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The Relation between Climatie Changes and Fleas in Stray Cats: with a Particular Reference to their Role as Intermediate Host of *Dipylidium caninum*

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Abstract

Dipylidium caninum is a prevalent tapeworm in canines and carries zoonotic significance, as it can result in clinical conditions in humans. The study therefore aimed to evaluate the prevalence, morphological, and molecular diagnosis of *D. Caninum* in stray cats as well as the association between climatic changes and fleas infesting strays and their role in the transmission of *D. caninum*. Between January 2023 and January 2024, fifty stray cats were gathered from various areas within the governorate of Alexandria. Twelve (24%) of the fifty stray cats that were investigated by us were positive for *D. caninum*. Sixty eight % of the stray cats had flea infestations. *Ctenocephalides felis* was the most often observed species on cats (28/50=56%), with *Ctenocephalides canis* coming in second (11/50=22%). *D. caninum*, *C.felis*, and C. canis were morphologically identified. The COX1 gene of the cestode species was amplified and yielded the expected PCR product size (450 bp) from samples then published (GenBank accession number OR511472 and OR511473). As shown in the sequence distance figure, the sequenced strains showed 90.1-99.7% identity to *Dipylidium caninum* strains confirming the clustering of the study strain with *Dipylidium caninum* A significant frequency of *D. caninum* was identified in stray cats in Alexandria, Egypt, with phylogenetic and molecular techniques employed to verify the species' identity. Comprehensive research on the prevalence, as well as molecular and genetic analysis of *D. caninum* in Egypt, is necessary alongside control strategies.

Keywords: cats, *D. caninum*, COX1, molecular, *C. felis, C. canis*.

Introduction

Dipylidium caninum is a prevalent tapeworm in canines and carries zoonotic significance, as it can result in clinical conditions in humans. [1]. Humans become inadvertent hosts following the ingestion of fleas. There are large differences between age maturation that this infection is more widespread in infants and young children, who, because of their playful behavior attract dogs and cats [2]

D. caninum is a common cestode infecting both cats and dogs, which causes dipylidiasis. Dipylidiasis is a metacestode disease that ranks as one of the most common infections in these animals while it is very rare in humans [3]. The life cycle of *D. caninum* is complex and requires more than one host, with gravid segments going through the feces of the mammal or being found about the anus of the host. The gravid segment releases the egg into the intermediate host mainly fleas of Ctenocephalides spp., (louse-*Trichdectus canis*), and the oncosphere is released in the intestine of the insect after eating an egg. The oncosphere penetrates the intestinal wall and develops in the insect's hemocoel and encysts as a cysticercoid larva. The adult flea/louse gets infected by the cysticercoid, which the dogs ingest to become infected [4].

The genus *Dipylidium* includes several suggested species according to historical morphological observations. However, the wide overlapping of morphological characters rendered it as one species namely *D. caninum*. Therefore, *Dipylidium* is now a monotypic genus. Nevertheless, when morphological characters are difficult to apply/understand or show insufficient variation, (many) cryptic species can be

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revealed with the aid of modern molecular methods. Molecular studies have the potential to provide an ideal system of study for species in the genus *Dipylidium* [5].

Fleas are a genus of ectoparasites characterized by their laterally compressed bodies. They are directly implicated in the transmission of various diseases, including bubonic plague, murine typhus, tularemia, and listeriosis [6]. Additionally, fleas can act as hosts for certain zoonotic tapeworms, namely *Dipylidium caninum* and *Hymenolepis diminuta* [7]. The cat flea, *C. felis*, serves as the primary intermediate host due to its global distribution and capacity to infest both dogs and cats [8].

Besides the factor of climate changes, a growing domestication and pet ownership not only closer relationship to their keepers and sheltered or stray animals but also in the number might influence the occurrence as well as endemicity of intermediate hosts [9, 10]. Also, today for that time changes in climatic conditions and the pronounced variability of temperature degrees in different seasons lead to changes in incidence rates as well as the geographical range of *D. caninium* and its intermediate host with high morbidity and mortality burdens.

The study therefore aimed to evaluate the prevalence, morphological, and molecular diagnosis of *D. Caninum* in stray cats as well as the association between climatic changes and fleas infesting strays and their role in the transmission of *D. caninum.*

Material and Methods

Study area

Between January 2023 and January 2024, fifty stray cats were gathered from various areas within the governorate of Alexandria. The Alexandria Governorate is situated in Egypt on the Mediterranean Sea's southern coast. It runs roughly 114 miles (183 kilometers) northwest of Cairo along the Mediterranean Sea shoreline in North Central Egypt. It is located on the strip of land between Lake Maryut and the sea at the western tip of the Nile River Delta. The climate in the city is pleasant Mediterranean. The hottest month is August, with an average temperature of (31°), while the coldest month is January, with an average temperature of (18°). According to the New World Encyclopedia, winters are stormy and cold, with hail and torrential rain.

Cat sampling

Trapping (using a baited cage trap) was used to capture stray cats. For parasitological analysis, the captured cats were moved to the Animal Health Research Institute's Alexandria lab's parasitology department. The confined felines were compassionately euthanized using Xylaject (Xylazine Hydrochloride 23.3 mg, Adwia business) via intramuscular injection (0.5 ml per 10 kg) and subsequently mercifully terminated with an overdose of chloroform, while their age was evaluated through dentition according to Floyd (1991) [11].

Morphological analysis

Flea specimens were obtained from stray cats using an appropriate comb, and a fine-toothed flea comb made of stainless steel was used to comb the entire body [12]. Samples were kept in 70% ethyl alcohol until processing. Species identification of fleas was based on microscopic examination as described by Wall and Shearer (2001) and Soulsby (1982) [13, 14].

Necropsy involves opening the abdominal cavity, removing the gastrointestinal system, opening it lengthwise, and looking for cestodal segments [15]. *Dipylidium caninum* worms underwent a series of steps including washing in physiological saline solution, relaxing in a refrigerator, fixing in 10% formalin, staining with a 1% concentration of acetic acid-alum carmine, dehydrating via ethyl alcohol serial passage, clearing in clove oil, briefly washing in xylene, and mounting in Canada balsam [16] and identified according to Yamaguti (1959) [17]. The worms are stored at -20°C until prepared for DNA extraction [18].

Molecular analysis

DNA extraction

DNA extraction from samples was performed using the QIAamp DNA Mini kit (Qiagen, Germany, GmbH) with modifications from the manufacturer's recommendations. Briefly, 25 mg of the sample was incubated with 20 µl of proteinase K and 180 µl of ATL buffer at 56^{O}C overnight. After incubation, 200 µl of AL buffer was added to the lysate, and incubated for 10 min. At 72^{O}C, then 200 µl of 100% ethanol was added to the lysate. The lysate was then transferred to a silica column and centrifuged. The sample was then washed and centrifuged following the manufacturer's recommendations. Nucleic acid was eluted with 100 µl of elution buffer provided in the kit.

PCR amplification

Targeting the COX1 mt DNA gene with expecting amplicon size of 450 bp. Primers Cestode COX1, Forward TTT TTT GGG CAT CCT GAG GTT TAT, and Reverse TAA AGA AAG AAC ATA ATG AAA ATG were utilized according to Aboelhadid et al. (2012) [19], conducted in a 25 µl reaction that includes 5 µl of DNA template, 5.5 µl of water, 1 µl of each primer at a concentration of 20 pmol, and 12.5 µl of EmeraldAmp Max PCR Master Mix (Takara, Japan). A 2720 thermal cycler from Applied Biosystems was used to carry out the reaction. Primary denaturation at 94°C for 5 minutes, followed by 35 cycles of amplification; secondary

denaturation at 94˚C for 30 seconds, annealing at 55˚C for 40 seconds, and extension at 72˚C for 45 seconds were the cycling conditions. Extension finalized: 72˚C/10 min.

Analysis of the PCR Products.

The PCR products were separated by electrophoresis employing gradients of 5V/cm on a 1.5% agarose gel (Applichem, Germany, GmbH) in 1x TBE buffer at room temperature. Each gel slot held 15 µl of the items for the gel analysis. The fragment sizes were calculated using the Fermentas, Germany-based Gene Ruler 100 bp Ladder. A gel documentation system (Alpha Innotech, Biometra) took pictures of the gel, and computer software was used to analyze the data.

Sequencing and phylogenetic analysis

Using a QIAquick PCR Product extraction kit (Qiagen, Valencia), PCR products were purified. The sequence reaction was carried out using a Bigdye Terminator V3.1 cycle sequencing kit (Perkin-Elmer), and it was then purified using a Centrisep spin column. The Applied Biosystems 3130 genetic analyzer (HITACHI, Japan) was used to collect DNA sequences, and BLAST® (Basic Local Alignment Search Tool) [20], was initially performed to establish sequence identity to GenBank accessions. LasergeneDNAStar version 12.1's Meg Align module generated the phylogenetic tree [21]**,** and using maximum likelihood, neighbor-joining, and maximum parsimony, phylogenetic analyses were conducted in MEGA6 [22].

Results

Twelve (24%) of the fifty stray cats that were investigated by us were positive for *D. caninum*. 68 percent of the stray cats had flea infestations. *Ctenocephalides felis* was the most often observed species on cats (28/50=56%), with *Ctenocephalides canis coming* in second (11/50=22%).

D. caninum was more common in cats over the age of one year (57.1%) than in children under the age of one (33.3%). In terms of the seasonal dynamics of *D. caninum* in stray cats, summer had the highest infection rate (80%), followed by autumn (66.7%), spring (33.3%), and winter (20%), which had the lowest prevalence rate.

In cats under one year old, the prevalence of flea infestation was 53.3%, whereas, in adults over one year old, it was 85.7%. Summer (93.3%) was the season with the highest prevalence of flea infection, and the prevalence in autumn was 80%, in winter was 40%, and in spring was 73.3%.

Morphological identification of Dipylidium caninum

D. caninum adults may reach to a maximum length of 50 cm. The scolex has a transverse diameter of 250–500 um and a rhomboidal shape. In addition to its four suckers, the scolex also features a retractable rostellum with four rows of hooks. In general, mature and gravid segments towards the posterior are larger than anterior immature segments. Every fully developed segment has two sets of reproductive organs, each of which has a lateral genital pore located roughly in the middle of the segment's lateral border. In gravid segments, D. caninum eggs are arranged throughout the middle region of the segment in remarkably recognizable egg packets or egg capsules. A packet of eggs can hold up to thirty eggs (fig.1).

Ctenocephalides felis

Ctenocephalides felis have six legs but no wings, are small (up to a few mm in length), and are laterally flattened. Because it is larger and longer than the other pairs of legs, the caudal pair is crucial for jumping. The male's penile sheath, claspers, and hind tibia are more distinct from the female's, which has a more c-shaped sperm theca, genal and pronotal comb, pygidium, and bristles that are crucial for identification. The female's head is roughly triangular (fig.2).

Ctenocephalides canis

Ctenocephalides canis has a more rounded head that is roughly 1.5 times longer than it is wide. It also contains a few bristles, a genal and pronotal comb, a c-shaped sperm theca unique to females, claspers, and a penile sheath for males (fig.2).

Sequencing and genotyping of isolates

The COX1 gene of the cestode species was amplified and yielded the expected PCR product size (450 bp) from samples (fig. 3), then published (GenBank accession number OR511472 and OR511473). As shown in the sequence distance figure, the sequenced strains showed 90.1-99.7% identity to Dipylidium caninum strains confirming the clustering of the study strain with Dipylidium caninum (fig. 4). The phylogenetic tree cleared the clustering of the collected Dipylidium caninum with Dipylidium caninum strains. (fig. 5).

Discussion

The cosmopolite tapeworm parasite *D. caninum* lives in the small intestines of dogs and cats and is regarded as a serious public health issue in many regions of the world [24].

The cat flea, *Ctenocephalides felis*, serves as the primary intermediate host of D. caninum. Moreover, *C. felis* can infest both canine and feline hosts. The dog flea (*Ctenocephalides canis*) also serves as an intermediate host but rarely infests felines. he molecular characterization of *D. caninum* isolates obtained from dogs and cats facilitated the identification of two distinct genotypes that exhibit differences from each other [5].

According to the current study, *D. caninum* was present in 24% of the stray cats examined in Alexandria. This result differed from other studies such as Rodriguez-Vivas et al. (2001), Canto et al. (2013), Calvete et al. (1998), Millán (2009), and Al-Ardi (2024) [25, 26, 27, 28, 29] as *D. caninum* was found in 17% and 3.3% in Mexico, 20.7%, and 3% in Spain, and 8.1% in Iraq, respectively. This result matched with Nichol et al. (1981) [30], that found D. caninum (35%) in England. Based on the species of animals and its lifestyle, there can be different risks of *D. caninum* infection. A higher risk of infection exists in stray and shelter animals because they are less likely to have access to veterinary care [31].

The current survey revealed that the incidence of *D. caninum* was higher in cats of age older than 1 year (57.1%) than in cats of age ≤ 1 year (33.3%). This result matched with López-Aria et al. (2019) and Nagamori et al., (2020) [32, 33]. This might be related to protective immunity in older individuals. other studies revealed that infection increased with age such as Al-Ardi (2024) [29]. There have also been reports linking prevalence to the animal's body temperature. Younger animals might find it more difficult to regulate their body temperature, which hinders the fleas' ability to create cysticercoids [31].

In this study, summer showed the highest infection rate of *D. caninum* while Calvete et al. (1998) [27] showed that the cold period had the highest infection rate.

A current study showed that the prevalence of fleas was 68% and the most common species was *Ctenocephalides felis*. These results agreed with Canto et al. (2013) [26] who found that 55% of stray cats were infected with fleas and the main species was *C. felis*, with Cruz-Vazquez et al. (2001) [34] which showed that 30.3% of cats infected with fleas and the common type was *C. felis*, and with Abdullah et al. (2019) [9] which found that *C. felis* was the main type infected cats and infection rate of fleas was 28.1%. While Kristensen et al. (1978), Beresford-Jones (1981), and Alcaino et al. (2001) [35, 36, 37] showed that the main species that infected cats, was *C. canis*. Due to its worldwide distribution, and its ability to infest dogs and cats, the cat flea, *C. felis*, is the main intermediate host [8].

This study revealed that adult cats were infected with fleas more than young cats. This result matched with Canto et al. (2013) [26].

The present study revealed that summer and autumn had the highest infection rates. This result matched with Canto et al. (2013) [26] in which autumn and summer showed the highest prevalence, and Xhaxhiu et al. (2009) [38] showed that the highest infection rate was in summer. This phenomenon is attributed to the relative humidity exceeding 50%, which is necessary for optimal larval development of these fleas [10].

Morphological examination of specimens in the present work agreed with the description of *D. caninum, C. felis,* and *C. canis* [13, 14, 17]

Visual examination using a hand lens or microscope can be employed to observe the worm; however, molecular diagnostic techniques utilizing specialized primers for specific genes provide more accurate and reliable results [29]. The current study's sequencing revealed that the species was *D. caninum* by BLAST, a comparison of the newly obtained COX1 sequence with other Dipylidium sequences on GenBank. The present study's *D. caninum* and South American dogs' *D. caninum* showed a significant degree of closeness, according to a phylogenetic tree based on COX1 [39].

Conclusions

A significant frequency of *D. caninum* was identified in stray cats in Alexandria, Egypt, with phylogenetic and molecular techniques employed to verify the species' identity. Comprehensive research on the prevalence, as well as molecular and genetic analysis of *D. caninum* in Egypt, is necessary alongside control strategies.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

To prevent harm and minimize pain, all procedures were created following national laws and regulations regarding the handling of animals.

Abbreviations

COX1	cytochrome oxidase 1
C. felis	*Ctenocephalides felis*
C. canis	*Ctenocephalides canis*
D. caninum	*Dipylidium caninum*

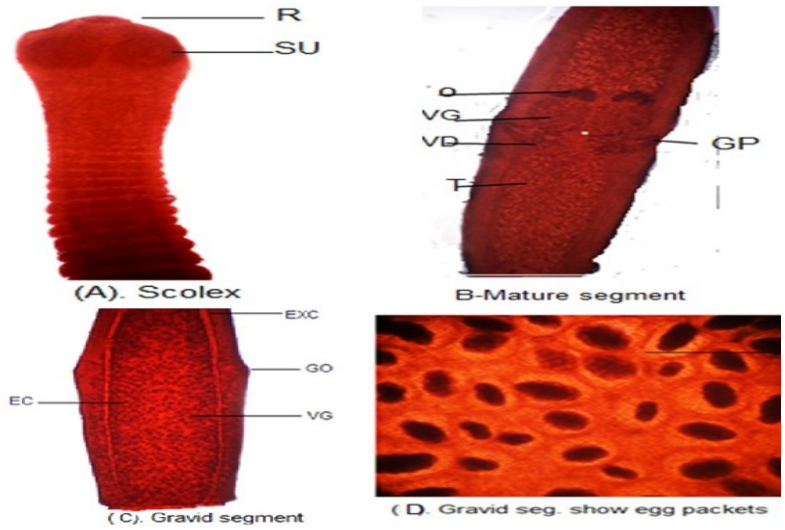

Fig. 1. ***Dipylidium caninum*** **showing:**

A) Scolex B) Mature segment C) Gravid segment
D) Gravid segment showing egg pockets
R: rostellum. RH: rostellar hooks. SU: suckers. GP: genital pore. T: testes. O: ovary. VG: vitelline glands. VD: vasa deferentia. EP: egg packets. EC: egg capsule.

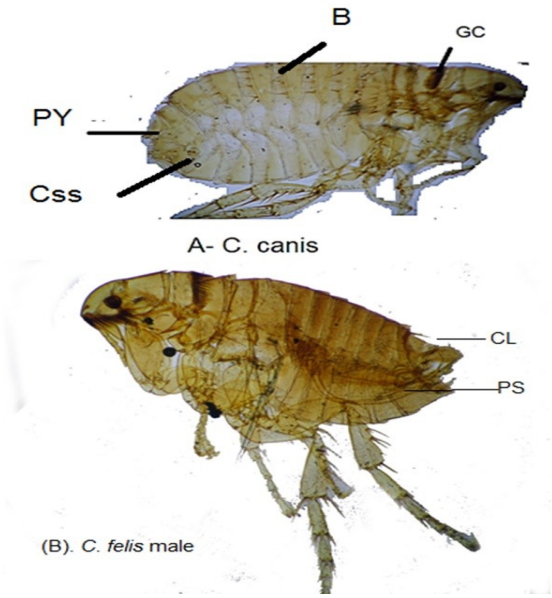

Fig. 2. ***Ctenocephalides*** **showing:**
A) *C. canis* B) *C. felis*
B: Bristles. GC: genal comb. PC: pronotal comb. PY: pygidium. CSS: c shape spermatheca. CL: clasper. PS: penile sheath.

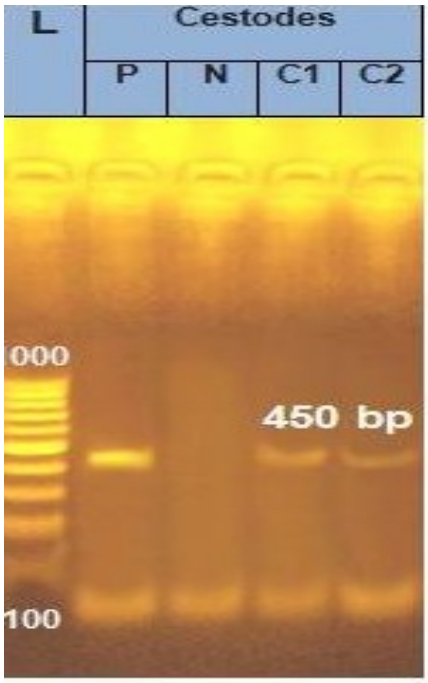

Fig. 3. PCR results for Cestode *COI* gene showing positive amplification of 450 bp of *COI* gene in the tested sample. L [Gene ruler 100 bp ladder (Fermentas, Thermo 100-1000 bp)].

C1: Sample2 C2: Sample2 N: Negative control
P: Positive control L: 100-1000 bp. Ladder

Percent Identity

Divergence

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
1		99.7	99.2	89.8	89.5	89.8	89.8	89.5	89.5	89.3	88.7	88.2	87.6	87.1	89.0	89.8	83.7	84.0	82.6	79.6	81.5	79.9	77.4	77.1	72.2	73.3	81.5	1
2	0.3		99.4	90.1	89.8	90.1	90.1	89.8	89.8	89.5	89.0	88.4	87.9	87.3	89.3	90.1	84.0	84.3	82.9	79.9	81.8	80.2	77.7	77.4	72.5	73.6	81.8	2
3	0.8	0.6		90.1	89.3	90.1	90.1	89.8	89.3	89.0	88.4	87.9	87.3	86.8	89.3	90.1	84.0	84.3	82.9	79.3	81.8	79.6	78.2	77.4	72.5	73.0	81.8	3
4	11.0	10.6	10.6		96.4	99.7	99.7	99.7	96.4	95.9	95.3	95.0	93.9	93.4	99.2	100.0	83.7	84.0	81.3	79.9	78.2	78.8	76.6	76.6	72.7	69.7	80.7	4
5	11.3	11.0	11.6	3.7		96.1	96.1	96.7	100.0	99.4	98.9	98.6	97.5	97.0	95.6	96.4	84.6	84.6	82.4	80.4	79.9	79.3	76.3	77.4	74.1	71.9	81.3	5
6	11.0	10.6	10.6	0.3	4.0		99.4	99.4	96.1	95.6	95.0	94.8	93.7	93.1	98.9	99.7	83.7	84.3	81.3	79.6	78.2	78.8	76.9	76.6	72.5	69.7	80.7	6
7	11.0	10.6	10.6	0.3	4.0	0.6		99.4	96.1	95.6	95.0	94.8	93.7	93.1	98.9	99.7	83.7	84.0	81.3	79.9	78.2	78.8	76.6	76.6	72.7	69.7	80.7	7
8	11.3	11.0	11.0	0.3	3.4	0.6	0.6		96.7	96.1	95.6	95.3	94.2	93.7	98.9	99.7	83.5	83.7	81.0	80.2	78.0	78.5	76.3	76.9	72.5	70.0	80.4	8
9	11.3	11.0	11.6	3.7	0.0	4.0	4.0	3.4		99.4	98.9	98.6	97.5	97.0	95.6	96.4	84.6	84.6	82.4	80.4	79.9	79.3	76.3	77.4	74.1	71.9	81.3	9
10	11.6	11.3	11.9	4.3	0.6	4.6	4.6	4.0	0.6		98.3	98.1	97.0	96.4	95.0	95.9	84.3	84.8	82.1	79.9	79.6	78.8	76.0	77.4	74.1	71.6	80.7	10
11	12.2	11.9	12.6	4.8	1.1	5.1	5.1	4.5	1.1	1.7		97.5	96.4	96.4	94.5	95.3	83.7	84.0	81.3	79.6	79.1	78.5	75.2	76.3	73.0	71.1	80.4	11
12	12.9	12.6	13.2	5.1	1.4	5.4	5.4	4.8	1.4	2.0	2.5		96.7	96.1	94.2	95.0	83.2	83.5	81.3	79.3	78.5	78.5	75.2	76.3	73.0	70.8	80.7	12
13	13.6	13.2	13.9	6.3	2.5	6.6	6.6	6.0	2.5	3.1	3.7	3.4		99.4	93.1	93.9	82.9	82.6	80.2	78.5	78.5	77.4	74.4	76.0	72.5	70.5	79.3	13
14	14.2	13.9	14.5	6.9	3.1	7.2	7.2	6.6	3.1	3.7	3.7	4.0	0.6		92.6	93.4	82.4	82.1	79.6	78.0	78.0	76.9	73.8	75.5	71.9	70.0	78.8	14
15	11.9	11.6	11.6	0.8	4.6	1.1	1.1	1.1	4.6	5.1	5.7	6.0	7.2	7.8		99.2	82.9	83.2	80.4	79.1	77.4	78.0	76.0	76.0	71.9	68.9	79.9	15
16	11.0	10.6	10.6	0.0	3.7	0.3	0.3	0.3	3.7	4.3	4.8	5.1	6.3	6.9	0.8		83.7	84.0	81.3	79.9	78.2	78.8	76.6	76.6	72.7	69.7	80.7	16
17	18.3	18.0	18.0	18.3	17.3	18.3	18.3	18.7	17.3	17.6	18.3	19.0	19.4	20.1	19.4	18.3		83.2	81.8	82.9	82.6	80.7	77.1	74.4	72.7	73.0	81.3	17
18	18.0	17.6	17.6	18.0	17.3	17.6	18.0	18.3	17.3	16.9	18.0	18.7	19.7	20.5	19.0	18.0	19.0		80.2	79.3	79.1	78.8	78.2	78.2	73.8	73.0	78.0	18
19	19.7	19.4	19.4	21.6	20.1	21.6	21.6	21.9	20.1	20.5	21.6	21.6	23.1	23.9	22.7	21.6	20.9	23.0		78.5	79.9	80.4	78.5	73.6	75.5	72.7	79.6	19
20	23.8	23.4	24.2	23.4	22.7	23.8	23.4	23.0	22.7	23.4	23.8	24.2	25.3	26.1	24.6	23.4	19.4	24.2	25.3		79.1	77.7	78.0	72.5	71.9	68.9	78.0	20
21	21.2	20.9	20.9	25.8	23.4	25.8	25.8	26.2	23.4	23.8	24.6	25.3	25.3	26.1	26.9	25.8	19.8	24.6	23.4	24.6		79.1	76.6	75.2	74.7	71.1	77.7	21
22	23.4	23.0	23.8	24.9	24.2	24.9	24.9	25.3	24.2	24.9	25.3	25.3	26.9	27.7	26.1	24.9	22.3	24.9	22.7	26.5	24.6		76.0	74.7	74.4	72.2	76.3	22
23	26.9	26.5	25.7	28.1	28.5	27.7	28.1	28.5	28.5	28.9	30.1	30.1	31.4	32.2	28.9	28.1	27.4	25.7	25.3	26.1	28.1	28.9		74.1	78.2	69.1	77.1	23
24	27.3	26.9	26.9	28.1	26.9	28.1	28.1	27.7	26.9	26.9	28.5	28.5	28.9	29.7	28.9	28.1	31.3	25.7	32.6	34.3	30.1	30.9	31.8		78.0	70.5	72.7	24
25	34.8	34.3	34.3	33.9	31.8	34.3	33.9	34.3	31.8	31.8	33.5	33.5	34.3	35.2	35.2	33.9	34.0	32.2	29.7	35.2	30.9	31.4	25.7	26.1		68.3	71.9	25
26	33.0	32.6	33.5	38.8	35.2	38.8	38.8	38.4	35.2	35.7	36.6	37.0	37.5	38.4	40.2	38.8	33.5	33.5	33.9	40.3	36.5	34.8	39.8	37.4	41.3		70.5	26
27	21.2	20.8	20.8	22.3	21.6	22.3	22.3	22.7	21.6	22.3	22.7	22.3	24.2	24.9	23.4	22.3	21.6	26.1	23.8	26.2	26.5	28.6	27.3	34.0	35.2	37.5		27
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	

1 NC_021145 D. caninum Dcan
2 OR251824 D. caninum Sv_PS_Amz_22
3 OR251823 D. caninum Sv_PS_Amz_21
4 MT806359 D. caninum 4245P18
5 ON954760 D. caninum dog1
6 MG587892 D. caninum R166
7 OK523385 D. caninum Dcan_feline_KS1
8 ON506044 D. caninum Isb1
9 ON954628 D. caninum cat1
10 ON954763 D. caninum cat1
11 ON954762 D. caninum dog3
12 ON954761 D. caninum dog2
13 ON954764 D. caninum cat2
14 ON954765 D. caninum cat3
15 OR511472 D. caninum Alex-1
16 OR511473 D. caninum Alex-2
17 KY766905 E. equinus G4
18 MN514028 M. melesi 00M3
19 MW350140 T. pisiformis
20 NC_028425 A. perfoliata
21 AY379529 R. mitchelli
22 AB033412 H. nana
23 MZ594630 Acanthobothrium sp. MZUSP 803
24 KY552878 D. cordatum PBI-429
25 MF189105 P. campbelli T164
26 OQ708301 Neospirorchis sp. g RC-2023 95
27 ON981095 J. pasqualei IT_DCG01

Fig. 4. Sequence distance of the *CO1* gene of the tested cestode strain (generated by laser gene software) showing an identity range of 90.1-99.7% with *Dipylidium caninum* strains.

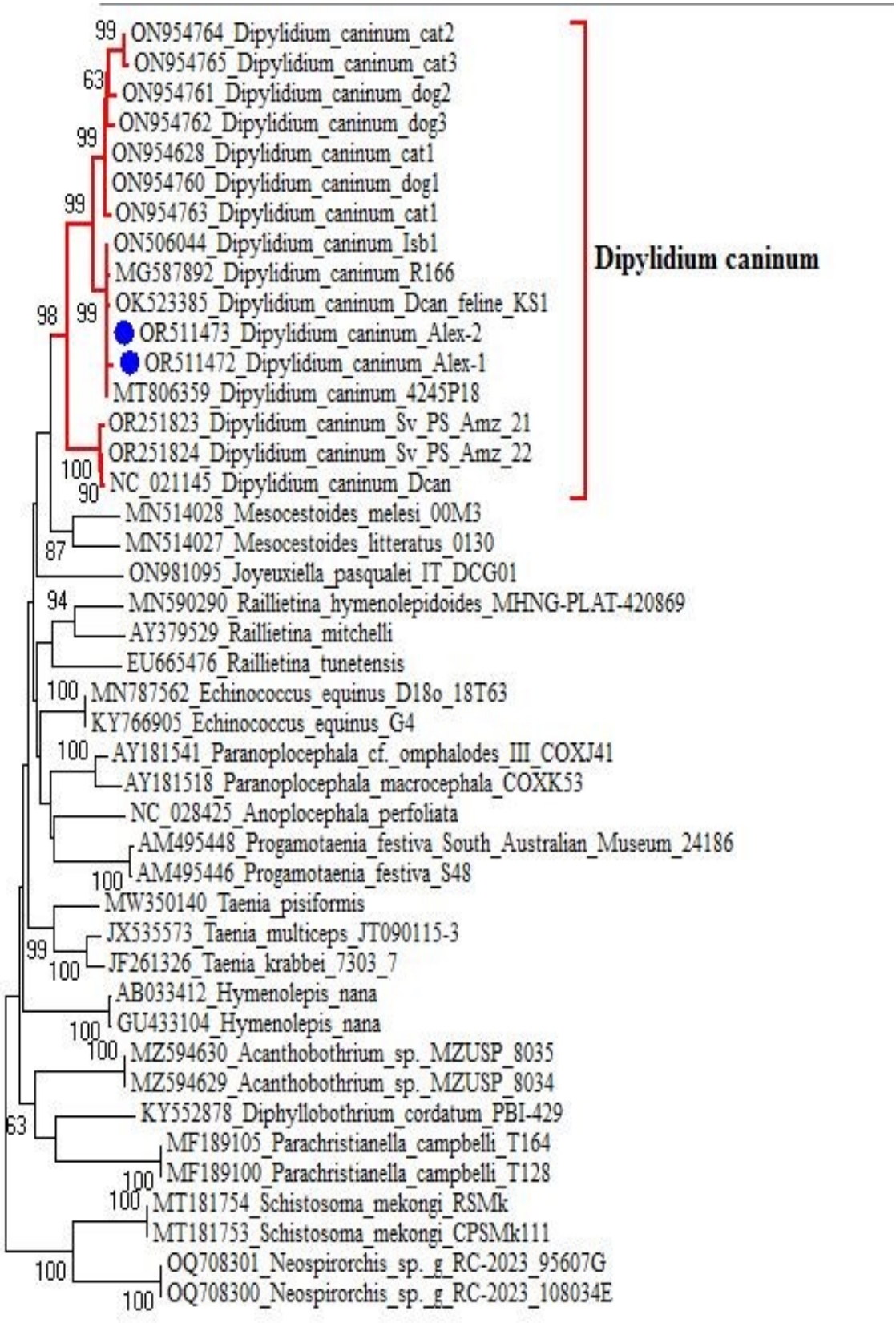

Fig. 5. Phylogenetic relatedness of the CO1gene. Maximum-likelihood unrooted tree indicated clustering of the tested strain with *Dipylidium caninum* strains apart from other cestodes.

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العلاقة بين تغيرات المناخ والبراغيث في القطط الضالة: مع إشارة خاصة إلى دورها كمضيف وسيط للديدان الشريطية الكلبية

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الملخص

الديدان الشريطية الكلبية هي دودة شريطية منتشرة في الكلاب وتحمل أهمية طبية، حيث يمكن أن تؤدي إلى اصابات في البشر. لذلك هدفت الدراسة إلى تقييم مدى انتشارها وتشخيصها المورفولوجي والجزيئي في القطط الضالة وكذلك الارتباط بين التغيرات المناخية والبراغيث التي تصيب الضالة ودورها في انتقال.

بين يناير 2023 ويناير 2024، تم جمع خمسين قطة ضالة من مناطق مختلفة داخل محافظة الإسكندرية. اثنا عشر (24٪) من القطط الضالة الخمسين التي تم التحقيق فيها من قبلنا كانت إيجابية للديدان الشريطية الكلبية و68 في المئة من القطط الضالة كانت مصابة بالبراغيث. كان البرغوث القططي هو النوع الأكثر ملاحظة على القطط (50/28 = 56٪)، وجاء البرغوث الكلبى في المرتبة الثانية (50/11 = 22٪). تم التعرف عليهم شكليا. تم تضخيم جين COX1 ثم نشر (رقم انضمام بنك الجينات OR511472 وOR511473). كما هو موضح في شكل المسافة المتسلسلة، أظهرت السلالات المتسلسلة هوية 90.1-99.7٪ لسلالات الديدان الشريطية الكلبية المجمعة من القطط في في الإسكندرية، مصر، مع استخدام تقنيات النشوء والتطور والجزيئية للتحقق من هوية الأنواع. من الضروري إجراء بحث شامل حول انتشار الديدان الشريطية الكلبية في مصر، وكذلك التحليل الجزيئي والجيني، جنبا إلى جنب مع استراتيجيات المكافحة.

الكلمات الدالة: القطط، الدودة الشريطية الكلبية، COX1، البرغوث القططى، البرغوث الكلبى.