersinia enterocolitica* which is pathogenic as bio/serotypes 4/O:3 and 2/O:9. While, nonpathogenic strains as biotype 1A or non-biotypable strains were also recognized [5]. Eleven serotypes among *Y. enterocolitica* serotypes isolated from human suffering from diarrhea as O:3, O:8, O:9 and O:5.27 were identified [6]. In Germany and in the European Union, yersiniosis has been found the third most described zoonotic infection in humans [7]. *Yersinia enterocolitica* is the most pathogenic one due to the presence of special virulence factors on it as ystA (*Yersinia* stable toxin gene), *ail* (attachment-invasion locus gene), *inv* (invasion gene) and yadA (*Yersinia* adhesion gene) [8].

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Domestic dogs are perceived as, guard dogs, and/or many other purposes [9, 10]. On the other hand, cat has been living in close association with human beings for at least 3500 years. The ancient Egyptians used cats routinely to keep mice, rats and other rodent away from grains. The history of domestic cats may extend to 8000 years old as cat bones and human bones were found buried together in Cyprus Island [11].

Dogs and cats are responsible for transmission of many serious zoonotic diseases to human as rabies, visceral leishmaniasis, influenza, salmonellosis, yersiniosis and cat scratch disease [12]. Furthermore, pet animals, especially dogs are considered to be reservoirs of *Yersinia enterocolitica* infection [13].

The epidemiology of *Y. enterocolitica* infections is complicated and remains inadequately understood [14]. *Y. enterocolitica* infection is more prevalent in children than old ages with signs of gastroenteritis in young age to mesenteric lymphadenitis in old age [15]. It invades intestinal cells then localizes in lymphoid tissue then finally reaches the mesenteric lymph node [3]. The consequent symptoms depend on immune status of infected person, with various clinical symptoms [16].

In Egypt, identification, and molecular characterization of *Y. enterocolitica* has been carried out in meat, milk, and their products [17-19]. However, little is known about the prevalence of such infection in dogs, cats, and their owners. Consequently, the aim of the present study was to identify the zoonotic importance of *Y. enterocolitica* in pets and their owners**,** and the most suitable antibiotics must be used to treat the infection.

Material and Methods

Samples collection and preparation

The present study included 250 fecal samples (200 of pet's origin and 50 of human origin). Two hundred pet's fecal samples were collected from dogs (n=80) and cats (n= 120) of different ages and sexes (Table 1) admitted to various private clinical hospitals, at Dakahlia Governorate, Egypt. As well as fifty human stool specimens were collected from contacts after taking an oral consent. The samples were collected into sterile labeled cups under complete aseptic condition and all the required information was recorded.

Pet's fecal swabs were inoculated into 10 ml peptone sorbitol bile broth tubes and were incubated at 4°C for 21 days (cold enrichment) [21]. For human specimens, Nearly, one gram of owner's stool specimens was inserted into 10 ml sterile peptone sorbitol bile broth tubes

TABLE 1. Oligonucleotide sequence of *Y. enterocolitica* virulence gene features.

Target gene	Primers	Oligonucleotide sequence (5′ → 3′)	Product size (bp)	Reference
YstA	Pr2a (F)	**5′** AATGCTGTCTTCATTTGGAGCA **′3**	145	
	Pr2c (R)	**5′** ATCCCAATCACTACTGACTTC **′3**		
ail	Ail1 (F)	**5′** ACTCGATGATAACTGGGGAG **′3**	170	Falcao et al. (2004) [8]
	Ail2 (R)	**5′** CCCCCAGTAATCCATAAAGG **′3**		
inv	YC1 (F)	**5′** CTGTGGGGAGAGTGGGGAAGTTTGG **′3**	570	
	YC2 (R)	**5′** GAACTGCTTGAATCCCTGAAAACCG **′3**		
YadA	yadA1 (F)	**5′** CTTCAGATACTGGTGTCGCTGT **′3**	849	Thoerner et al. (2003)[20]
	yadA2 (R)	**5′** ATGCCTGACTAGAGCGATATCC **′3**		

under aseptic conditions. The inoculated tubes were incubated at 4°C for 21 days [22]. The bacteriological examinations were done on the laboratory of Hygiene and Zoonoses, Faculty of Veterinary Medicine, Mansoura University. All procedures were approved by Mansoura University Ethical Committee.

Isolation and identification of Y. enterocolitica

After cold enrichment, a loopful was taken from every cultured broth and then spread on CIN (cefulidin- irgasan -novobiocin agar, Oxoid, UK) plates. These plates were incubated at 37°C for 48 h. Colonies suspected of growth were picked up from the surface of CIN medium featuring a dark red center surrounded by a transparent outer region 'red bull's eye', cultured on CIN medium and incubated at 37°C for 24 h for purification. Then, purified colony was placed on tryptone and soybean agar slopes and incubated at 37°C for 18-24 h for further identification. The identified samples were subjected to biochemical tests such as Oxidase test, Triple sugar iron agar (TSI), Methyl Red test and Rapid system.

Molecular characterization

All the identified samples (n=250) were subjected to molecular characterization by PCR.

DNA extraction and preparation from bacterial culture

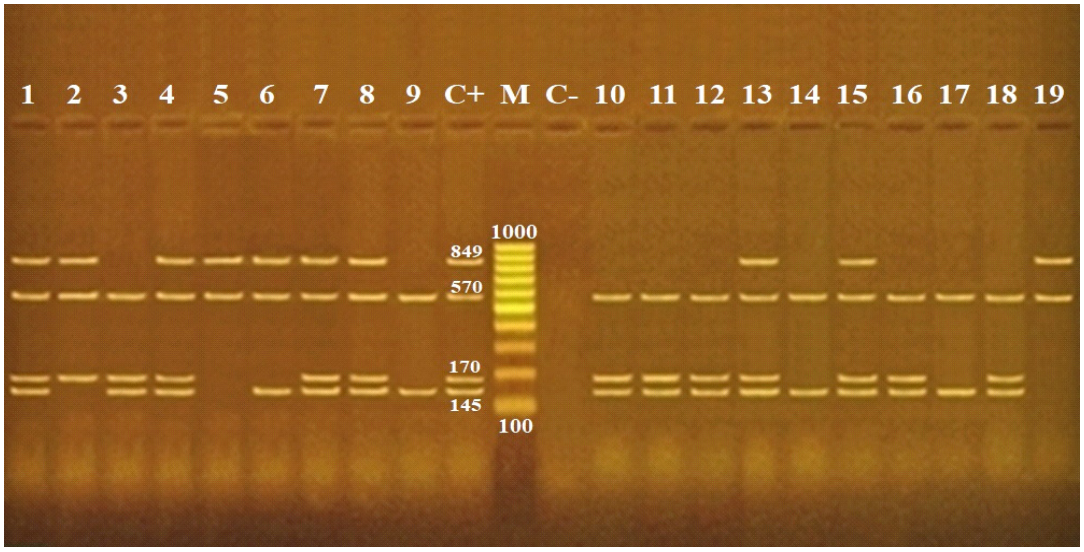
DNA preparation acted by heating as described [24]. Five bacterial colonies with similar shape were obtained and were mixed with 100 µl of sterilized distilled water, then exposed to heat lysis in dry heat block at 95ºC for 15 minutes and centrifuged at 13000 rpm for 2 minutes at 4°C. The supernatant was transferred to sterilized tubes and reserved at -20ºC to use as DNA template.

Amplification of YstA, ail, inv and YstA gene

According to standard technique [25], amplification was performed on a thermos circulator (Cycling Expert, Eppendorf, Hamburg, Germany). Serial circulation polymerization was performed to detect virulence genes of *Yersinia enterocolitica* (*ail* gene, *inv* gene, YstA and YadA gene). The oligonucleotide sequence used was illustrated in table (IV). Polymerase chain reaction were performed in a total volume of 25 µL consists of 10 µL readymade master mix, 1µL of each primer, 1µL of DNA template the completed to 25 µL of DNA free water. The cycle started with denaturation at 94°C for 5 min, followed by 36 cycles of heat denaturation at 94°C for 45 s, denaturation at 62 °C for 45 s, and nuclear thermonuclear extension at 72°C for 45 s. Final cycle incubation at 72°C for 7 minutes. Photographed on UV rays. The sequencing polymerase products were imaged on 1.5% gels stained with ethidium bromide. Molecular marker of 100 bp was used in addition to the evidence ladder.

Lane M: 100 bp ladder as molecular size DNA marker.

Lane C+: Control positive *Y. enterocolitica* for



Photograph (1): Agarose gel electrophoresis of multiplex PCR of YstA (145 bp), *ail* (170 bp), *inv* (570 bp) and YadA (849 bp) virulence genes for characterization of *Yersinia enterocolitica.*

YstA, *ail*, *inv* and YadA genes.

Lane C-: Control negative.

Lanes from 1 to 19: Positive strains for both *inv* gene.

Lanes 1, 3, 4, 6, 7, 8, 9 & from 10 to 18: Positive strains for Yst *A* gene.

Lanes 1, 2, 3, 4, 7, 8, 10, 11, 12, 13, 15, 16 & 18: Positive strains for *ail* gene.

Lanes 1, 2, 4, 5, 6, 7, 8, 13, 15 & 19: Positive strains for Yad A gene.

Antibiotic sensitivity of isolated Yersinia enterocolitica (Antibiograms)

Antimicrobial susceptibility was tested by disc diffusion method for *Y. enterocolitica* (n=19). The antibiotics used were ciprofloxacin, cefepime, imipenem, norfloxacin, amikacin, cefotaxime, trimethoprim-sulphamethoxazol, gentamycin, tetracycline, streptomycin, ampicillin, nalidixic acid, erythromycin and cephalothin Sensitivity tablets with variable concentrations were used to determine the sensitivity of isolated bacterial strains (Oxoid Limited, Basingstoke, Hampshire, UK) according to the standard guidelines stipulated [26]**.**

Results and Discussion

Yersiniosis is a severe disease of public health hazard [3]. Among the gastrointestinal disease in Europe, yersiniosis takes the third level of foodborne gastrointestinal disease [27].

In this study, the occurrence of *Yersinia* spp. in fecal samples of apparently healthy or diarrheic dogs and cats were determined. Table (2) showed that by examining 200 pet fecal samples (80 for dogs and 120 for cats), 11(13.7%) of dog fecal samples were positive for *Yersinia* species. These were allocated to *Yersinia enterocolitica* 7 (63.6%), *Yersinia intermedia* 2 (18%) and *Yersinia Frederiksen* 2 (18%). Nearly similar occurrence rate (9.8 %) was recorded in dogs [28]. However, higher occurrence rate (43.6%) has been also reported [29]. On the other hand, lower occurrence was recorded in several reports [23, 30-32] with isolation rates of 1.3%, 1%, 0.4% and 4.6%, respectively.

Concerning cat samples, the results summarized in table (2) clarified that 18 (15%) of 120 cat samples were positive for *Yersinia* species. These were typed as *Yersinia enterocolitica* 8 (44.4%), *Yersinia intermedia* 4 (22.2%) and *Yersinia Fredriksson* 6 (33.3%). Nearly similar occurrence rate was previously detected by Hashemi et al. [33] who reported the isolation rate (8%) of *Yersinia enterocolitica* from cats. While the occurrence rates (2 and 0.3%) were previously reported [30, 32], respectively.

Regarding the serotyping of *Yersinia enterocolitica* isolated from pets, table (3) revealed that three different serotypes and biotypes of *Yersinia enterocolitica* recovered from fecal samples of dogs were identified. The identified *Yersinia enterocolotica* strains were belonged to serotype/biotype O:3/2, O:8/3, O:5/4, O:5/3,

TABLE 2. Frequent distributions of *Yersinia* spp. from the examined Pets animals and their owners.

Source of samples	examined Samples (n=250)	Positive	Total %	*Yersinia* species *					
				Y. enterocolitica (n=19)	% (7.6)	Y.intermedia (n=7)	%	Y. Frederiksenii (n=11)	% (4.4)
Cat fecal swab	**120**	**18**	**15**	**8**	**44.4**	**4**	**22.2**	**6**	33.3
Dog fecal swab	80	11	13.7	7	63.6	2	18.1	2	18.1
Human stool	50	8	16	4	50	1	12.5	3	37.5

The percentage of each isolated *Yersinia* species was calculated from the number of examined samples of each category.

O:3/3 and O:5/2. While the identified serotypes and biotypes of *Yersinia enterocolitica* isolated from cats were O:5/3, O:3/2, O:3/4, O:5/5, O5/2, O:3/3 and O:8/3. It has been found that nearly similar biotypes of *Yersinia enterocolitica* were isolated from fecal samples of dogs and cats. The identified dog biotypes were 4, 2, 3 and 5, however, the cat biotypes were 4, 3, 2 [32]. At the same time, the serotype and biotype of fecal sample isolated from dogs was O:3/4 [34, 35]. Moreover, the same sero/biotype O:3/4 has been identified in dog and cat samples [36].

In the present study by examination of 50 human stool samples (Table 2), it was clarified that *Yersinia* species was allocated to 8 (16%), *Y. enterocolitica* 50 % (4 out of 8). A lower occurrence rate (18%) was previously detected after examination of 406 fecal samples [5]. Moreover, in human, 55.4% of 12526 stool samples were found positive [37]. On the other hand, lower occurrence rates of *Y. enterocolitica* was previously recorded by many authors with isolation rates of 3.2%, 3%, 1.2%, 5.5% and 4 % respectively [6, 23, 38-40]**.** Concerning the isolated *Yersinia* species strains other than *Y. enterocolitica*, *Y. intermedia* was detected only from one sample with isolation rate of 12.5%. Moreover, *Yersinia Frederiksen* was detected in three sample with isolation rate 37.5 %.

Investigation of 50 human fecal samples revealed that 8 (16%) were positive for *Yersinia* species, 7 (87.5%) from diarrheic patients and 1 (12.5%) from apparently healthy persons (Table 3). From diarrheic patients, 7 samples were identified

TABLE 3. Virulence, antimicrobial resistance, serotypes and biotypes of the isolated *Yersinia enterocolotica* strains from pets' animals and human (n=19).

Source of sample	Virulence gene	Antimicrobial resistance profile	MAR index	Serotype/ Biotype
Human	inv, YstA, YadA ail gene	CN, E, NA, AM, S, T, G, SXT, CTX, AK, NOR IPM, FEP, CP	1	O:5/1A
Human	inv, YstA, ail, YadA gene	CN, E, NA, AM, S, T, G, SXT, CTX, AK, NOR IPM, FEP	0.958	O:9/5
Dog	inv gene	CN, E, NA, AM, S, T, G, SXT, CTX, AK, NOR	0.786	O:3/2
Dog	inv, YstA, ail gene	CN, E, NA, AM, S, T, G, SXT, CTX	0.643	O:5/3
Dog	inv, YstA, YadA gene	CN, E, NA, AM, S, T, G, SXT, CTX	0.643	O:8/3
Dog	inv, YstA, ail gene	CN, E, NA, AM, S, T, G	0.500	O:5/4
Dog	inv, YstA, ail gene	CN, E, NA, AM, S, T, G	0.500	O:5/3
Human	inv, ail, YstA gene	CN, E, NA, AM, S, T	0.428	O:3/4
Cat	inv, YadA, yst Agene	CN, E, NA, AM, S	0.357	O:5/3
Cat	inv, yst Agene	CN, E, NA, AM, S	0.357	O:3/2
Cat	inv, YstA, ail, YadA gene	CN, E, NA, AM	0.286	O:3/4
Human	inv, ail, YstA, YadA gene	CN, E, NA, AM	0.286	O:3/3
Cat	inv, ail, YstA gene	CN, E, NA, AM	0.286	O:5/5
Cat	inv, YstA, YadA gene	CN, E, NA	0.214	O:5/3
Cat	inv, ail, YadA gene	CN, E	0.143	O:5/2
Dog	inv, ail, YstA, YadA gene	CN, E	0.143	O:3/3
Cat	inv, ail gene	CN	0.071	O:3/3
Cat	inv, ail, YstA, YadA gene	CN	0.071	O:8/3
Dog	inv, ail, YstA, YadA gene	CN	0.071	O:5/2
		Average 0.417		

CN: Cephalothin E: Erythromycin NA: Nalidixic acid AM: Amp
S: Streptomycin T: Tetracycline G: Gentamicin AK: Amikacin
CTX: Cefotaxime Nor: Norfloxacin IPM: Imipenem FEP: Cefepime CP: Ciprofloxacin
TMP-SXT: Sulphamethoxazol

as *Y. enterocolitica* 3 (42.8%), *Y. intermedia* 1 (14.2) and *Y. Frederiksen* 3 (42.8%). However, from apparently healthy, 1 sample was allocated to *Y. enterocolitica* 1 (100%). Many researchers were previously isolated *Y. enterocolitica* from diarrheic patients [6, 38, 40, 41].

Table (3) illustrated the biotypes and serotypes isolated from human samples, it was found that the biotypes O:5/1A is prevalent, which considered to be non-pathogenic, this finding was supported by result of previous report [42]**.** Less serotypes were detected in other report in which serotyping of 37 *Y. enterocolitica* strains isolated from fecal sample of human suffering from diarrhea found that all the identified serotypes were belonged to O:3/4 [34]. While in India, examination of 1198 children stool sample suffering from diarrhea and by serotyping, all the isolates were belonged to biotype 1A [38]. In 2005, two bio serotypes 1A, and O:3/4 have been identified [43].

In the present study PCR was applied to detect the presence of virulence genes in identified *Y. enterocolitica* strains (n=19) isolated from fecal sample of human (n=4), dog (n=6) and cat (n=8) as shown in figure 1. Yst A (Yersinia stable toxin gene) gene was identified in 16 sample of all isolated *Y. enterocolitica* strains from human, dog, and cat with percentage of 84.2. It was found in all human and dog isolates while in cat it was detected in 6 out of 8 isolates.

While *ail* (attachment-invasion locus gene) gene was identified from 13 *Y. enterocolitica* isolates with percentage of 68.4. It was found in all human isolates, 5 dog isolates out of 6 and in 4 cat isolates out of 8. In a study, ail gene was identified in the examined *Y. enterocolitica* strains isolated from fecal sample of dog and cat as 5 in dog samples and 3 in cat samples [3]. Earlier report detected the presence of ail gene in isolated *Y. enterocolitica* strains from examined fecal samples of dog and cat at 91.6% of dog samples, and 100% of cats [32].

On the other hand, *inv* (invasion gene) gene was detected in all the examined isolates. While YadA (Yersinia adhesion gene) gene was identified from 10 isolates of *Y. enterocolitica* with percentage of 52.6. Three isolates belonged to human, 3 for dog and 4 for cat. Our results are similar to those reported in previous study which detected the presence of inv, ail and Yst A in all strains isolated from fecal sample of human and dog [8]. In a study carried out in China on *Yersinia enterocolotica* strains isolated from fecal sample of dog, three strains were examined by PCR. The result was, only 2 strains had *ail*, Yst B gene, while, one strain had *ail*, Yst B and Yst A gene [28].

In this study, the susceptibility of 19 *Y. enterocolitica* strains isolated from fecal sample of human, dog and cat suffered from diarrhea or apparently healthy to 14 different antibiotics was applied. The resistance to cephalothin was 100%, but the resistance decreased gradually to erythromycin (84.2%), nalidixic acid (73.7%), ampicillin (68.4%), streptomycin (52.6%), tetracycline (42.1%), gentamycin (36.8%), trimethoprim- sulphamethoxazol (31.6%), cefotaxime (26.3%), amikacin (26.3%), norfloxacin (15.8%), imipenem (10.5%), cefepime (10.5%) and finally ciprofloxacin (5.3%).

So, it was concluded that the most suitable antibiotic for treatment of *Yersinia enterocolitica* infection is ciprofloxacin. These results agreed with the result reported by Falcão et al.[44] who used disc diffusion method to detect antimicrobial resistance of some antibiotic to *Yersinia enterocolitica* isolates isolated from human and pet animals. Human strains were resistant to at least ampicillin, cephalothin and cephazolin while animal strains were resistant to the same antibiotics and amikacin. However, [39] detected sensitivity of 3 of *Yersinia enterocolitica* isolates recovered from human stool to different antibiotics. Two of them were sensitive to nalidixic acid and tetracycline and resistant to rifampin, imipenem, ceftazidime, amoxycillin and cephalexin.

The results obtained by Saraka et al.[41] go in harmony with the present study shown in table (7) as they examined *Yersinia enterocolitica* isolates obtained from human and animal samples by the disc diffusion method on Mueller-Hinton agar for the Antibiotic susceptibility. Their results revealed that 2 isolates were resistant to amoxicillin, amoxicillin/clavulanic acid, cephalothin, and ticarcillin. Moreover, the susceptibilities of the examined isolates were to cefoxitin, ceftriaxone, ciprofloxacin, nalidixic acid, trimethoprim, sulphonamide and tetracycline.

Furthermore, the present finding agreed with Cilia et al. [21] who carried out antibiotic sensitivity test to 7 *Yersinia enterocolotica* strains isolated from dog in Italy. They used desc diffusion method to apply antibiotic sensitivity tests. The isolates were resistant to amoxicillin–clavulanic acid, cephalothin, and ampicillin.

TABLE 4. Antimicrobial susceptibility of *Yersinia enterocolitica* strains (n=19).

Antimicrobial agent	Sensitivity disc content	Sensitive		Intermediate		Resistant	
	(ug)	No	%	No	%	No	%
Cephalothin (CN)	10	-	-	-	-	19	100
Erythromycin (E)	30	-	-	3	15.8	16	84.2
Nalidixic acid (NA)	30	2	10.5	3	15.8	14	73.7
Ampicillin (AM)	10	4	21.1	2	10.5	13	68.4
Streptomycin (S)	5	5	26.3	4	21.1	10	52.6
Tetracycline (T)	30	9	47.4	2	10.5	8	42.1
Gentamicin (G)	10	11	57.9	1	5.3	7	36.8
Trimethoprim-Sulphamethoxazol (TMP-SXT)	20	12	63.2	1	5.3	6	31.6
Cefotaxime (CTX)	30	11	57.9	3	15.8	5	26.3
Amikacin (AK)	10	13	68.4	1	5.3	5	26.3
Norfloxacin (NOR)	15	15	78.9	1	5.3	3	15.8
Imipenem (IPM)	30	15	78.9	2	10.5	2	10.5
Cefepime (FEP)	10	16	84.2	1	5.3	2	10.5
Ciprofloxacin (CP)	25	18	94.7	-	-	1	5.3

Conclusion:

In conclusion, *Yersinia* species particularly *Y. enterocolitica* and related species are existing in dogs, cats, and their human contacts in our locality. Recovery of such enteropathogens and identification of the virulent genes provide an information about the public health hazard and zoonotic role played by such pets as a source and reservoirs. Identification of prevalence of such infection may help to construct the ideal treatment and preventive measures.

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Ethical approval

This study was conducted with the approval of PHD 51.

Conflict of Interest

The authors declare that there is no conflict of interest.

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التوصيف الجزيئي ومدى انتشار أنواع ميكروب اليرسينيا المعزولة من الكلاب والقطط

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تعتبر العدوي بميكروب اليرسينيا هي واحدة من أهم خمسة أمراض معدية معوية بكتيرية رئيسية للإنسان، وما زالت المعلومات المتاحة محدودة عن وجود أنواع اليرسينيا في الحيوانات الأليفة وخاصة الكلاب والقطط. لذلك أجريت هذه الدراسة للتحقق من وجود أنواع ميكروب اليرسينيا في الحيوانات المرافقة ولتقييم خصائص مضادات الميكروبات للعزلات ذات المنشأ الحيواني والتي تم التعرف عليها وذلك باستخدام التقنيات الميكروبيولوجية وتفاعل البلمرة المتسلسل المتعدد والذي يستهدف التعرف علي أربعة جينات مختلفة وهي YstA)و ail و inv و (YstA وقد تضمنت هذه الدراسة جمع عدد 200 عينة براز (120 من القطط و 80 من الكلاب) وكذلك جمع عدد 50 عينة براز من أصحاب الحيوانات الأليفة المخالطة وأسفرت النتائج علي العثور على تسعة وعشرين عترة (14.5٪) من إجمالي عدد 200 عينة برازية لتكون موجبة لأنواع عترات اليرسينيا التي تم تحديدها على أنها 15 عينة تنتمي اليY. enterocolitica وعدد 6 عينات تنتمى الىY. intermedia وعدد 8 عينات تنتمى الى Y. Frederiksen

وبالنسبة لعينات البراز البشرية ، وجد أن أنواع اليرسينيا تصل إلى عدد 8 (16٪) ،تم تحديد عدد ارعة عينات منهم على انه Y.enterocoliticaو عينة واحدة من Y. intermedia وعدد 3 عينات من Y. Frederiksen

وكانت معدلات حساسية Y. enterocolotica للمضادات الحيوية التالية: سيبروفلوكساسين ، سيفيبيم ، إيميبينيم ، نورفلوكساسين ، أميكاسين ، سيفوتاكسيم 94.7٪ ، 84.2٪ ، 78.4٪ ، 78.4٪ ، 68.4٪ و 57.9٪ على التوالي.

وقد تبين من النتائج أنه تم عزل أنواع متشابهة في التركيب الجيني موجودة في الكلاب والقطط وكذلك الأشخاص المخالطين مما يوضح مخاطر هذه العترات علي الصحة العامة والدور الوبائي الهام الذي تلعبه هذه الحيوانات الأليفة كمصدر وعائل خازن للعدوي مما يساعد علي معرفة مدى انتشار مثل هذه العدوى في تحديد العلاج الأمثل والتدابير الوقائية اللازمة لمنع انتشار العدوي.

الكلمات المفتاحية: ميكروب اليرسينيا ، الحيوانات الأليفة ، حساسية المضادات الحيوية , جهاز البلمرة المتسلسل المتعدد.