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Department of Microbiology



Prevalence, Some Hematological and Biochemical Aspects of *Otodectes Cynotis* infestation in Cats in Al Nasiriyah city.

A Thesis

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Sciences (Microbiology).

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﴿ يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا

الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ ﴾

صدق الله العلي العظيم

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Declaration

I hereby declare that the entitled(**Prevalence,Some Hematological and Biochemical Aspects of *Otodectes Cynotis* infestation in Cats in Al Nasiriyah city**) is my original work,except for quotations and citations,which have been previously submitted and is not currently submitted for any other degree at the university of Shatrah or any other institution.

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Supervisor Certification

We certify (**Prevalence,Some Hematological and Biochemical Aspects of *Otodectes Cynotis* infestation in Cats in Al Nasiriyah city**) the thesis entitled was prepared under our supervision at the Department of Microbiology/ College of Veterinary Medicine/ University of Al-Shatrah as a partial of the requirements for **Master's Degree** in Veterinary Sciences (Microbiology).

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Dedication

To God Almighty, who made everything possible,

To the soul of my dear father, in gratitude for his endless kindness, asking Almighty Allah to make this work a continuous charity for him.

My beloved Mother

To the one who reached out to me tirelessly when I was weak,

My Wife and my Daughters

To the one who believed in my abilities and the safety of my days, to the one who reminds me of my strength and stands behind me like my shadow,

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Summary

The present study was conducted to investigate the Prevalence, hematological, and biochemical impacts of ear mite *O. cynotis* infestation in domestic cats in Nasiriyah City, Iraq, over a period from July 2025 to February 2026. A total of 150 cats were enrolled, comprising 75 owned Persian cats (aged 3 months to 3 years) and 75 free-roaming local breed cats (aged 1 to 3 years). Clinical examination, otoscopic evaluation, and microscopic identification of ear swab samples were performed to confirm *O. cynotis* infestation and characterize its various life stages. including sex, age, household cat density, litter type, and geographic location, were analyzed using Chi-square tests ($P \leq 0.05$). Blood samples were collected for complete blood count (CBC) analysis and serum biochemical profiling, including liver and kidney function tests.

The total prevalence of *O. cynotis* infestation was 60% (90/150). Higher infection rates were observed in female cats (63.3%) compared to males (36.7%), though this difference was not statistically significant ($P = 0.41$). Age was identified as a significant risk factor ($P < 0.001$), with the highest prevalence recorded in young cats aged 2 months to <1 year (80%), followed by cats aged 1 to <3 years (60%), and the lowest in cats aged ≥ 3 years (40%). Management practices also significantly influenced infestation rates; cats housed with garden soil as litter had a significantly higher prevalence (75%) compared to those using commercial litter (42.8%, $P < 0.001$). Furthermore, household cat density showed a strong positive association, as all cats from households with more than three cats were infested (100%, $P < 0.001$). No significant geographical variation in prevalence was detected ($P > 0.05$).

Clinically, intense pruritus and head shaking were observed in all infected cats (100%), followed by coffee-ground-like aural discharge and deep excoriations behind the ears and neck (88.8%). Subclinical infections, detectable only by microscopy, were noted in 44.4% of the cases.

Hematological analysis revealed no significant differences ($P > 0.05$) between infected and non-infected cats in the majority of erythrocyte, platelet, and total leukocyte parameters. However, a slight decrease in total white blood cell counts and granulocyte percentages was observed in infected cats, suggesting a localized rather than systemic inflammatory response.

In contrast, serum biochemical analysis revealed significant alterations indicative of potential systemic effects. In male Persian cats, a significant increase in urea and total bilirubin was observed, while female Persian cats showed a significant elevation in alanine aminotransferase (ALT). In local breed cats, infected males exhibited significantly elevated ALT, aspartate aminotransferase (AST), urea, and creatinine. Infected local breed females showed significant increases in ALT, AST, alkaline phosphatase (ALP), urea, creatinine, and total bilirubin ($P < 0.05$). Serum potassium levels were significantly elevated only in infected female Persian cats ($P = 0.002$), while calcium and potassium levels remained largely unchanged in other groups.

In conclusion, *O. cynotis* infestation is a highly prevalent parasitic condition in the feline population of Nasiriyah, strongly influenced by host age and environmental management factors. While it does not induce significant systemic hematological changes, the infestation is associated with notable biochemical derangements, particularly in liver and kidney function parameters. These findings underscore the importance of routine

microscopic diagnosis, early intervention, and comprehensive health monitoring to manage the clinical and subclinical consequences of otodectic mange in cats, emphasizing the need for targeted control strategies in high-risk populations .

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List of Abbreviations

Abbreviations	Title
ALP	Alkaline Phosphatase
ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
BUN	Blood Urea Nitrogen
CBC	Complete Blood Count
EDTA	Ethylenediaminetetraacetic Acid
Hb	Hemoglobin
HCT	Hematocrit
IgE	Immunoglobulin E
MCH	MCH Mean Corpuscular Hemoglobin
MCHC	MCHC Mean Corpuscular Hemoglobin Concentration
MCV	Mean Corpuscular Volume
<i>O. cynotis</i>	<i>Otodectes cynotis</i>
PCR	Polymerase Chain Reaction
PLT	Platelets
RBC	Red Blood Cells
RDW-SD	Red Cell Distribution Width - Standard Deviation
WBC	White Blood Cell count

CHAPTER ONE

INTRODUCTION

Chapter One.....Introduction

1.1.Introdction

Ectoparasites represent a diverse group of arthropods that live on the external surface of their hosts, constituting a significant health concern in companion animal medicine worldwide (Wall and Shearer, 2001; Dryden and Payne, 2018). These parasites, including mites, ticks, fleas, and lice, are responsible for a wide range of dermatological and systemic disorders, causing pruritus, skin lesions, secondary infections, and in some cases, acting as vectors for infectious diseases (Beugnet and Franc, 2012). Among these ectoparasites, ear mites of the genus *Otodectes* are considered one of the most prevalent and clinically significant parasites affecting domestic carnivores, particularly cats (Bowman *et al.*, 2021).

Otodectes cynotis is a surface-dwelling, non-burrowing ectoparasitic mite that primarily infests the external ear canal of cats and dogs, although it has also been reported in other carnivores such as ferrets and foxes (Taylor *et al.*, 2016; Wall and Shearer, 2001). Belonging to the family Psoroptidae, this obligate parasite completes its entire life cycle—from egg to larva, nymph, and adult—within the host's ear canal over approximately three weeks (Bowman *et al.*, 2021; Taylor *et al.*, 2016). The mites feed on epithelial debris, cerumen (ear wax), lymph, and tissue fluids, causing intense irritation and inflammation of the external auditory meatus (Scott *et al.*, 2001; Bowman, 2014). *O. cynotis* is regarded as one of the most frequently diagnosed parasitic infestations in cats globally, particularly in stray, young, and neglected animals, due to its direct transmission through intimate physical contact (Beck *et al.*, 2018; Farkas *et al.*, 2007).

Chapter One.....Introduction

The clinical condition caused by this mite, commonly referred to as otodectic mange or parasitic otitis externa, is characterized by severe pruritus, head shaking, scratching of the pinna and ear canal, and the accumulation of a dark, waxy exudate resembling coffee grounds within the external auditory canal (Scott *et al.*, 2001; Paterson, 2015). These clinical signs result from both the mechanical irritation caused by mite activity and the host's hypersensitivity reaction to mite antigens (Powell *et al.*, 1980; Blazejak *et al.*, 2023). If left untreated, the infestation may progress to chronic otitis externa, predisposing the ear to secondary bacterial and fungal infections, and in severe cases, may lead to tympanic membrane rupture, otitis media, and hearing impairment (Pereira *et al.*, 2019; Little and Duncan, 2021).

Epidemiological studies have demonstrated that the prevalence of *O. cynotis* infestation in cats is highly variable, depending on numerous factors including geographical location, climatic conditions, seasonality, host age and sex, population density, and management practices (Pereira *et al.*, 2019; El-Dakhly *et al.*, 2024). In many tropical and subtropical regions, prevalence rates can exceed 50%, whereas lower rates are typically reported in temperate zones (Silva *et al.*, 2018; Miró *et al.*, 2020). Several studies conducted in different parts of the world have identified young age, outdoor access, multi-cat households, and poor hygiene as significant risk factors (Abd El-Gawad *et al.*, 2024; Sarker *et al.*, 2024; Zhou *et al.*, 2022). In Iraq, limited epidemiological data are available, although recent studies from Fallujah (36.4%), Karbala (45.99%), and Babylon (60.66%) have reported substantial prevalence rates, with higher infection rates in kittens and female cats (Hameed *et al.*, 2019; Hussein *et al.*, 2024; AL-khafaji and Al-Musawi, 2025).

Chapter One.....Introduction

Despite its widespread distribution and clinical significance, comprehensive epidemiological and hematological data for *O. cynotis* infestation in cats remain scarce in many regions of Iraq, including southern provinces. The lack of systematic studies hinders the development of evidence-based prevention and control strategies. Hematological and biochemical alterations associated with parasitic infestations can provide valuable insights into the systemic effects and disease severity.

Previous studies have reported varying degrees of hematological changes, including eosinophilia, mild anemia, and alterations in leukocyte profiles, as well as biochemical changes such as elevated liver enzymes and renal markers, reflecting the host's immune response and potential organ involvement (Zaki *et al.*, 2020; Singh *et al.*, 2020). However, such data for *O. cynotis* infestation in Iraqi cats are largely lacking.

The present study was therefore undertaken to investigate the epidemiological aspects of *O. cynotis* infestation in stray and domestic cats in Nasiriyah city, southern Iraq, by estimating the prevalence rate, identifying potential risk factors such as age, sex, household density, and litter type, characterizing the associated clinical signs, and evaluating the hematological and biochemical changes in infected cats. The findings are intended to provide baseline data for the region and to support the development of effective prevention and control strategies for otodectic mange in feline populations.

Chapter One.....Introduction

1.2. Aim of Study

This study aims to investigate the prevalence and clinical impact of *O.cynotis* infestation in both stray and domestic (Persian) cats in Nasiriyah city, through:

1. To determine the overall prevalence rate of *O. cynotis* infestation in selected studied cat population.
2. To evaluate the influence of risk factors including age, sex, and seasonal variation on the infestation rates.
3. To assess the alterations in selected hematological and biochemical parameters in infested cats compared to healthy ones.

CHAPTER TWO

LITERATURE OF REVIEW

Chapter Two..... Literature Review

2-Literature Review

2.1.Historical Background

The ear mite *O. cynotis* has been recognized as a significant cause of otitis externa in carnivores for over a century, with its initial description dating back to 1838 (Lohse *et al.*, 2002). Since then, extensive research has elucidated its taxonomy, biology, and clinical significance, establishing it as one of the most common ectoparasites affecting domestic cats and dogs worldwide (Bowman *et al.*, 2009; Taylor *et al.*, 2016). Historically, the first documentation of this parasite in Iraq was reported by Kallo (2004), highlighting its long-standing presence in the region. *O. cynotis* was extensively recognized in veterinary literature by the middle of the 20th century as the main cause of otitis externa in dogs and cats. It was firmly placed into the order Astigmata according to standard taxonomic sources, such as those by Soulsby (1982). Its categorization and evolutionary connections have been resolved in the contemporary age by molecular methods (Lohse *et al.*, 2002; He *et al.*, 2022), and epidemiological investigations have shown its worldwide occurrence among both domestic and wild carnivores (Huang-Bastos *et al.*, 2020).

2.2. Scientific Classification

Kingdom: Animalia

Phylum: Arthropoda

Class: Arachnida

Order: Acari

Family: Psoroptidae

Genus: Otodectes

Species: cynotis (Lohse et al., 2002).

Chapter Two..... Literature Review

2.3. Morphology

2.3.1. Egg

Adult female mites lay oval, white ova, measuring between 170 to 206 μm in length, on the hair shafts or epidermis of the external ear canal. Following three to four days, the eggs hatch, releasing larvae that immediately begin feeding on cerumen and epithelial debris (Bowman, 2014; Tierarzt-Karlsruhe, 2024). During their reproductive phase, female mites typically lay 10–20 eggs (Bowman *et al.*, 2021).

2.3.2. Larvae

The six-legged larvae that emerge from the eggs are smaller than subsequent developmental stages. These larvae feed actively for three to eight days before molting into the nymphal stage. The larval stage is highly motile and contributes significantly to irritation of the auditory canal (Hiblu *et al.*, 2020).

Otodectes cynotis larvae are oval-shaped, typically ranging from 150 to 250 μm in length (Arlian, 2020). They possess three pairs of short, unsegmented legs, each terminating in a small sucker (pulvillus) that facilitates attachment to the host's epithelial surface (Bowman, 2014). Their thin, translucent cuticle allows faint visualization of internal structures under microscopy (Arlian, 2020). Unlike nymphs and adults, larvae lack genital and reproductive structures, a key distinguishing morphological feature (Bowman, 2014).

2.3.3. Nymphal Stages

Following the larval stage, the mite undergoes two eight-legged nymphal stages: the protonymph and the deutonymph. The deutonymph is particularly significant because it can mate with an adult male before reaching maturity, a characteristic that ensures rapid population expansion (Marvistavet, 2024). The pre-mated deutonymph subsequently molts into an adult female that is already capable of laying viable eggs (Taylor *et al.*, 2016).

2.3.4. Adult Stage

Adult mites exhibit clear sexual dimorphism in size and shape. Female mites typically measure 0.30 to 0.45 mm in length and 0.25 to 0.35 mm in width. Their oval bodies support attachment through the presence of suckers (pulvilli) on the anterior pairs of legs. Females are specialized for reproduction, living on the host for up to two months and laying two to three eggs daily. They burrow within the epidermis, continuously feeding and depositing eggs (Blazejak, 2023; Bowman *et al.*, 2009). In contrast, male mites are considerably smaller, measuring 0.20–0.24 mm in length and 0.15–0.20 mm in width. All legs except the third pair bear suckers, enhancing mobility on the skin surface. Males typically dig shallow feeding trenches until locating female burrows for mating, and they often die soon after copulation, resulting in a brief lifespan. This dimorphism reflects the functional division of roles within the species, with females adapted for long-term survival and reproduction, and males primarily focused on reproduction (Blazejak, 2023).

Chapter Two..... Literature Review

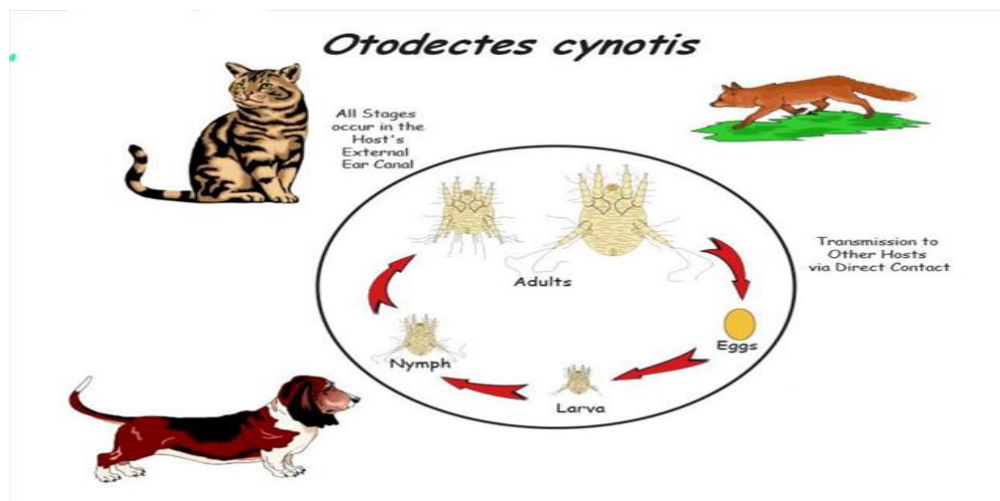
2.4. Life Cycle

2.4.1. Complete Life Cycle Duration

Under optimal conditions, the entire life cycle—from egg deposition to the emergence of new egg-laying adults—is completed in approximately three weeks (18–28 days). As all stages occur on the host with no free-living phase, direct contact between animals remains the primary mode of transmission (Bowman *et al.*, 2021).

2.4.2. Ecology and Life Cycle

Throughout its approximately 18–28 day life cycle, *O. cynotis* progresses through egg, larva, protonymph, deutonymph, and adult stages. Both adults and nymphs complete their development and reproduction on the surface of the ear canal. The non-burrowing nature of this mite is a major contributing factor to its pathogenicity and ease of transmission among domestic animals, distinguishing it from other ectoparasitic mites (Powell *et al.*, 1980).



figure(2_1)ShowLifeCycleof*O. cynotis*. Wall, R., & Shearer, D. (2008).

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2.5. Transmission

Otodectes cynotis is predominantly transmitted through direct contact between infected and susceptible animals, occurring during social interactions such as grooming, mating, or maternal care (Yeruham *et al.*, 1998). Kittens frequently acquire the mite from their mothers during the nursing period, as close and sustained contact facilitates the transmission of motile stages (Beck *et al.*, 2018). Although less common, indirect transmission can occur via contaminated fomites, including bedding, grooming equipment, or transport cages, where mites can survive temporarily outside the host under favorable humidity and temperature conditions (Scott *et al.*, 2001). The parasite's obligate surface-dwelling nature and preference for warm, humid microenvironments within the external ear canal contribute to its rapid spread in multi-animal households or catteries (El-Dakhly *et al.*, 2024).

2.6. Prevalence *O. cynotis* infestation

2.6.1. Risk Factors in Iraq

Despite the absence of national-level prevalence statistics, field observations and epidemiological studies confirm that *O. cynotis* is widespread in Iraqi domestic and stray cat populations (Ghufran *et al.*, 2025). A survey of 140 cats at Fallujah's veterinary facilities reported a prevalence of 36.4%, with significantly higher infection rates in kittens aged one to six months (Hameed *et al.*, 2019). Research conducted in Karbala Province between November 2023 and October 2024 found infestations affecting 45.99% of the cats examined (86 of 187), with higher rates among younger animals (Hussein *et al.*, 2024). More recent research in Babylon City documented an infestation prevalence of 60.66% (91 of 150 cats), with females and kittens under six months exhibiting

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greater susceptibility, and the central areas of the governorate being more affected (AL-khafaji and Al-Musawi, 2025). Although factors such as breed, outdoor access, and veterinary practices remain insufficiently investigated in Iraq-specific studies, the consistently high prevalence in young and female cats underscores the urgent need for targeted antiparasitic control measures and public veterinary awareness programs (AL-khafaji and Al-Musawi, 2025).

2.6.2. Epidemiological Risk Factors

Several host and environmental factors have been identified as significant epidemiological risk factors for *O. cynotis* infestation:

Breed differences: Long-haired breeds typically exhibit higher prevalence due to the favorable microclimate within their ear canals, which promotes mite proliferation (Shihab *et al.*, 2018). Age: Kittens and younger cats are more susceptible owing to their immature immune systems and inadequate grooming practices (Abdullah *et al.*, 2020). Outdoor access: Cats that spend considerable time outdoors are at significantly greater risk of infestation than indoor cats, as they are more likely to encounter infected stray animals (Rahman *et al.*, 2019). Seasonal variations: Warmer and more humid months have been associated with higher prevalence, likely because these conditions favor mite survival and transmission, Kallo (2004). Stray cats and kittens are particularly considered high-risk groups due to poor grooming habits, malnutrition, exposure to harsh environments, and confined living conditions in colonies. Collectively, these factors encourage mite survival and rapid spread within stray populations (Saleh and Hassan, 2022).

2.6.3. Global Distribution and Burden

Otodectes cynotis is recognized as one of the most significant parasitic mites affecting cats worldwide. Epidemiological reports from North America, Asia, and Europe indicate prevalence rates ranging from 25% to 85%, depending on the study population, diagnostic methods, and living conditions (Beck *et al.*, 2012; Yang and Kim, 2016; AL-khafaji and Al-Musawi, 2025). Infestation rates are substantially higher in multi-pet households and sheltered environments. Although zoonotic potential is minimal, transient human infestations have been reported, typically resolving spontaneously (Beck *et al.*, 2012; Yang and Kim, 2016). This global diversity is corroborated by numerous international studies. In Egypt, prevalence was 46.15%, particularly in young cats aged 1–6 months, with season and breed identified as important risk factors (Abd El-Gawad *et al.*, 2024). In Iran (Ahvaz), prevalence reached 22.95%, peaking in winter and in cats older than three years (Yakhchali and Hosseini, 2006). In Greece, 14.02% of kittens were infected, with higher rates in the 3–6 month age group (Diakou *et al.*, 2009). In Bangladesh, prevalence was 46.15%, associated with young age, poor physical condition, poor ear hygiene, and lack of preventive care (Sarker *et al.*, 2024). In Spain, over 30% of cats tested positive, with higher frequency in adults, during winter, and in peri-urban areas (Miró *et al.*, 2020). Brazil has documented one of the highest global infection rates at 52.6% (Silva *et al.*, 2018).

2.7. Clinical Presentation and Pathophysiology

The clinical presentation of *O. cynotis* infestation in cats ranges from severe suppurative otitis externa to subclinical or asymptomatic cases, depending on parasite burden, host immune response, and the

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presence of secondary infections (Norsworthy, 2018). Extreme pruritus is one of the most distinctive features, resulting in frequent scratching, head shaking, and rubbing of the ears against objects. This persistent discomfort leads to self-inflicted injuries, frequently causing excoriations and alopecia around the face and ears (Rahman *et al.*, 2019). The presence of a dark brown, coffee-ground-like exudate composed of keratin, cerumen, inflammatory cells, and mite feces is a hallmark of infestation. This exudate serves not only as a diagnostic feature but also promotes colonization by secondary bacteria (Patel and Forsythe, 2012). Fungal and bacterial secondary infections are common. *Staphylococcus* species are frequently isolated from affected ears, exacerbating the inflammatory response and prolonging clinical symptoms (Lee *et al.*, 2020). Chronic pain, purulent discharge, and malodor often result from *O. cynotis*-induced otitis.

Untreated or recurrent infestations may lead to chronic pathological alterations, including:

- Aural hematomas resulting from repeated head shaking and scratching (Saleh *et al.*, 2022).
- Ear canal constriction and chronic inflammation due to fibrosis and epithelial hyperplasia.
- Hyperplasia of the ceruminous glands, exacerbating wax accumulation.
- Tympanic membrane perforation, potentially leading to otitis media and hearing impairment (Abdullah *et al.*, 2021).

2.8. Hematological and Physiological Alterations

Parasitic infestations frequently elicit systemic immunological responses reflected in quantifiable hematological markers (Beck *et al.*,

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2018). Understanding these changes is essential for correlating the level of parasitism with host health status. Although *O. cynotis* primarily affects the ear canal, hematological investigations have demonstrated systemic changes associated with infection (Singh *et al.*, 2020). Studies conducted in Egypt and India have reported significantly higher eosinophil levels in infested cats compared to healthy controls, highlighting the immunological stress imposed by the parasite (Mohammed *et al.*, 2020).

2.9. Hematological Markers of Infestation

Otodectes cynotis-infested cats often exhibit moderate normocytic normochromic anemia resulting from persistent inflammation or scratching injuries Antipov(2017), while eosinophilia correlates with infestation severity (Al-Salihi, 2017). Neutrophilia, monocytosis, and lymphocytosis indicate immune activation (Rahman *et al.*, 2019; Ahmed *et al.*, 2018). Additional findings include hyperglobulinemia, hypoalbuminemia, and sporadically elevated ALT/AST ratios, indicative of hepatic stress (Eze *et al.*, 2012; El-Sayed *et al.*, 2019).

2.10. Diagnosis

The diagnosis of *O. cynotis* infestation is based on a combination of clinical signs, otoscopic examination, and laboratory confirmation. Clinically, affected cats typically present with intense pruritus, head shaking, and the accumulation of dark, coffee-ground-like ceruminous debris within the external auditory canal, which are considered pathognomonic indicators of mite infestation (Beck, 2018).

Otoscopic examination serves as a valuable diagnostic tool, as motile, small, whitish mites may be directly visualized within the ear canal (Miller *et al.*, 2020). However, due to the potential for false-negative results when mite numbers are low, microscopic examination of aural

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exudate remains the gold standard for definitive diagnosis. A sample is collected using a cotton swab, transferred to a glass slide with a drop of mineral oil, and examined under light microscopy to identify adult mites, larvae, nymphs, and eggs (Singh *et al.*, 2020).

Advanced diagnostic modalities, including dermatoscopy and video-otoscopy, have been introduced to enhance diagnostic sensitivity, particularly in cases of mild or early-stage infestations (Plant *et al.*, 2019). Furthermore, molecular techniques such as Polymerase Chain Reaction (PCR) have been investigated for their ability to detect mite DNA with high specificity, although their application in routine clinical practice remains limited (Zhu *et al.*, 2021).

Given that the clinical manifestations of *O. cynotis* infestation may closely resemble those of other conditions—including bacterial otitis externa, fungal infections, and allergic dermatitis—accurate differentiation is imperative. Therefore, laboratory confirmation remains indispensable for establishing a definitive diagnosis and implementing appropriate therapeutic and monitoring strategies (Scott *et al.*, 2018).

2.11. Treatment

Effective treatment of *O. cynotis* requires elimination of the mites, management of resultant irritation, and treatment of secondary infections. Therapeutic strategies commonly employ topical or systemic acaricides in conjunction with ear cleaning to remove debris and exudate (Beck *et al.*, 2018c). Topical treatment is the most widely used approach. Macrocyclic lactones such as moxidectin and selamectin, formulated as spot-on applications, are highly effective, offering convenient administration and prolonged protection (Miller *et al.*, 2020). Ivermectin, administered topically or subcutaneously, has also demonstrated efficacy, although off-

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label use requires veterinary supervision (Plant *et al.*, 2019). Systemic therapies including oral or injectable ivermectin and milbemycin oxime are particularly advantageous in multi-cat households or when consistent topical application is challenging (Scott *et al.*, 2018). Pre-treatment ear cleaning is strongly recommended, as it removes debris and wax that may harbor mites, reduces irritation, and enhances drug absorption (Singh *et al.*, 2020). In cases complicated by secondary bacterial or fungal infections, adjunctive antimicrobial or antifungal therapy may be necessary. Corticosteroid-containing ear preparations may also help reduce inflammation and pruritus, though they should be used judiciously (Zhu *et al.*, 2021). As *O. cynotis* is highly contagious, all in-contact animals should be treated simultaneously to prevent reinfestation. Environmental cleaning, while not as critical as for flea infestations, is recommended in severe or persistent cases (Miller *et al.*, 2020).

2.12. Zoonotic Aspects and Public Health

Although *O. cynotis* is primarily a parasite of cats, transient human infestations have been documented. Pruritic papular dermatitis, particularly on the arms, neck, and trunk, may occur in individuals with intimate contact with infected cats (Beck *et al.*, 2018b; Cafarchia *et al.*, 2019). Although these infestations typically resolve spontaneously, they underscore the importance of parasite control for safeguarding both human and animal health (El-Dakhly *et al.*, 2025). The large populations of stray cats in urban Iraq pose particular concern, as they serve as reservoirs, allowing infestation to spread and persist within communities (Hameed *et al.*, 2019; Shihab *et al.*, 2020).

CHAPTER THREE
MATERIALS AND METHODS

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3.Material and Methods

3.1. Instruments and Equipments

Table(3-1): Equipment with manufactures and companies that were used in the current study.

(No)	(Item / Equipment)	(Company)	(Country)
1	Auto dry biochemistry analyzer	seamaty	China
2	CBC-BC10	Mindray	China
3	Cotton	Mevid	China
4	Cotton Swabs	—	China
5	Cover Slide	Mevid	China
6	Disposable gloves	Rotiprotect	China
7	ETDA	Victor	China
8	Havahart 1045 trap	Woodstream	USA
9	Light microscope	Olympus	Japan
10	Microscope digit camera	Samos	England
11	Otoscope	PA	China
12	Slide	Mevid	Germany
13	tube Blastic	lancaster	China

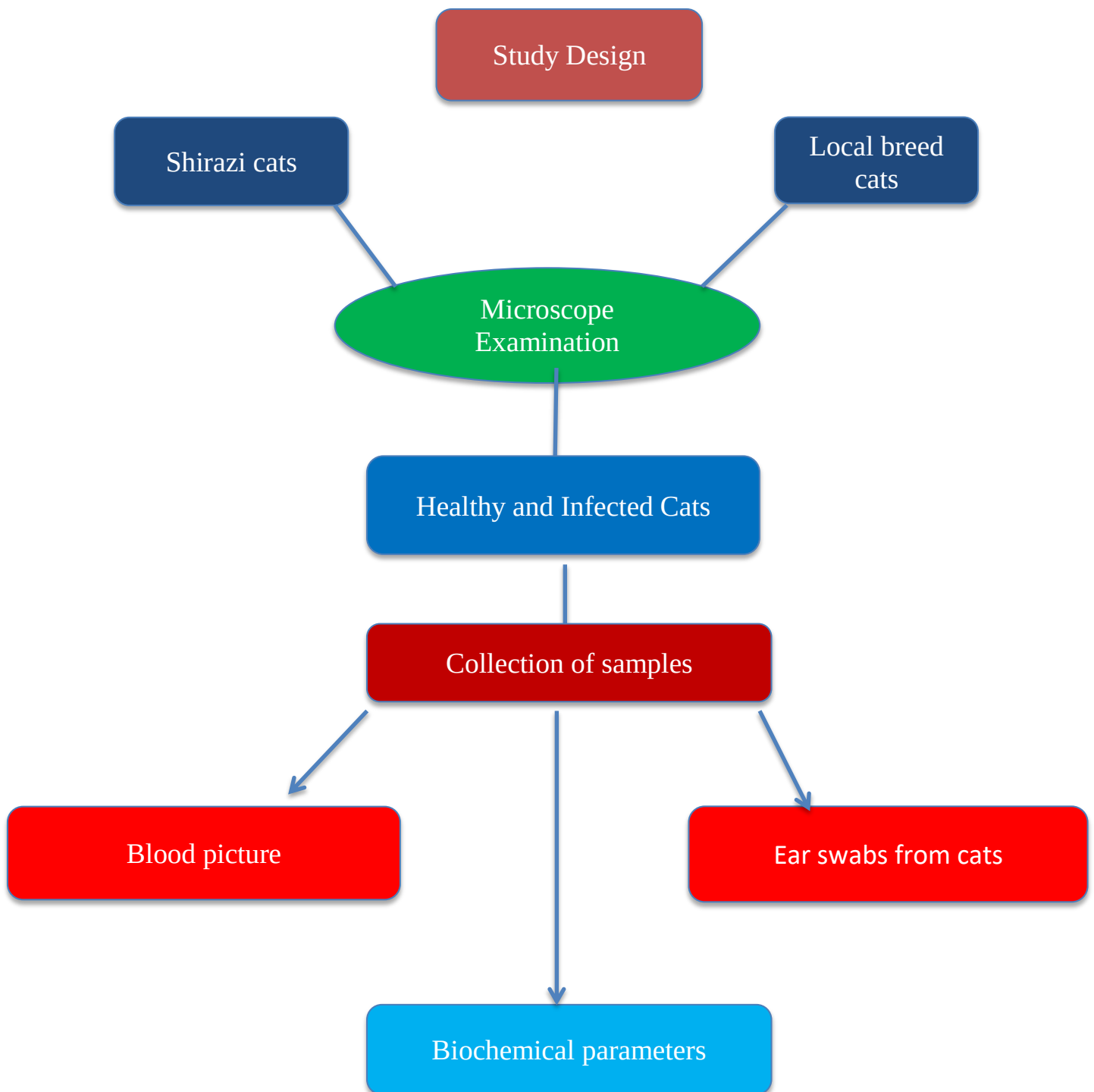
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3.2. Chemicals Substances

Table(3-2): Chemical materials with their manufactures and companies that were used in the present study.

No.	Chemical / Material Name	Company	Country
1	Absolute Ethanol	BDH	England
2	Canada Balsam	Merck	Germany
3	Glycerin	Mevid	Iraq
4	Ketamine	Alfasan	Holland
5	Xylazine	BDH	England

3.3. Study Design



Figure(3.1) :Study Design

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3.4. Area Of Study

The study evaluated 150 cats (75 owned Persians and 75 free-roaming local cats) in Nasiriyah from July 2025 to February 2026, recording 90 positive cases of ear mites *O. cynotis* at a 60% infection rate. The study population comprised 91 females (57 infected) and 59 males (33 infected), equally split across three age groups of 50 cats each (highest prevalence was 80% in cats under 1 year). Samples were collected from 8 areas (Hay Ur, Al-Shumukh, Al-Mansouriya, Al-Fidaa, Orido, Al-Salihiya, Al-Shohadaa, Al-Talea) using sterile cotton swabs. Swabs were preserved in 70% ethanol to prevent microbial growth and 10% glycerin to prevent specimen dehydration. Diagnostic examination was conducted at the College of Veterinary Medicine using an otoscope, followed by light microscopy (10X magnification for screening and 40X for morphological confirmation).

3.5. Sample, Blood Collection, and Laboratory Processing Procedures .

A total of 150 cats—comprising 75 owned Shirazi cats (aged 3 months to 3 years) and 75 adult stray cats (aged 1 to 3 years)—were included in this study from various locations across Al-Nasiriyah city, alongside healthy domestic cats acquired from a local veterinary clinic for comparative purposes. Stray cats were humanely captured using a specifically designed Havahart 1045 trap (Figure 4). To ensure safe handling, all animals underwent physical examination and appropriate restraint to minimize stress-induced hematological alterations (Sparkes *et al.*, 2016). When necessary, captured strays received an intramuscular injection of a ketamine–xylazine combination, with dosages tailored to individual body weight according to standard protocols (Shin *et al.*,

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2024). Overall, 90 infected cats displayed identical clinical symptoms regardless of breed or origin, while 60 clinically healthy cats served as controls. Blood sampling was conducted in accordance with standard veterinary clinical pathology guidelines (Weiss and Wardrop, 2010; Thrall *et al.*, 2012). Venipuncture was primarily performed via the jugular or femoral veins under aseptic conditions using 22–25 gauge needles/syringes, with the cephalic or saphenous veins utilized as secondary sites when necessary (Keir and McLellan, 2018). For jugular or femoral venipuncture, cats were placed in lateral recumbency, the site was asepticated with 70% alcohol, and blood (1–3 mL) was drawn, ensuring the volume did not exceed 1% of body weight to prevent hematological compromise. Direct pressure was applied post-withdrawal to prevent hematoma formation (Jackson and Villiers, 2008; Tvedten, 2017). Each blood sample was immediately divided into two portions: 1.5 mL was transferred into EDTA tubes for Complete Blood Count (CBC) analysis using an automated hematology analyzer to measure erythron (RBC, HGB, HCT, MCV, MCH, MCHC, RDW), leukon (total WBC, LYM, MID, GRAN), and thrombon indices (PLT, MPV, PDW, PCT, P-LCR). The remaining 2.5 mL was placed into plain gel tubes, allowed to clot, and centrifuged at 3000 rpm for 10 minutes to harvest serum (Figure 3-6). Serum samples were processed via an automated clinical chemistry analyzer using commercial kits to evaluate liver enzymes (ALT, AST, ALP, Total Bilirubin), renal function parameters (Blood Urea, Creatinine), and electrolyte levels (Calcium Ca, Potassium K).



Figure (3-2): Clinical examination using otoscope

Since these symptoms are known to be early clinical markers of otoacariasis in cats, clinical indicators such as crusting, erythema, otic discharge, pruritus, and head shaking were noted and recorded



Figure (3_3): Coffee-colored waxy excretion collected from ear.



Figure (3_4): Stray cats in Havahart 1045

3.6. Microscopic Identification

Ear swab specimens were prepared for microscopic examination to detect and identify the developmental stages of *O. cynotis* (eggs, larvae, nymphs, and adults). The collected debris from the ear canal was placed onto a clean glass slide, mixed with a drop of mineral oil (paraffin oil) to facilitate clear visualization, and covered with a coverslip. The slides were examined under a light microscope at low magnification (10X) for initial screening and parasite localization, and subsequently at higher magnification (40X) to confirm morphological features and species identification according to established parasitological protocols (Hendrix and Robinson, 2016; CAPC, 2020).

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3.7. Morphological Characterization of *O. cynotis*

Positive samples identified during the initial screening (Section 3.8) were subjected to detailed taxonomic characterization to confirm the species-specific features of *O. cynotis*. Morphological identification was based on distinct key anatomical structures, including the presence of short, unjointed pedicels (stalks) bearing cup-shaped suckers (ambulacra) on the first and second pairs of legs in females, and on all four pairs of legs in adult males. In addition, adult males were distinguished by the presence of prominent copulatory lobes and pair of anal suckers at the posterior margin of the body. Developmental stages, including oval thick-shelled eggs, hexapod larvae, octopod nymphs, and mature adults, were differentiated based on standard acarological keys (Wall and Shearer, 2001; Taylor *et al.*, 2016).

3.8. Preservation and Fixation of Ear Mite Samples

Preserving the material obtained from the external ear canal using sterile cotton swabs is essential to guaranteeing the structural integrity of *O. cynotis* specimens, especially if microscopic diagnosis is delayed.

This was accomplished by carefully inserting each swab into a 1.5 ml sterile Eppendorf tube filled with a solution of 70% ethanol, which acts as a fixative and antibacterial agent 10% glycerin, which keeps the sample hydrated and stops it from drying out.

It has been demonstrated that this combination maintains the morphology of mites (adult and immature stages) without causing tissue to shrink or deform, making microscopic study easier later on (Soulsby, 1982). As a humectant, glycerin maintains the mites' cuticle and

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appendages pliable and soft for improved light microscopy visibility (Bowman *et al.*, 2009).



Figure (3-5) : Femoral vein blood draw

3.9. Hematological Evaluation

Venous blood samples (approximately 2–3 ml) were collected aseptically using EDTA tubes for complete blood count, and additional blood samples (3–5 ml) were collected in plain tubes for serum separation. The samples were analyzed using an automated hematology analyzer and a chemical analyzer to determine the red blood cell count, hemoglobin concentration, packed cell volume, red blood cell indices (mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, and red cell distribution width), total white blood cell count, and differential leukocyte count including neutrophils, eosinophils, lymphocytes, monocytes, and basophils, as well as platelet count and mean platelet volum. In addition, the serum

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biochemical parameters were measured including liver enzymes such as alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase, as well as total bilirubin, kidney function tests including urea and creatinine, and electrolytes including calcium and potassium. These parameters, both hematological and serum biochemical, were compared between infested and non-infested cats to determine the hematological and biochemical impact of infestation (Thrall *et al.*, 2012).

3.10.Statistical Analysis

Data were analyzed using SPSS software (Version 25.0, IBM Corp., Armonk, NY, USA). The chi-square (χ^2) test was used to assess associations between categorical variables. Results were expressed as frequencies and percentages. A p-value ≤ 0.05 was considered statistically significant. The independent samples t-test was used to compare the mean values of hematological parameters (RBC, HGB, HCT, MCV, MCH, MCHC, RDW-CV, RDW-SD, PLT, MPV, PDW, PCT, P-LCR, total and differential WBC counts) and serum biochemical parameters (ALT, AST, ALP, urea, creatinine, total bilirubin, calcium, and potassium) between *O. cynotis*-infected and healthy control cats. Results were expressed as mean $\pm$ standard deviation (SD) (Field, 2018; Petrie and Watson, 2013).

CHAPTER FOUR

RESULTS

4. Results

4.1. Total infestation of *O.cynotis*:

The overall rate of *O.cynotis* infestation among the examined cats was 60%, as illustrated in Table (4-1). Out of the 150 cats included in the study, 90 animals were positive for the infestation, while 60 animals were negative. Statistical analysis indicated a statistically significant difference between positive and negative cases ($\chi^2 = 6.00 \setminus \{df\} = 1, P = 0.014$).

Table (4-1). Prevalence of *O.cynotis* infestation in examined cats.

Total number of cats	Positive cases N (%)	Negative cases N (%)	Prevalence rate (%)
150	90 (60)	60 (40)	60
p	0.014		

Chi-square = χ^2 , Degrees of freedom =df , $P \leq 0.05$

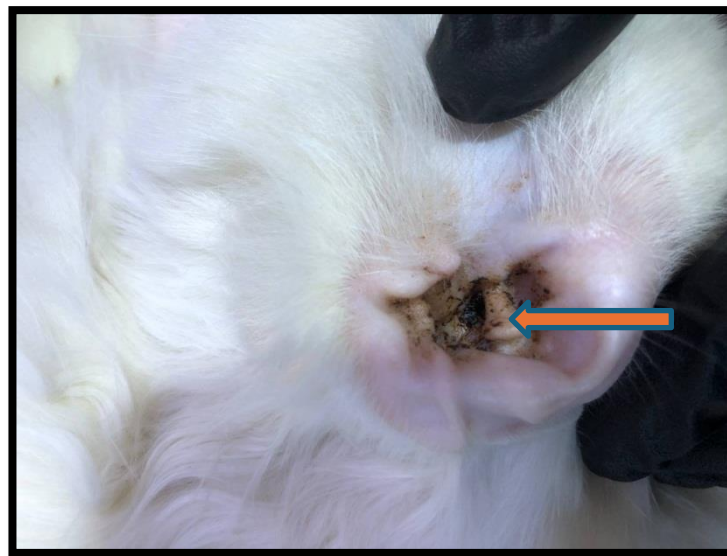


Figure (4-1): Coffee-colored waxy excretion in the infected ear



Figure (4-2): Otitis externa in cat showing crust formation and inflammation of the ear canal.



Figure (4-3): Secondary skin lesions due to intense scratching associated with *O. cynotis* infestation in a cat.

4.2. Morphological of the *O. cynotis*.

Within the host's external auditory canal, *O. cynotis* eggs represent the initial stage of the parasite's life cycle. Their oval to elliptical shape and smooth, translucent surface make them easy to identify under optical microscopy. In order to evaluate morphological diversity, five egg samples were tested. The largest egg measured 200 μm in length and 110

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μm in width, while the smallest egg was 180 μm in length and 100 μm in breadth, Figure (4-4).

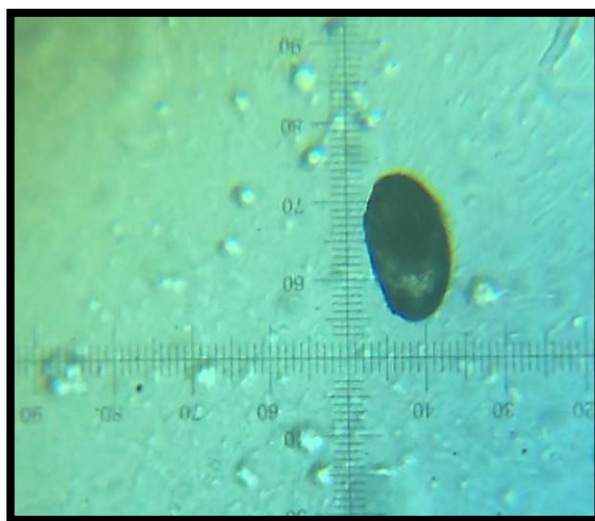


Figure (4-4): Ova of *O. cynotis* (10x)

The larvae of *O. cynotis* are tiny, white, hexapod (six-legged) creatures measuring approximately 210 μm in length and 240 μm in width. Morphologically, the body is divided into two primary regions: the anterior gnathosoma (capitulum) and the posterior idiosoma, which is further differentiated into the leg-bearing podosoma and the hind region, the opisthosoma. The gnathosoma houses the specialized feeding mouthparts, including the chelicerae and palpal appendages, which enable the mite to adhere securely to the epithelial surface and feed on tissue fluids, cerumen (earwax), and epidermal debris. Located on the podosoma, the larval stage possesses three pairs of legs; the relatively longer anterior pairs function primarily as sensory appendages, aiding in spatial orientation within the ear canal and detection of environmental stimuli, whereas the shorter posterior pair on the opisthosomal boundary is predominantly adapted for attachment and locomotion. Furthermore, the dorsal surface of the idiosoma is finely striated and bearing short setae that provide structural protection and facilitate camouflage within the otic debris (Figure 5a,b). Figure (5a,b)

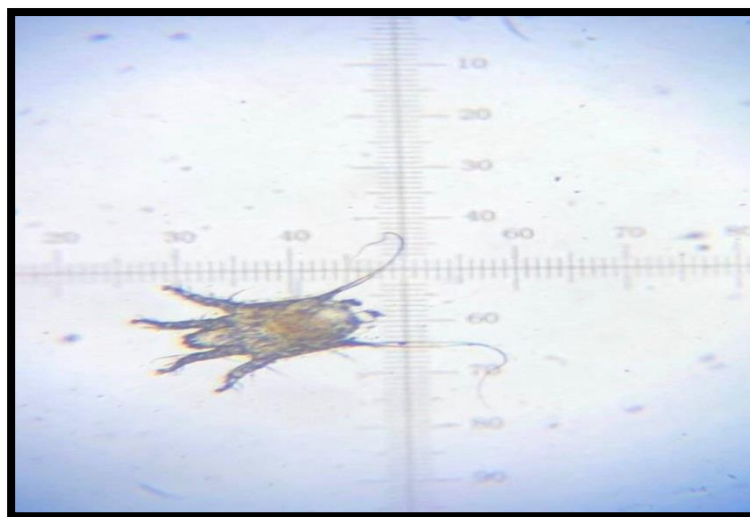


Figure (4-5,a): Ventral view of a larva under Ocular Micrometer (10x).

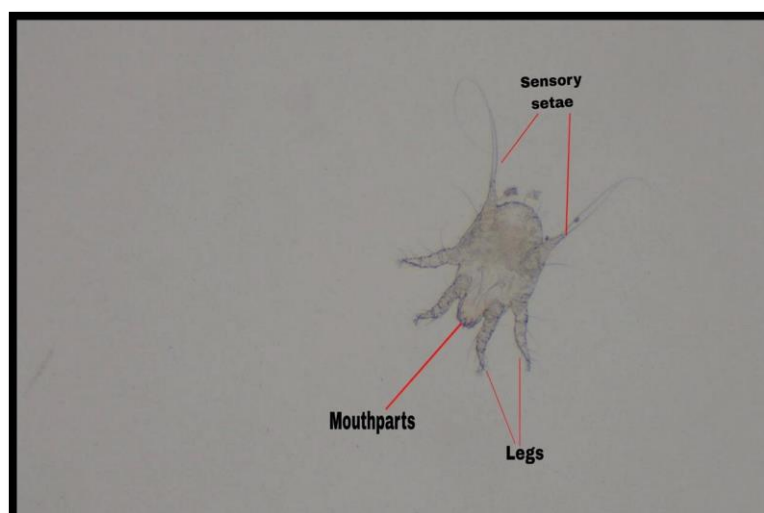


Figure (4-5,b): larvae(10x).

The distinct morphology of the adult male ear mite *O. cynotis* is illustrated in Figure (insert number). The male is characterized by a broadly oval body shape, measuring approximately 410 in length and 290in width, with fine transverse striations imparting a finely rugose appearance to the dorsal cuticular surface. The body is differentiated into the anterior gnathosoma, bearing feeding apparatus, and the larger idiosoma, comprising the leg-bearing podosoma and the posterior opisthosoma. Males are identified by the presence of four pairs of legs, all

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terminating in cup-shaped suckers (pulvilli) mounted on short, unsegmented pedicels; these structures are crucial for attachment within the host's ear canal. The most decisive morphological characteristic distinguishing adult males from females is the presence of a pair of large, circular copulatory suckers situated on the posterior ventral aspect of the opisthosoma. These copulatory suckers entirely lack in the female of the species. (6)(A.B).

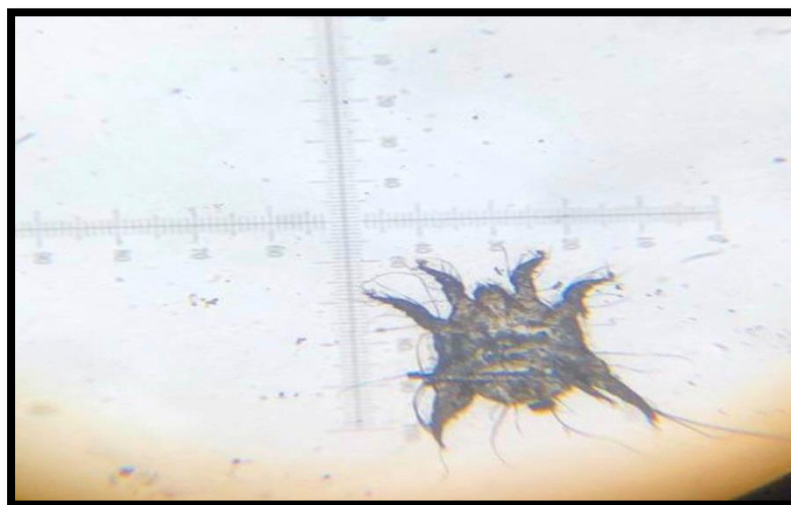


Figure (4-6,a):Male *O. cynotis* under Ocular Micrometer

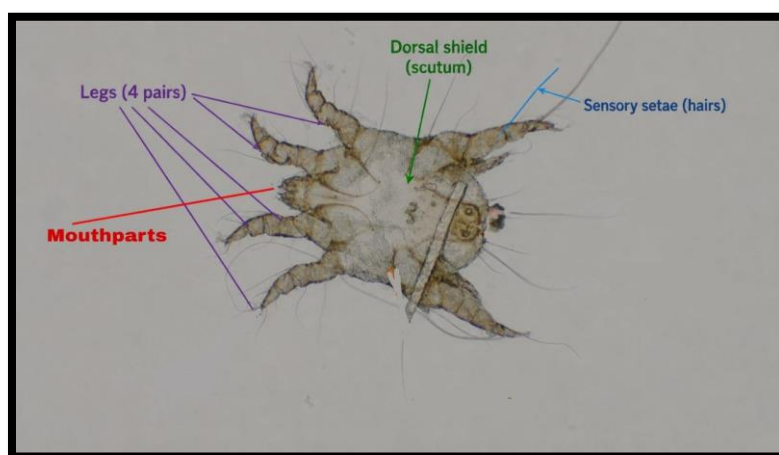


Figure (4-6,b):Male *O. cynotis* under light microscopy(10x).

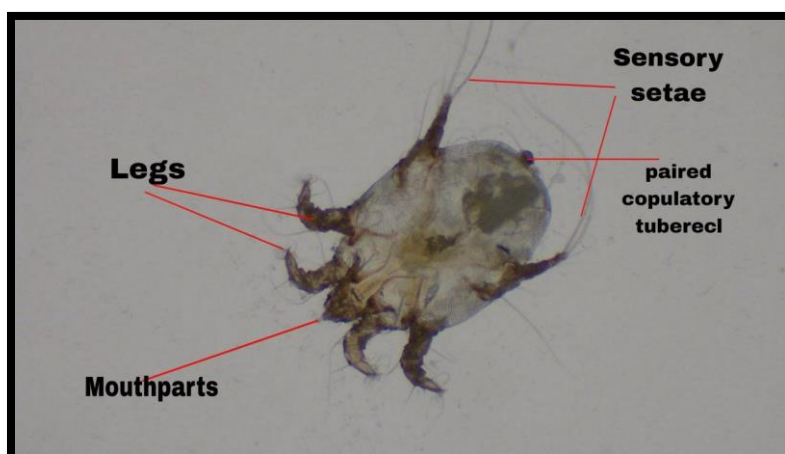


Figure (4-7,a): Female *O. cynotis* under light microscopy(10x).



Figure (4-7,b): Female *O.cynotis* under Ocular Micrometer

4.3. Prevalance of *O.cynotis* infection according to sex in cats.

A mating event between a male and female *O. cynotis* mite was detected during the microscopic analysis of a sample taken from the external ear canal of an infected cat, as illustrated in figure (8).



Figure (4-8): The copulatory position of male and female (5x)

The obtained from the present study revealed the prevalence of *O. cynotis* infection among cats according to sex. Out of 91 female cats examined, 57 (63.3%) were found to be infected, while 33 out of 59 male cats (36.7%) tested positive. The overall prevalence in the studied population was 60% (90/150).

Table (4-2): percentage of *O. cynotis* infection according to sex in cats.

Sex	Examined Cats (N)	Infected Cats N.(%)
Female	91	57 (63.33)
Male	59	33 (36.67)
Total	150	90
χ^2	0.68	
Df	1	
P	0.41	

Chi-square = χ^2 , Degrees of freedom =df , $P \leq 0.05$

4.4. Prevalence of *O.cynotis* infection among cats according to age:

The table (4-3) presents the prevalence of *O.cynotis* infection among cats according to different age groups. A total of 150 cats were examined, divided equally into three age categories. The highest infection rate was observed in young cats aged 2 months to <1 year, with 40 out of 50 cats infected (80%), followed by cats aged 1 to <3 years, with 30 out of 50 cats infected (60%). The lowest prevalence was found in cats aged ≥ 3 years, with 20 out of 50 cats infected (40%).

Table (4-3): Prevalence of *O.cynotis* infection among cats according to age group

Age group	Number of examined cats (N)	Number of infected cats N (%)	Number of non-infected cats N (%)
2 months – <1 year	50	40 (80)	10 (20)
1 year – <3 years	50	30 (60)	20 (40)
≥ 3 years	50	20 (40)	30 (60)
Total	150	90 (60)	60 (40)
(χ^2)	16.66		
Df	2		
P	<0.001		

Chi-square = χ^2 , Degrees of freedom =df , $P \leq 0.05$

Note: Cats' ages were estimated based on standard dental examination criteria (deciduous and permanent tooth eruption patterns and dental wear

4.5. Distribution of *O.cynotis* Infestation According to Household Cat Density:

The results represented in Table (4-4) revealed a prevalence of *O.cynotis* infestation among cats was strongly associated with the number of cats per household. Among households with a single cat, 41.7% (25/60) were infected, whereas in households with 2–3 cats, 54.5% (30/55) of cats were infected. Notably, all cats (100%, 35/35) in households with more than three cats were found to be infested. The overall prevalence across the studied population was 60% (90/150).

Table (4-4): Distribution of Ear Mite Infestation According to the Number of Cats in the Household

Number of cats per household	Examined cats (N)	Infected cats N (%)	Non-infected cats N (%)
1 Cat	60	25 (41.7)	35 (58.3)
2–3 Cats	55	30 (54.5)	25 (45.5)
More than 3 Cats	35	35 (100)	0 (0)
Total	150	90 (60.0)	60 (40.0)
(χ^2)	32.41		
Df	2		
P	<0.001		

Chi-square = χ^2 , Degrees of freedom =df , $P \leq 0.05$

4.6.The distribution of *O.cynotis* infection among owned Shirazi cats:

The distribution of *O.cynotis* infection among owned Shirazi cats was significantly influenced by the type of litter material used table (4-5). Cats housed with commercial cat litter showed a prevalence of 42.8% (30/70), whereas those using garden soil exhibited a markedly higher prevalence of 75% (60/80). The overall prevalence among all examined cats was 60% (90/150). Chi-square analysis confirmed a highly significant association between litter type and infection rates ($\chi^2 = 16.07$, df = 1, $P < 0.001$),

Table (4-5): Distribution of ear mite infection among owned Persian cats according to the type of litter material used

Type of litter material	Examined cats (N)	Infected cats N (%)	Non-infected cats N (%)	Prevalence rate (%)
Commercial cat litter	70	30 (42.8)	40 (57.2)	42.8
Garden soil	80	60 (75.0)	20 (25.0)	75.0
Total	150	90 (60.0)	60 (40.0)	60.0
χ^2	15.82			
Df	1			
P	<0.001			

Chi-square = χ^2 , Degrees of freedom =df , $P \leq 0.05$

4.7. Distribution of Cats Infected with *O.cynotis* According to Geographic Locations in the Study Area.

The data as illustrated in the Table (4-6) demonstrated that the distribution of *O.cynotis* infection among cats across different geographic locations in the study area was relatively uniform. Infection rates ranged from 57.9% in Al-Tali'aa to 61.1% in Al-Fidaa and Al-Salihiya, with Hay Ur, Al-Mansouriya, Al-Shohadaa, and Aredo showing prevalence rates around 60%. The overall prevalence among all examined cats was 60% (90/150). Chi-square analysis indicated no statistically significant association between location and infection rate ($\chi^2 = 0.15$, df = 7, $P > 0.05$).

Table (4-6): Distribution of Cats Infected with *O.cynotis* According to Geographic Locations in the Study Area.

Location	Examined cats (N)	Infected cats N (%)	Non-infected cats N (%)	Prevalence rate (%)
Hay Ur	25	15 (60.0)	10 (40.0)	60.0
Al-Shumookh	17	10 (58.8)	7 (41.2)	58.8
Al-Mansouriya	20	12 (60.0)	8 (40.0)	60.0
Al-Fidaa	13	8 (61.1)	5 (38.9)	61.1
Aredo	23	14 (60.9)	9 (39.1)	60.9
Al-Salihiya	18	11 (61.1)	7 (38.9)	61.1
Al-Shohadaa	15	9 (60.0)	6 (40.0)	60.0
Al-Tali'aa	19	11 (57.9)	8 (42.1)	57.9
Total	150	90 (60.0)	60 (40.0)	60.0
(χ^2)	0.15			
df)	7			
P	>0.05			

Chi-square = χ^2 , Degrees of freedom =df , $P \leq 0.05$

4.8.Frequency of clinical signs

The results presented in Table (4-7) indicate the percentage of clinical signs of the 90 cats infected with *O.cynotis* revealed intense itching and head shaking as the most prevalent signs, each observed in all infected animals (100%). Deep wounds behind the ears and neck, as well as coffee-colored waxy discharge, were recorded in 80 out of 90 cats (88.8%), indicating significant local irritation and ear involvement. Mild infections detectable only by microscopic examination were found in 44 cats (44.4%), highlighting the occurrence of subclinical cases. Additional systemic or secondary manifestations included purulent otitis in 35 cats (38.9%), loss of appetite in 30 cats (33.3%), and weight loss in 25 cats (27.8%). These findings demonstrate that while certain clinical signs, such as intense itching and head shaking, are universal in *O.cynotis* infestation, other symptoms vary in frequency and severity among affected cats.

Table (4-7): percentage of clinical signs observed in cats infected with *O. cynotis*

Clinical signs and symptoms	Total infected cats examined (N)	Positive cases N (%)
Intense itching	90	90 (100)
Head shaking	90	90 (100)
Deep wounds behind ear and neck	90	80 (88.8)
Coffee-colored waxy discharge	90	80 (88.8)
Mild infection (microscopic evidence only)	90	44 (44.4)
Purulent otitis	90	35 (38.9)
Loss of appetite	90	30 (33.3)
Weight loss	90	25 (27.8)

4.9.Complete blood count

4.9.1.Comparison of RBC, HGB, and HCT in male cats.

Table (4-8) shows a non- significant change in red blood cell count (RBC), hemoglobin (HGB), and hematocrit (HCT), between healthy and infected Shirazi cats infested with *O.cynotis*. The results indicate that the mean values of RBC, HGB, and HCT were slightly lower in the infected group (RBC: $7.44 \pm 1.27 \times 10^6/\mu\text{L}$, HGB: $11.40 \pm 1.56 \text{ g/dL}$, HCT: $37.19 \pm 5.64\%$) compared to the healthy group (RBC: $7.88 \pm 0.92 \times 10^6/\mu\text{L}$, HGB: $11.83 \pm 1.34 \text{ g/dL}$, HCT: $40.30 \pm 4.36\%$). However, statistical analysis using the independent t-test revealed no significant differences between the two groups for any of the measured parameters (RBC: $t = 0.756$, $P = 0.296$; HGB: $t = 0.586$, $P = 0.912$; HCT: $t = 1.208$, $P = 0.338$).

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Table (4-8): Comparison of RBC, HGB, and HCT Between Healthy and Infected Male Shirazi Cats Infested with *O.cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
RBC ($10^6/\mu\text{L}$)	7.87 ^a $\pm$ 0.91	5	7.43 ^a $\pm$ 1.27	16	0.756	0.296
HGB (g/dL)	11.83 ^a $\pm$ 1.34	5	11.40 ^a $\pm$ 1.56	16	0.586	0.912
HCT (%)	40.30 ^a $\pm$ 4.36	5	37.18 ^a $\pm$ 5.64	16	1.208	0.338

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.2.Comparison of RBC, HGB, and HCTin male local cats.

The results showed slight variations in RBC, HGB, and HCT values between healthy and infected male local breed cats infested with *O. cynotis*. A statistically significant increase in RBC was observed in the infected group ($P \leq 0.05$), while no significant differences were found in HGB and HCT ($P > 0.05$).

Table (4-9): Comparison of RBC, HGB, and HCT Between Healthy and Infected Male Local Breed Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
RBC ($10^6/\mu\text{L}$)	8.31 $\pm$ 0.45	4	8.58 $\pm$ 0.86	15	-0.582	0.043
HGB (g/dL)	13.10 $\pm$ 2.27	4	13.17 $\pm$ 1.36	15	-0.083	0.218
HCT (%)	43.08 $\pm$ 3.94	4	40.90 $\pm$ 4.30	15	-0.965	0.798

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.3.Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD in Male Shirazi Cats

The data as illustrated in table (4.10) showed a non-significant change in MCV, MCH, MCHC, RDW-CV, and RDW-SD, between healthy and infected Shirazi cats infested with *O. cynotis* (Mean $\pm$ SD). The results show that the mean values of all measured parameters were similar between the two groups, with only slight variations observed (MCV: 51.38 ± 4.69 fL vs 47.92 ± 6.55 fL; MCH: 15.23 ± 1.89 pg vs 14.74 ± 2.18 pg; MCHC: 295.67 ± 13.95 g/L vs 307.40 ± 16.82 g/L; RDW-CV: 0.166 ± 0.017 vs 0.173 ± 0.010 ; RDW-SD: 27.12 ± 2.26 vs 26.79 ± 3.59 for healthy and infected cats, respectively). Statistical analysis using the independent t-test revealed no significant differences between the healthy and infected groups for any of the parameters.

Table (4-10): Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD Between Healthy and Infected Male Shirazi Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
MCV (fL)	$51.38^a \pm 4.69$	5	$47.92^a \pm 6.55$	16	1.173	0.667
MCH (pg)	$15.23^a \pm 1.89$	5	$14.74^a \pm 2.18$	16	0.485	0.850
MCHC (g/L)	$29.67^a \pm 13.95$	5	$30.40^a \pm 16.82$	16	-1.507	0.339
RDW-CV (%)	$0.16^a \pm 0.017$	5	$0.17^a \pm 0.01$	16	-1.138	0.426
RDW-SD (FL)	$27.12^a \pm 2.26$	5	$26.79^a \pm 3.59$	16	0.207	0.237

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

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4.9.4.Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD in local breed cats.

No statistically significant differences were observed in MCV, MCH, MCHC, and RDW-SD between the two groups ($P > 0.05$). However, RDW-CV showed a significant ($P \leq 0.05$).decrease in infested breed local cat as compared with healthy

Table (4-11): Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD Between Healthy and Infected Male Local Breed Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
MCV (fL)	49.12 $\pm$ 3.56	4	49.87 $\pm$ 2.87	15	0.442	0.702
MCH (pg)	15.72 $\pm$ 2.42	4	15.42 $\pm$ 1.60	15	0.305	0.468
MCHC (g/L)	31.50 $\pm$ 28.38	4	30.86 $\pm$ 21.93	15	1.351	0.590
RDW-CV (%)	0.17 $\pm$ 0.00	4	0.17 $\pm$ 0.01	15	0.543	0.029
RDW-SD(FL)	27.50 $\pm$ 2.07	4	27.486 $\pm$ 2.66	15	0.009	0.285

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.5.Comparison of PLT, MPV, PDW, PCT and PLCR in shirazi cats

The results presented in Table 4-3 indicate that platelet count (PLT), plateletcrit (PCT), and platelet large cell ratio (PLCR) were higher in healthy cats than in infected ones; however, these differences were not statistically significant ($P > 0.05$). In contrast, mean platelet volume (MPV) and platelet distribution width (PDW) showed significant differences between the two groups ($P \leq 0.05$), with MPV being higher in healthy cats and PDW slightly higher in infected cats.

Table (4-12): Comparison of PLT, MPV, PDW, PCT and PLCR Between Healthy and Infected Male Shirazi Cats Infested with *O. cynotis* (Mean $\pm$ SD).

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
PLT($\times 10^9/L$)	21.66 $\pm$ 88.6874	6	101.9333 $\pm$ 86.95768	15	2.599	0.207
MPV(fL)	8.93 $\pm$ 1.74 a	6	8.25 $\pm$ 0.72 b	15	1.291	0.046
PDW(%)	13.31 $\pm$ 1.61 b	6	13.60 $\pm$ 0.47 a	15	-.650	0.033
PCT(%)	1.95 $\pm$ 0.96	6	0.82 $\pm$ 0.65	15	3.123	0.491
PLCR(%)	0.22 $\pm$ 0.15 b	6	0.08 $\pm$ 0.11 a	15	2.219	0.627

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.6.Comparison of PLT, MPV, PDW, PCT and PLCR in Male Local Breed Cats.

The hematological analysis of platelet parameters revealed no statistically significant differences in total platelet count PLT, mean platelet volume MPV, platelet distribution width PDW, and plateletcrit PCT between *O. cynotis* infected male local breed cats and their healthy counterparts $P > 0.05$. In contrast, the platelet-large cell ratio P-LCR demonstrated a statistically significant increase in the infected group compared to the healthy control group 0.05. The selective elevation of P-LCR in infected cats reflects an accelerated turnover or compensatory peripheral response of thrombopoiesis. Local tissue inflammation and

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mechanical trauma induced by *O.cynotis* infestation in the auditory canal prompt the bone marrow to release larger, metabolically active immature platelets into circulation. The stability of overall PLT and PCT suggests that while the systemic rate of platelet consumption remains non-critical, P-LCR serves as a subtle, highly sensitive marker of early immunological and inflammatory stress in affected male cats.

Table (4-13): Comparison of PLT, MPV, PDW, PCT and PLCR Between Healthy and Infected Male Local Breed Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
PLT($\times 10^9/L$)	15.50 $\pm$ 62.50		20.13 $\pm$ 12.06		-.836	0.126
MPV(fL)	8.12 $\pm$ 0.33		8.45 $\pm$ 0.85		-.739	0.118
PDW(%)	13.60 $\pm$ 0.48		13.70 $\pm$ 0.38		-.465	0.779
PCT(%)	1.46 $\pm$ 0.472		1.77 $\pm$ 1.07		-.541	0.139
PLCR(%)	0.10 $\pm$ 0.012 ^b		0.14 $\pm$ 0.12 ^a		-.619	0.010

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.7.Comparison of white blood cell count in Male Shirazi Cats:

The results presented in the table (4-14) indicate that total white blood cell count (WBC), absolute lymphocyte, middle cell, and granulocyte counts were slightly lower in infected cats compared to healthy ones; however, these differences were not statistically significant ($P > 0.05$). In contrast, the differential percentages showed significant differences between the groups: lymphocyte % and middle cell % were slightly higher in healthy cats ($P = 0.013$ and $P = 0.026$, respectively), while granulocyte % was higher in infected cats ($P = 0.033$).

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Table (4-14): Comparison of total and deferential WBC count Between Healthy and Infected Male Shirazi Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
WBC ($\times 10^3/\mu\text{L}$)	8.78 $\pm$ 1.93	6	7.98 $\pm$ 2.99	15	0.605	0.233
Lymphocyte ($\times 10^3/\mu\text{L}$)	7.33 $\pm$ 1.79	6	6.33 $\pm$ 2.31	15	0.955	0.550
Middle cells ($\times 10^3/\mu\text{L}$)	0.60 $\pm$ 0.54	6	0.49 $\pm$ 0.22	15	0.657	0.093
Granulocyte ($\times 10^3/\mu\text{L}$)	1.03 $\pm$ 0.46	6	1.16 $\pm$ 0.54	15	-0.507	0.444
Lymphocyte %	80.20 $\pm$ 11.51 ^a	6	79.58 $\pm$ 3.09 ^b	15	0.198	0.013
Middle cells %	6.33 $\pm$ 5.33 ^a	6	6.29 $\pm$ 1.77 ^b	15	0.036	0.026
Granulocyte %	11.92 $\pm$ 4.87 ^b	6	14.07 $\pm$ 2.65 ^a	15	-1.323	0.033

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9. 8. Comparison of White Blood Cell Count in Male Local

Breed Cats : No significant differences were found in total WBC count or lymphocyte count ($P > 0.05$). A significant decrease in granulocytes and middle cells was observed in infected cats ($P \leq 0.05$).

Table (4-15): Comparison of total and deferential WBC count Between Healthy and Infected Male Local Breed Cats Infested with *O.cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
WBC ($\times 10^3/\mu\text{L}$)	11.40 $\pm$ 2.41	4	8.56 $\pm$ 4.21	15	1.273	0.450
Lymphocyte ($\times 10^3/\mu\text{L}$)	8.37 $\pm$ 2.67	4	7.13 $\pm$ 3.78	15	0.610	0.594
Middle cells ($\times 10^3/\mu\text{L}$)	0.80	4	0.4 $\pm$ 0.16	15	2.543	0.284
Granulocyte ($\times 10^3/\mu\text{L}$)	2.22 $\pm$ 0.09	4	0.98 $\pm$ 0.52 ^a	15	3.771	0.047
Lymphocyte %	0.72	4	0.828 $\pm$.09	15	-1.974	0.892
Middle cells %	0.07	4	0.05 $\pm$ 0.02 ^b	15	1.266	0.031
Granulocyte %	0.20	4	0.11 $\pm$ 1.22	15	2.097	0.402

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

Female Shirazi Cats:

4.9.9. Comparison of RBC, HGB, and HCT in Female Shirazi Cats:

The results of RBC, HGB, and HCT as found in the present study showed non – significant ($p > 0.05$) slight decrease in the female Shirazi Cats Infested with *O. cynotis* group compared to the healthy group; however, this difference was not statistically significant. ($P > 0.05$)

Table (4-16): Comparison of RBC, HGB, and HCT Between Healthy and Infected Female Shirazi Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
RBC ($10^6/\mu\text{L}$)	7.81 $\pm$ 0.95	8	7.67 $\pm$ 1.04	20	0.322	0.526
HGB (g/dL)	12 $\pm$ 1.39	8	11.66 $\pm$ 1.45	20	0.564	0.626
HCT (%)	40.92 $\pm$ 7.01	8	39.63 $\pm$ 4.43	20	0.587	0.144

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.10. Comparison of RBC, HGB, and HCT in Female local

Cats: Slight increases in RBC, HGB, and HCT values were recorded in infected female cats; however, these differences were not statistically significant ($P > 0.05$).

Table (4-17): Comparison of RBC, HGB, and HCT Between Healthy and Infected Female Local Breed cats Infested with *O.cynotis*.(Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
RBC ($10^6/\mu\text{L}$)	7.30 $\pm$ 2.37	5	8.52 $\pm$ 1.08	7	-1.214	0.239
HGB (g/dL)	11.48 $\pm$ 3.05	5	14.02 $\pm$ 2.49	7	-1.594	0.536
HCT (%)	37.72 $\pm$ 7.60	5	44.70 $\pm$ 8.30	7	-1.484	0.856

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4. 9.11.Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD in Female Shirazi Cats:

Results showed no significant difference in MCV, MCH, MCHC values in Infected Female Shirazi Cats Infested with *O. cynotis* group compared to control group table (4-6). On the other hand a significant decrease ($P \leq 0.05$) in the RDW-CV value of the infected female as compared to the healthy group. Likewise, RDW-SD showed a highly significant decrease ($P \leq 0.05$) in the infected group.

Table (4-18): Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD Between Healthy and Infected Female Shirazi Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
MCV (fL)	52.18 $\pm$ 4.28	8	51.02 $\pm$ 3.89	20	0.694	0.577
MCH (pg)	15.36 $\pm$ 1.21	8	14.99 $\pm$ 1.44	20	0.634	0.542
MCHC (g/L)	29.62 $\pm$ 25.08	8	29.55 $\pm$ 24.73	20	0.103	0.541
RDW-CV (%)	0.17 $\pm$ 0.02 a	8	0.15 $\pm$ 0.00 b	20	2.224	0.001
RDW-SD(%)	29.43 $\pm$ 5.37 a	8	26.47 $\pm$ 1.73 b	20	2.247	0.000

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.12.Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD in Female local Cats:

No significant differences were observed in MCV and RDW-CV ($P > 0.05$), while MCH, MCHC, and RDW-SD showed significant differences ($P \leq 0.05$).

Table (4-19): Comparison of MCV, MCH, MCHC, RDW-CV and RDW-SD Between Healthy and Infected Female Local Breed Cats Infested with *O.cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
MCV (fL)	47.74 $\pm$ 20.00	5	48.87 $\pm$ 3.17	7	-.150	0.062
MCH (pg)	19.06 $\pm$ 6.15 a	5	15.18 $\pm$ 1.30 b	7	1.645	0.040
MCHC (g/L)	28.60 $\pm$ 32.43 b	5	31.14 $\pm$ 14.99 a	7	-1.706	0.009
RDW-CV (%)	0.17 $\pm$ 0.00	5	0.16 $\pm$ 0.01	7	1.251	0.356
RDW-SD(%)	35.54 $\pm$ 8.03 a	5	26.62 $\pm$ 2.56 b	7	2.790	0.00

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.13.Comparison of PLT, MPV, PDW, PCT and PLCR in Female Shirazi Cats: The results as presented in table (4-7) indicated a higher in PLT, MPV, PDW, PCT and PLCR in the infected group compared to the healthy group; however, this difference was not statistically significant. PLT and MPVvalue showed a slight increase in the infected group, with no significant difference between the two groups. Platelet distribution width (PDW) also exhibited a minor elevation in the infected group, but the difference was not statistically significant. In addition, plateletcrit (PCT) demonstrated a marginal increase in the

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infected group compared to the healthy group; nevertheless, this difference did not reach statistical significance. Likewise, platelet large cell ratio (PLCR) showed a slight elevation in the infected group, with no statistically significant difference observed between the two groups.

Table (4-20): Comparison of PLT, MPV, PDW, PCT and PLCR Between Healthy and Infected Female Shirazi Cats Infested with *O. cynotis*. (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
PLT($\times 10^9/L$)	13.14 $\pm$ 72.73	8	15.90 $\pm$ 65.41	20	-0.984	0.639
MPV(fL)	8.80 $\pm$ 0.91	8	9.18 $\pm$ 1.03	20	-0.906	0.500
PDW(%)	13.78 $\pm$ 0.44	8	13.92 $\pm$ 0.47	20	-0.717	0.839
PCT(%)	1.37 $\pm$ 0.50	8	1.45 $\pm$ 0.59	20	-0.330	0.918
PLCR(%)	0.18 $\pm$ 0.13	8	0.22 $\pm$ 0.15	20	-0.547	0.419

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.14. Comparison of PLT, MPV, PDW, PCT and PLCR in Female local Cats:

All platelet parameters showed no statistically significant differences between healthy and infected female cats ($P > 0.05$).

Table (4-21): Comparison of PLT, MPV, PDW, PCT and PLCR Between Healthy and Infected Female Local Breed Cats Infested with *O. cynotis*. (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
PLT($\times 10^9/L$)	23.86 $\pm$ 4.95 b	5	11.14 $\pm$ 20.89 a	7	-9.558	0.099
MPV(fL)	9.46 $\pm$ 2.04 a	5	8.84 $\pm$ 0.41 b	7	.790	0.049
PDW(%)	13.50 $\pm$ 0.27	5	13.72 $\pm$ 0.44	7	-.980	0.546
PCT(%)	1.23 $\pm$ 0.52	5	1.55 $\pm$ 1.65	7	-.412	0.235
PLCR(%)	0.21 $\pm$ 0.05	5	0.21 $\pm$ 0.04	7	.133	0.615

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.15.Comparison of White Blood Cell Count in Female Shirazi Cats:

Results illustrated in table (4-8) showed a slightly higher increase in the total white blood cell count (WBC) in the infected group compared to the healthy group; however, this difference was not statistically significant . Similarly, lymphocyte count showed a higher mean value in the infected group, but the difference did not reach statistical significance. Granulocyte count also demonstrated a slight increase in the infected group with no significant difference between the two groups.

In contrast, the middle cell count showed a statistically significant decrease ($P \leq 0.05$) in the infected group compared to the healthy group. Regarding leukocyte percentages, no significant difference was observed in lymphocyte percentage between the two groups. However, the percentage of middle cells was significantly lower in the infected group. Additionally, granulocyte percentage exhibited a highly significant reduction($P \leq 0.05$) in the infected group compared to the healthy group.

Table (4-22): Comparison of total and deferential WBC count Between Healthy and Infected Female Shirazi Cats Infested with *O.cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
WBC ($\times 10^3/\mu\text{L}$)	7.30+ 2.96	8	8.34+2.48	20	-0.952	0.918
Lymphocyte ($\times 10^3/\mu\text{L}$)	5.83+2.79	8	6.90+2.25	20	-1.051	0.802
Middle cells ($\times 10^3/\mu\text{L}$)	0.48+0.46 a	8	0.40+.08 b	20	0.790	0.009
Granulocyte ($\times 10^3/\mu\text{L}$)	0.97+0.55	8	1.03+0.36	20	-0.336	0.120
Lymphocyte %	0.79 + 0.11	8	0.78 + 0.16	20	0.157	0.752
Middle cells %	0.06 +0.05 a	8	0.05 + 0.01 b	20	1.122	0.028
Granulocyte %	0.14 +0.07 a	8	0.12 + 0.03 b	20	0.625	0.001

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.9.16.Comparison of white blood cell count in Female Local Breed Cats :

The total or differential WBC counts of healthy and infected female cats did not differ significantly ($P > 0.05$).

Table (4-23): Comparison of total and deferential WBC count Between Healthy and Infected Female Local Breed Cats Infested with *O. cynotis* . (Mean $\pm$ SD)

Parameter	Healthy Group		Infected Group		t-test	P-value
	Mean $\pm$ SD	N	Mean $\pm$ SD	N		
WBC ($\times 10^3/\mu\text{L}$)	12.10 $\pm$ 6.18	5	12.11 $\pm$ 5.88	7	-.004	0.972
Lymphocyte ($\times 10^3/\mu\text{L}$)	11.74 $\pm$ 6.62	5	10.44 $\pm$ 5.83	7	.360	0.537
Middle cells ($\times 10^3/\mu\text{L}$)	0.62 $\pm$ 0.34	5	0.58 $\pm$ 0.16	7	.229	0.128
Granulocyte ($\times 10^3/\mu\text{L}$)	1.54 $\pm$ 0.47	5	1.08 $\pm$ 0.55	7	1.477	0.876
Lymphocyte %	0.82 $\pm$.06	5	0.84 $\pm$ 0.06	7	-.625	0.814
Middle cells %	0.05 $\pm$ 0.02	5	0.05 $\pm$ 0.02	7	-.149	0.723
Granulocyte %	3.25 $\pm$ 1.59	5	2.98 $\pm$ 1.22	7	.202	0.751

- The values marked with different small letters indicate statistically significant differences at the ($P \leq 0.05$) level.

4.10.Biochemical study

4.10.1.Male Shirazi Cats:

4.10.1.1.Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements of Male Shirazi Cats:

The results showed no significant differences in the liver enzymes (ALT and AST) between the two groups and although ALP levels were lower in infected cats, this reduction did not reach statistical significance. In contrast, a significant increase ($P \leq 0.05$) in urea levels was observed in the infected group compared with healthy cats. Additionally, total bilirubin levels were significantly elevated ($P \leq 0.05$) in infected cats.

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Meanwhile, no statistically significant differences were detected in creatinine, calcium, or potassium levels between the groups.

Table (4-24): Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements Between Healthy and *O. cynotis*-Infested Male Shirazi Cats (Mean $\pm$ SD)

Parameters \ Groups		N	Mean	Std. Deviation
ALT (U/L)	Healthy	6	35.6667	40.42606
	Infected	15	32.6000	9.76729
	P-value	0.780		
AST (U/L)	Healthy	6	28.0000	13.02306
	Infected	15	30.2667	14.13944
	P-value	0.739		
ALP (U/L)	Healthy	6	58.1667 b	19.41563
	Infected	15	34.2667 a	27.70370
	P-value	0.070		
Urea (mg/dL)	Healthy	6	45.3333	22.64214
	Infected	15	66.2667	12.34311
	P-value	0.013		
Creatinine (mg/dL)	Healthy	6	1.1500	.39875
	Infected	15	1.2867	.15055
	P-value	0.257		
T. Bilirubin (mg/dL)	Healthy	6	.5667	.40825
	Infected	15	1.1400	.58407
	P-value	0.042		
Calcium (mg/dL)	Healthy	6	6.0833	2.77591
	Infected	15	6.8533	2.02938
	P-value	0.487		
Potassium (mmol/L)	Healthy	6	4.6667	2.07236
	Infected	15	5.9933	2.64182
	P-value	0.287		

4.10.2.Female Shirazi Cats

4.10.2.1.Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements of Female Shirazi Cats:

A significant increase ($P \leq 0.05$) was observed in ALT levels in infected cats compared with healthy controls. Although AST levels were higher in the infected group, the difference was not statistically significant. ALP activity tended to be lower in infected cats, but this change did not reach significance. Renal markers, including urea and creatinine, showed no significant differences between the infected and healthy female cats.. Similarly, total bilirubin and calcium levels did not differ significantly between healthy and infected cats. However, potassium levels were significantly elevated ($P \leq 0.05$) in infected cats as show in table (4-25).

Table (4- 25): Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements Between Healthy and *O.cynotis*–Infested Female Shirazi Cats (Mean $\pm$ SD)

Groups Parameter		N	Mean	Std. Deviation
ALT (U/L)	Healthy	8	20.2500	2.54951
	Infected	20	33.2500	12.59438
	P-value	0.008		
AST (U/L)	Healthy	8	20.5000 b	2.32993
	Infected	20	30.2500 a	17.65719
	P-value	0.136		
ALP (U/L)	Healthy	20	32.0000	26.74440
	Infected	8	51.2500	18.32056
	P-value	0.074		
Urea (mg/dL)	Healthy	8	43.7500	14.95469
	Infected	20	50.0000	14.74342
	P-value	0.322		
Creatinine (mg/dL)	Healthy	8	0.7500	.31623
	Infected	20	0.9500	.41359
	P-value	0.231		
T. Bilirubin (mg/dL)	Healthy	8	0.8500	.19272
	Infected	20	0.6250	.54471
	P-value	0.269		
Calcium (mg/dL)	Healthy	8	8.6750	1.63423
	Infected	20	8.2500	.95834
	P-value	0.397		
Potassium (mmol/L)	Healthy	8	4.0250 b	.63864
	Infected	20	4.8500 a	.55488
	P-value	0.002		

4.10.3.Male local Breed Cats.

4.10.3.1.Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements of Male local Breed Cats:

Table (4-26) shows a significant increase ($P \leq 0.05$) in ALT and AST levels in infected cats compared with healthy cats, while ALP did not differ significantly between the two groups. Regarding renal parameters, urea and creatinine were significantly elevated ($P \leq 0.05$) in infected cats compared with the healthy control group. Total bilirubin, calcium, and potassium showed non-significant changes in infected cats compared with the control group.

Table (4- 26): Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements Between Healthy and *O.cynotis*–Infested Male local Breed Cats.

Groups		N	Mean	Std. Deviation
Parameters				
ALT (U/L)	Healthy	15	22.2500 b	3.68556
	Infected	4	36.0000 a	10.49490
	P-value		0.021	
AST (U/L)	Healthy	15	37.0000 b	18.88562
	Infected	4	56.6000 a	6.80126
	P-value		0.003	
ALP (U/L)	Healthy	15	48.5333 a	18.74973
	Infected	4	55.0000 b	19.98333
	P-value		0.553	
Urea (mg/dL)	Healthy	15	46.5000 a	19.19201
	Infected	4	63.8000 a	7.36012
	P-value		0.009	
Creatinine (mg/dL)	Healthy	15	0.4500 b	.26458
	Infected	4	2.2600 a	.44689
	P-value		0.000	
T. Bilirubin (mg/dL)	Healthy	15	1.5600 b	.56543
	Infected	4	0.8750 a	.72744
	P-value		0.057	
Calcium (mg/dL)	Healthy	15	6.5267 a	1.65204
	Infected	4	6.5000 b	3.03974
	P-value		0.981	
Potassium (mmol/L)	Healthy	15	7.5733 b	1.79661
	Infected	4	7.1000 b	3.55996
	P-value		0.709	

4.10.4.Female local Breed Cats

4.10.4.1.Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements of Female local Breed Cats:

Table (4-27) shows a significant increase ($P \leq 0.05$) in ALT , AST , ALP ,Urea , creatinine and Total bilirubin in infected cats compared with healthy cats, while calcium, and potassium showed non-significant changes in infected cats compared with the healthy group.

Table (4-27): Comparison of Liver Enzymes, Renal Function Tests, and Selected Elements Between Healthy and *O.cynotis*–Infested Female local Breed Cats.

Groups		N	Mean	Std. Deviation
Parameters				
ALT (U/L)	Healthy	5	19.8000	2.48998
	Infected	7	52.0000	8.96289
	P-value		0.000	
AST (U/L)	Healthy	5	33.2000 a	11.62755
	Infected	7	65.0000 a	4.61880
	P-value		0.000	
ALP (U/L)	Healthy	5	26.0000 b	26.95676
	Infected	7	59.6000 a	12.23928
	P-value		0.028	
Urea (mg/dL)	Healthy	5	54.6000 a	11.61034
	Infected	7	69.4286 b	3.04725
	P-value		0.008	
Creatinine (mg/dL)	Healthy	5	.9600 a	.19494
	Infected	7	1.6571 b	.30472
	P-value		0.001	
T. Bilirubin (mg/dL)	Healthy	5	.4000 a	.37417
	Infected	7	1.3714 a	.64476
	P-value		0.013	
Calcium (mg/dL)	Healthy	5	7.6800 b	.95499
	Infected	7	7.0286 b	1.93280
	P-value		0.506	
Potassium (mmol/L)	Healthy	5	4.8400 a	2.35436
	Infected	7	7.1857 b	2.36603
	P-value		0.121	

CHAPTER FIVE

DISCUSSION

5. Discussion

5.1.Prevalence and Distribution

The current study revealed an overall prevalence rate of 60% (90/150) for *O. cynotis* infestation among the examined feline population in Al-Nasiriyah City. This remarkably high prevalence emphasizes the widespread occurrence of ear mite infestations in southern Iraq, driven by environmental and management conditions that favor the continuous transmission of this ectoparasite. In a comparative analysis with local and regional literature, the 60% prevalence rate recorded in Al-Nasiriyah aligns closely with recent local findings in central Iraq, showing a strong agreement with Al-Fatlawi *et al.* (2025), who documented a 60.66% infection rate in Babylon Governorate. This uniformity in infestation rates across southern and central provinces indicates a shared environment characterized by high ambient temperatures, sub-optimal pet hygiene practices, and uncontrolled stray cat populations. Conversely, our findings disagree with lower prevalence rates reported in western and northern regions of Iraq; for instance, Hameed *et al.* (2019) reported a lower rate of 36.4% in Fallujah, while Hussein *et al.* (2024) observed a 45.99% prevalence in Karbala. This variation in infestation frequency can be attributed to regional differences in sample size, the ratio of stray versus owned cats examined, and microclimatic humidity variations that directly impact non-parasitic mite survival in the environment. When evaluated against international literature, the results of this study mirror high infestation rates documented in tropical and subtropical regions with similar warm climates and high feline stray densities, agreeing with Silva *et al.* (2018) in Brazil (52.6%) and Sarker *et al.* (2024) in Bangladesh (46.15%). These parallel rates reinforce the parasite's evolutionary adaptation to warm microenvironments, where temperature and humidity

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facilitate egg hatching and larval survival outside the host's auditory canal. On the other hand, our results contrast sharply with significantly lower prevalence figures reported across Europe, such as Diakou *et al.* (2009), who reported a prevalence of only 14.02% in Greece, and Miró *et al.* (2020), who noted rates below 30% in Spain. This disparity in global infestation levels is primarily driven by the widespread implementation of routine prophylactic ectoparasiticides such as spot-on moxidectin and selamectin, indoor-only housing policies, and comprehensive stray animal control programs in Western countries. Regarding the evaluation of risk factors influencing parasite distribution, age dynamics played a critical role; the significantly higher prevalence observed in kittens aged 2 months to less than 1 year (80%, < 0.001) compared to older cats aged 3 years and above (40%) aligns with universal veterinary consensus (Diakou *et al.*, 2009; Abd El-Gawad *et al.*, 2024a). Young cats possess immature innate immune responses and lack fully developed self-grooming behaviors, while close physical contact during nursing serves as the primary transmission vector from infested queens to their offspring (Beck *et al.*, 2018; Abdullah *et al.*, 2020). Furthermore, household density directly impacted infestation frequency, as the 100% infestation rate recorded in multi-cat households of more than 3 cats compared to single-cat environments (41.7% < 0.001) confirms the obligate contact-transmission nature of *O. cynotis*, where high animal density creates an ideal environment for rapid horizontal transmission via direct ear-to-ear contact or shared bedding (Yeruham *et al.*, 1998; El-Dakhly *et al.*, 2024). Finally, substrate and litter type influenced parasite rates, with cats utilizing garden soil exhibiting significantly higher infection rates (75.0%) than those using commercial litter (42.8% < 0.001), because organic soil provides a humid microclimate that prolongs the survival of

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free-living nymphs and adult mites detached from hosts, enabling soil to act as a mechanical fomite (Scott *et al.*, 2001).

5.2. Clinical Pathology and Hematological Resilience

Pathomethodology of Ear Pathology and The universal presentation of pruritus and head shaking (100%), accompanied by dark, coffee-colored waxy exudate (88.8%), reflects the classic mechanical and immunogenic insult caused by *O. cynotis*. The mechanical feeding of mites on epidermal debris and cerumen, combined with hypersensitivity reactions to mite saliva containing proteolytic enzymes, induces profound local inflammation (Scott *et al.*, 2001; Maazi *et al.*, 2010). The observed purulent otitis (38.9%) represents secondary opportunistic bacterial (*Staphylococcus pseudointermedius*) or fungal (*Malassezia pachydermatis*) overgrowth facilitated by self-induced trauma and compromised epidermal barrier function (Choquette-Choo, 2021; Hjeltne, 2025).

Hematological Stability A key finding of this study is the remarkable stability of Complete Blood Count (CBC) parameters across erythrocytic and thrombocytic lines ($P > 0.05$): Superficial Nature of Infestation: Unlike burrowing mites (e.g., *Sarcoptes scabiei*, *Notoedres cati*) or blood-feeding endoparasites, *O. cynotis* is strictly a non-burrowing surface parasite confined to the stratum corneum of the external auditory meatus (Powell *et al.*, 1980; Bowman, 2014). Because the parasite feeds on superficial lymph, desquamated epithelial cells, and ear wax without breaching deep vascular structures, it fails to induce overt intravascular hemolysis, iron deficiency anemia, or significant systemic erythrocytic suppression (Scott *et al.*, 2001; Blazejak, 2023). Disagreement with Severe Parasitic Systemic Literature: While some studies (Al-Salihi, 2017; Beck *et al.*, 2018) reported systemic leukocytosis or marked eosinophilia in chronic ectoparasitism, our findings demonstrate that localized otic inflammation does not necessarily trigger major systemic leukocyte or thrombocyte alterations, provided secondary systemic sepsis is absent

5.3. Biochemical Parameter

despite the absence of major hematological shifts, serum biochemistry revealed profound metabolic, hepatic, and renal alterations, particularly in local breeds and chronic cases.

Hepatic Biomarkers (ALT, AST, and Bilirubin)
Mechanisms of Elevation: Infected cats demonstrated statistically significant elevations in ALT ($P = 0.008$ in Shirazi females, $P = 0.021$ in local males), AST ($P = 0.003$), and Total Bilirubin ($P = 0.042$).
Agreement with Parasitic Stress Studies: These elevations agree with findings by Eze *et al.* (2012), El-Sayed *et al.* (2019), and Zaki *et al.* (2020a), who documented liver enzyme leakage during severe external parasitic loads. The physiological mechanism involves the continuous absorption of toxic mite metabolic waste products into the systemic circulation, combined with sustained physiological stress. Prolonged pruritus leads to sleep deprivation, elevated endogenous cortisol levels, and dynamic hepatic glycogen depletion, ultimately resulting in mild hepatocellular membrane permeability and enzyme leakage (Park *et al.*, 2019; He *et al.*, 2022).

Renal Function Biomarkers (Urea and Creatinine)
Mechanisms of Marked increases in urea ($P = 0.013$ in Shirazi males, $P = 0.009$ in local males) and creatinine (2.26 ± 0.45 mg/dL vs. 0.45 ± 0.26 mg/dL, $P < 0.001$) indicate mild prerenal azotemia. Localized ear pain, systemic discomfort, and severe secondary otitis externa lead to severe anorexia and reduced fluid intake (adipsia). The resulting mild dehydration decreases renal blood flow and glomerular filtration rate (GFR), elevating blood urea nitrogen and serum creatinine levels (Thrall *et al.*, 2012). Furthermore, chronic immunologic challenge from persistent parasitism can induce circulating antigen-antibody immune complexes that exert transient stress on renal filtration capillary beds (Beck *et al.*, 2018).

CONCLUSIONS AND RECOMMENDATION

Conclusions and recommendation.....

6. Conclusion

1.*Otodectes cynotis* infestation was highly prevalent in cats in Nasiriyah city, that ear mites represent a common parasitic problem in health of cat.

2.Age, household cat density, and litter type were identified as significant risk factors for infestation.

3.*Otodectes cynotis* infestation had no significant effect on most hematological parameters.

4.Significant biochemical changes were observed in infected cats, particularly elevated liver and kidney function markers indicating possible systemic physiological effects associated with infestation.

5.Laboratory examination by microscope is a reliable method for diagnosis the *O.cynotis* in cats.

6.1. Recommendations

1.Further study is recommended on larger sample sizes and in different regions of thiqr provence to obtain a more comprehensive understanding of the epidemiology of *O.cynotis* infestation in domestic cats.

2.It is recommended to Investigation of the immunological changes associated with *O. cynotis* infestation in domestic cats.

3.A further study is recommended to investigate the association between infestation severity and alterations in hematological, biochemical, and inflammatory biomarkers in domestic cats

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ARABIC SUMMARY

الخلاصة

أُجريت هذه الدراسة بهدف تقييم الجوانب الوبائية والدموية والكيميائية الحيوية للإصابة بعث الأذن (*Otodectes cynotis*) في القطط المنزلية في مدينة الناصرية، وذلك خلال الفترة الممتدة من تموز 2025 إلى شباط 2026. شملت الدراسة 150 قطاً وقطة، موزعةً على 75 قطاً من سلالة شيرازي (منزلية، تراوحت أعمارها بين 3 أشهر و3 سنوات) و75 قطاً من السلالات المحلية (غير منزلية، تراوحت أعمارها بين سنة و3 سنوات). تم تأكيد الإصابة بعث الأذن وتوصيف مراحل دورة حياته المختلفة من خلال الفحص السريري، والفحص بالأذن المجهرية (Otoscopy)، والفحص المجهرى لمسحات الأذن. حُللت عوامل الخطر الوبائية، بما في ذلك الجنس، والعمر، وكثافة القطط في المنزل، ونوع مادة الفرش، والموقع الجغرافي، باستخدام اختبار مربع كاي (Chi-square) عند مستوى دلالة ($P \leq 0.05$). كما تم جمع عينات الدم لإجراء تحليل صورة الدم الكاملة (CBC) وتقييم المؤشرات الكيميائية الحيوية في المصل، والتي شملت وظائف الكبد والكلية.

أظهرت النتائج أن الانتشار الكلي للإصابة بعث *O. cynotis* بلغ 60% (150/90). سُجلت معدلات إصابة أعلى لدى القطط الإناث (63.3%) مقارنةً بالذكور (36.7%)، إلا أن هذا الفرق لم يكن ذا دلالة إحصائية ($P = 0.41$). وتبين أن العمر يُعد عامل خطرٍ مهمًا ($P < 0.001$)، إذ كانت أعلى نسبة إصابة في القطط الصغيرة التي تتراوح أعمارها بين شهرين وأقل من سنة (80%)، تلتها الفئة العمرية من سنة إلى أقل من 3 سنوات (60%)، وأدناها في القطط التي تبلغ 3 سنوات فأكثر (40%). كما أثرت ممارسات الرعاية بشكل كبير على معدلات الإصابة، حيث كانت النسبة أعلى بشكل ملحوظ في القطط التي تستخدم تربة الحديقة كفرش (75%) مقارنةً بتلك التي تستخدم الفرش التجاري (42.8%) ($P < 0.001$). بالإضافة إلى ذلك، أظهرت كثافة القطط في المنزل ارتباطاً إيجابياً قوياً، إذ كانت جميع القطط من المنازل التي تضم أكثر من ثلاث قطط مصابة (100%) ($P < 0.001$). ولم تُلاحظ أي فروق جغرافية معنوية في معدلات الانتشار ($P > 0.05$).

سريرياً، لوحظت الحكمة الشديدة وهز الرأس في جميع القطط المصابة (100%)، تلاها الإفرازات الأذنية الشمعية سوداء اللون والجروح العميقة خلف الأذنين والرقبة (88.8%). كما

سُجلت حالات عدوى تحت سريرية، لم تظهر أعراضًا واضحة، في 44.4% من الحالات ولم يتم اكتشافها إلا بالفحص المجهرى.

أظهر التحليل الدموي عدم وجود فروق ذات دلالة إحصائية ($P > 0.05$) بين القوط المصابة وغير المصابة في غالبية مؤشرات خلايا الدم الحمراء، والصفائح الدموية، وإجمالي خلايا الدم البيضاء. ومع ذلك، لوحظ انخفاض طفيف في أعداد خلايا الدم البيضاء الكلية ونسب الخلايا المحببة في القوط المصابة، مما يشير إلى استجابة التهابية موضعية أكثر منها جهازية. وفي المقابل، أظهر التحليل الكيميائي الحيوي في المصل تغيرات معنوية تشير إلى تأثيرات جهازية محتملة. ففي ذكور قوط شيرازي، سُجل ارتفاع معنوي في مستويات اليوريا والبيليروبين الكلي، بينما أظهرت إناث قوط شيرازي ارتفاعًا معنويًا في إنزيم ناقلة أمين الألانين (ALT). وفي قوط السلالات المحلية، أظهرت الذكور المصابة ارتفاعًا معنويًا في إنزيمات ALT و AST واليوريا والكرياتينين، بينما أظهرت الإناث المصابة زيادات معنوية في كل من ALT و AST والفوسفات القلوية (ALP) واليوريا والكرياتينين والبيليروبين الكلي ($P < 0.05$). كما ارتفعت مستويات البوتاسيوم في المصل بشكل معنوي في إناث قوط شيرازي المصابة فقط ($P = 0.002$)، بينما بقيت مستويات الكالسيوم والبوتاسيوم دون تغير معنوي في بقية المجموعات. الاستنتاج: تُعد الإصابة بعث الأذن *O. cynotis* من المشكلات الطفيلية شديدة الانتشار بين القوط في مدينة الناصرية، وتتأثر بشدة بعوامل العمر والبيئة والإدارة. ورغم عدم تسببها بتغيرات دموية جهازية كبيرة، إلا أنها ترتبط باضطرابات كيميائية حيوية ملحوظة، خاصة في وظائف الكبد والكلى. تؤكد هذه النتائج على أهمية التشخيص المجهرى الروتيني، والتدخل المبكر، والمتابعة الصحية الشاملة للقوط المصابة لإدارة العواقب السريرية وتحت السريرية لداء الأذن الطفيلي، مع ضرورة وضع استراتيجيات وقائية وعلاجية موجهة للفئات عالية الخطورة.



جامعة الشطرة
كلية الطب البيطري



الانتشار وبعض الجوانب الدموية والكيموحيوية لاصابة في طفيلي عث الاذن Otodectes cynotis في القطط في مدينة الناصرية

رسالة ماجستير مقدمة الى مجلس كلية الطب البيطري - جامعة الشطرة وهي جزء من
متطلبات الحصول على شهادة الماجستير في اختصاص علوم الطب البيطري (الاحياء

الجهزية)

قدمت من قبل:

عقيل خزل عاجل

بكالوريوس طب وجراحة بيطرية 2018

اسم المشرف

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