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Biochemical impact of chronic poor mouth and dental hygiene on cat health: ameliorative by clindamycin

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ABSTRACT

Periodontal disease is a multifactorial chronic inflammatory disease that can have a significant impacts on a pet's health. Home oral hygiene and diet have been shown to have an impact on periodontal health. The present study aimed to evaluate the effect of periodontitis on the development of oxidative stress and the disturbance of some reproductive hormones in male cats. The present study was carried out on twenty male cats aged from 7 months to 2.5 years, 10 healthy and 10 suffering from oral inflammation, from some veterinary clinics in Cairo. They were divided into 3 groups. group1 apparently healthy, group2 chronic oral inflammation gp before treatment, group3 the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp). Our results displayed a significant increase in serum malondialdehyde, glucose, estradiol, liver, kidney, and heart biomarkers; conversely, a significant decrease in serum total protein, albumin, total beta, albumin: globulin ratio, and testosterone were observed in oral inflammation-non-treated cats as compared with normal healthy cats. The results of the present study suggested that oral inflammation in cats is associated with oxidative stress. Furthermore, our study showed that oral inflammation diseases could not only cause oral local diseases but could also induce systemic diseases through the effect of oxidative stress.

INTRODUCTION

The veterinary dentistry field is consistently evolving as dental care is critical to maintaining good health and improving the quality of life of an animal **(Holmstrom et al. 2013)**. Oral diseases have been recognized as the main commonly diagnosed clinical disorders in domestic cats and dogs. They can be di-

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vided into factors that impact on the tooth, periodontium and other oral tissues (**Logan 2006)**. Periodontal disease is a multivariate inflammatory oral disease that is reportedly prevalent in domestic dogs and cats, with symptoms varying from moderate gingivitis to irreversible damage to the supporting structures of the tooth causing tooth loss **(O'Neill et al. 2014; Lund et al. 1999**).

It has been recorded that by two years of age, about 70% of cats and 80% of dogs have some form of periodontal diseases **(Wiggs and Lobprise 1997)**. The relationships between periodontal disorder in cats and the evolution of impaired hepatic and renal function have been recommended **(Moosavian et al. 2024)**. Several factors related to the oral health status of a pet, and many of these may be impacted by the owner. It is known that diet and oral home care level are owner-controlled factors that play an important role in detecting the oral health status of pet animals (**Logan et al. 2002; Gorrel and Bierer 1999)**. Several studies displayed an impact of home oral hygiene and diet on periodontal health **(Thyse et al. 2003; Harrison 2017**). The gold standard for the care of good oral hygiene in pets is thorough and frequent tooth brushing **(Gorrel and Rawlings, 1996)**. Recently, the veterinarians educated the pet owners with proper knowledge and awareness regarding the oral health complications in pet animals and the importance of tooth brushing, as a daily oral hygiene regimen should be a part of every dog and cat's routine. There are animal tooth brushes specifically designed for cleaning the teeth of pet animals **(Chaubey et al. 2021)**.

There are several factors that impact the health of these pet animals, such as feeding and dental hygiene. Therefore, the aim of this study is to evaluate the impact of poor dental hygiene on the general health of cats by measuring oxidative stress, antioxidants, hepatorenal function, and some reproductive hormones during chronic oral diseases resulting from poor dental hygiene.

MATERIALS and METHODS

Materials:

Drugs:

Clindamycin: Clindaclear, a broad spectrum antibiotic, oral solution (Pen and Strep, Norbrook Company) each ml contains: Clindamycin 25 mg (Clindamycin Hydrochloride 27.15 mg). The recommended dose according to the manufacturer's instructions is 5.5 mg/kg.b.wt., orally per 12 hours for 7 to 10 consecutive days depending on the severity of the infection.

Chemicals:

Total antioxidant capacity (TAC) and superoxide dismutase (SOD) kits were obtained from Bio-diagnostic kit CAT. No. NO TA 2513 and SD 25 21 respectively. Furthermore, Total protein kits, creatine phosphokinase (CPK) and lactate dehydrogenase (LDH) were obtained from Spectrum kit CAT. NO 310 001, 238 001 and 283 001 respectively. Metaphosphoric acid (MPA), tris hydroxyl methyl amine, Temed (N.N.N.N. tetra methyl ethylene diamine), acrylamide, Bis (methyline bis acrylamide) were obtained from Sigma-Aldrich, Germany. Ammonium per sulphate, glycine and glacial acetic acid were purchased from El Nasr Pharmaceutical Chemicals. 2, 6-di-tert-butyl-4-methyl phenol (BHT), Retinol, and α-tocopherol were obtained from Sigma-Aldrich. The grade hexane and methanol of HPLC were purchased from Fisher Scientific. Additionally, ethanol (HPLC-grade) was purchased from Carlo Erba and the purified deionized water was prepared by using a Milli-Q system.

Design of experimental:

Twenty male cats (10 apparently healthy and 10 chroinic oral inflammation) aged between 7 months to 2.5 years from some veterinary clinics in Cairo were divided into 3 groups. group1 apparently healthy, group2 chroinic oral inflammation gp before treatment, group3 the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp). The treatment of the chronic oral inflammation of the same cats

occurs under the supervision of veterinary clinics.

Samples collection:

Collection of blood samples:

Blood samples (about 3 ml) were collected through saphenous vein from each cat in the 3 groups. Clindamycin treated group sample collected one week after the last dose of clindamycin. Serum samples were obtained via centrifuging the blood samples at 4000 rpm for 6 minutes. Sera were stored at -20°C until biochemical assessment.

Biochemical Analysis:

Serum total protein and electrophoretic pattern were assesed according to **Kaplan and Szalbo (1983) and Davis (1964)** respectivly, and the calculated depending on SynGene S. No. 17292*14518 sme*mpcs program. Aspartate amino transferase (AST) and alanine amino transferase (ALT) activities were evaluated according to **Schumann et al. (2002)**. alkaline phosphatase (ALP) was determined depending on **EL-Aaser and EL-Merzabani (1975)**. lactate dehydrogenase (LDH) was determined depending on **Bais and Philcox (1994)**. Creatine phosphokinase CPK was assesed according to **Burtis** and **Ashwood** (**1999**). Urea, creatinine and glucose levels detected by method described by **Wybenga et al. (1971)**; **Henry (1974) and Tietz (1995)** respectively. Levels of malonaldehyde (MDA), total antioxidant capacity (TAC), reduced glutathione (GSH), superoxide dismutase (SOD), and catalase (CAT) were determined according to **Mesbah et al. 2004, Koracevic et al. 2001, Beutler et al. 1963, Nishikimi et al. 1972 and Aebi 1974** respectively. Quantitative determination of serum testosterone and estradiol were carried out using ELISA kit (Monocent, Inc., USA, catalog No. EL 1-1263) and (DiaMetra, Italy, catalog No. DKO003) respectively.

Vitamin A (VIT A) (retinol) and vitamin E (VIT E) (α-tocopherol) levels in serum samples were carried out by High Performance Liquid Chromatography (HPLC) (Agilent 1200 series, Software – Agilent Chemistation Version B.040.01) SP1 (Agilent Technologies, Germany), with a pump, degasser, autosampler, DAD detector and Chromatographic column - Agilent C18, 100A (4.6 x 250 mm, 5 μm) as the stationary phase was applied. The chromatographic condition was set depending on **Bystrowska et al. (2009)**. Also, stock, and intermediate standard solutions of vitamin A and vitamin E were prepared based on **Bystrowska et al. (2009)**. The calibration curve was produced by spiking blank cat serum with varying intermediate standard solution volumes at concentrations ranging between 0.1 to 100 μg/mL. Three different concentrations of quality control (QC) samples were prepared in blank cat's serum and were applied for achieving the method of validation requirements.

Samples extraction were carried out by a liquid-liquid extraction technique based on **Siluk et al. (2007)** which was a modified version of an earlier recorded performed by **Aebischer et al. (1999)** and validated based on **USP (2021)** by the detection of method precision, recovery, linearity, the limit of detection (LOD), and quantification (LOQ). HPLC method was accurate with high recovery (95-99%) of good linearity ($r2 \geq 0.999$) with a low LOD and LOQ; as LOD was 0.10 μg and LOQ was 0.29 μg. Specificity and selectivity were displayed with chromatogram of Vitamin A at 21.2 min retention time (Fig. 1) and chromatogram of Vitamin E at 12.31 min retention time (Fig. 2).

Statistical Analysis:

The data were statistically analyzed by the One-Way Analysis of Variance (ANOVA) test. Data were given as mean ± standard error (SE) using SPSS 14.0 (2006) followed by Duncan's test. Statistical significance was set at $p<0.05$.

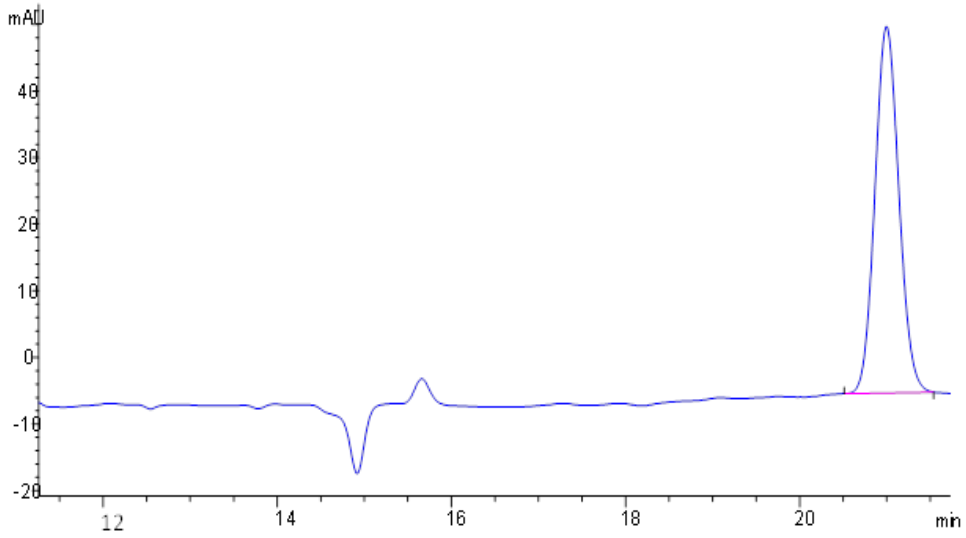

Figure 1. chromatogram of vitamin A at 21.2 minutes retention time

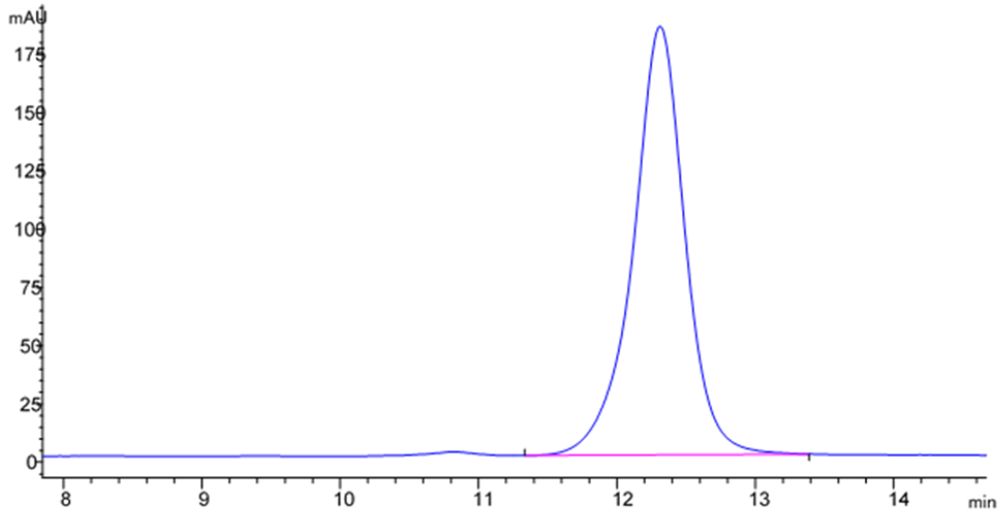

Figure 2. Chromatogram of vitamin E at 12.31 minutes retention time

RESULTS

The results of the current study in table (1) showed that, chronic oral inflammation group showed a noticeable increase in serum MDA meanwhile, there were noticeable decreases in TAC, CAT, SOD, GSH, VIT A and VIT E compared to apparently healthy cats. On the other hand, clindamycin treatment groups displayed a noticeable decrease in serum MDA associated with noticeable increases in TAC, CAT, SOD, GSH, VIT A and VIT E compared with chronic oral inflammation group.

The findings of our study in table (2) pointed out that, chronic oral inflammation group showed a noticeable increase in serum AST, ALP, ALT, LDH, CPK, urea, and glucose compared to apparently healthy cats. Meanwhile, clindamycin

treatment groups displayed a noticeable decrease in all these biochemical parameters compared with chronic oral inflammation group.

The results of present study displayed in table (3), showed noticeable decrease in t. protein, albumin, total beta globulin and A:G ratio, while, there were noticeable increases in total alpha and total gamma globulin in chronic oral inflammation gp before treatment compared to the apparently healthy group. Meanwhile, clindamycin treatment groups displayed a noticeable increase in t. protein, albumin, total beta globulin and A:G ratio associated with a non-significant decreases in total alpha and total gamma globulin compared with chronic oral inflammation group.

The results of present study displayed in table (4), showed noticeable increase in alpha 1 and gamma 1 globulin, while, there were noticeable decrease in alpha 2, beta1,2 and gamma 2 globulin in chronic oral inflammation gp before treatment compared to the apparently healthy group. On the other hand, clindamycin treatment groups displayed a non-significant decrease in alpha 1 and gamma 1 associated with an elevated in alpha 2, beta1,2 and gamma 2 globulin compared with chronic oral inflammation group.

The observed data of serum testosterone and estradiol concentrations in table (5) demonstrated a significant decrease in serum testosterone while there was a significant increase in estradiol in oral inflammation group compared to apparently healthy cats. Meanwhile, clindamycin treatment groups displayed a noticeable increase in serum testosterone associated with a significant decrease in estradiol compared with chronic oral inflammation group.

Table 1. Oxidative stress biomarkers and some vitamins in serum cats suffering from chronic oral inflammation

Groups Parameters	Group 1	Group 2	Group 3
MDA (nmol/ml)	0.61 ± 0.02^{c}	1.53 ± 0.05^{a}	1.00 ± 0.08^{b}
TAC (Mm/l)	1.89 ± 0.11^{a}	0.79 ± 0.02^{c}	1.25 ± 0.04^{b}
CAT (u/ml)	16.42 ± 0.73^{a}	11.07 ± 0.12^{c}	13.40 ± 0.54^{b}
SOD (u/ml)	41.25 ± 1.29^{a}	27.23 ± 1.08^{c}	32.51 ± 1.02^{b}
GSH (u/ml)	4.33 ± 0.18^{a}	2.48 ± 0.01^{b}	4.25 ± 0.22^{a}
Vitamin A (µg/ml)	0.70 ± 0.03^{a}	0.16 ± 0.04^{b}	0.81 ± 0.09^{a}
Vitamin E (µg/ml)	0.38 ± 0.03^{a}	0.12 ± 0.01^{b}	0.36 ± 0.05^{a}

Results are represented as (Mean±SE); (n = 4 cats); Mean value in the same raw with different letter is significantly different at ($P < 0.05$).
Group 1: apparently healthy
Group 2: chronic oral inflammation gp before treatment
Group 3: the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp).

Table 2. Serum liver and kidney function and glucose in cats suffering from chronic oral inflammation.

Groups Parameters	Group 1	Group 2	Group 3
AST (U/L)	11.00 ± 0.58^{c}	56.33 ± 4.81^{a}	24.33 ± 2.60^{b}
ALT (U/L)	6.00 ± 0.58^{c}	19.67 ± 1.20^{a}	11.33 ± 1.45^{b}
ALP (U/L)	167.60 ± 8.59^{c}	258.80 ± 2.12^{a}	204.43 ± 9.27^{b}
LDH (U/L)	244.33 ± 16.84^{c}	439.33 ± 2.60^{a}	335.33 ± 2.03^{b}
CPK (U/L)	48.33 ± 2.96^{c}	131.67 ± 9.13^{a}	86.67 ± 0.88^{b}
Urea (mg/dl)	42.07 ± 1.23^{b}	51.40 ± 2.10^{a}	44.47 ± 1.13^{b}
Creatinine (mg/dl)	0.97 ± 0.07^{a}	1.08 ± 0.03^{a}	0.94 ± 0.02^{a}
Glucose (mg/dl)	70.33 ± 1.76^{b}	88.33 ± 4.84^{a}	74.67 ± 1.20^{b}

Results are represented as (Mean±SE); (n = 4 cats); Mean value in the same raw with different letter is significantly different at ($P < 0.05$)
Group 1: apparently healthy
Group 2: chronic oral inflammation gp before treatment
Group 3: the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp).

Table 3. Serum t. protein and its fractions (g/dl) in cats suffering from chronic oral inflammation

Groups parameters	Group 1	Group 2	Group 3
T.protein	4.76 ± 0.01^{a}	4.14 ± 0.04^{b}	4.55 ± 0.12^{a}
Albumin	1.69 ± 0.04^{a}	0.96 ± 0.03^{b}	1.40 ± 0.02^{c}
Total alpha	0.90 ± 0.04^{b}	1.13 ± 0.04^{a}	1.05 ± 0.08^{ab}
Total beta	0.94 ± 0.01^{a}	0.65 ± 0.03^{c}	0.76 ± 0.03^{b}
Total gamma	1.23 ± 0.01^{b}	1.39 ± 0.01^{a}	1.35 ± 0.03^{a}
Total globulin	3.07 ± 0.04^{a}	3.17 ± 0.01^{a}	3.15 ± 0.10^{a}
A:G ratio	0.55 ± 0.02^{a}	0.30 ± 0.01^{c}	0.44 ± 0.01^{b}

Results are represented as (Mean±SE); (n = 4 cats); Mean value in the same raw with different letter is significantly different at ($P < 0.05$)
Group 1: apparently healthy
Group 2: chronic oral inflammation gp before treatment
Group 3: the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp).

Table 4. Serum protein sub-fraction (g/dl) in cats suffering from chronic oral inflammation.

Groups parameters	Group 1	Group 2	Group 3
Alpha 1	0.38 ± 0.03^{b}	0.80 ± 0.05^{a}	0.67 ± 0.08^{a}
Alpha 2	0.51 ± 0.03^{a}	0.33 ± 0.01^{b}	0.38 ± 0.00^{b}
Beta 1	0.37 ± 0.01^{a}	0.23 ± 0.02^{c}	0.30 ± 0.01^{b}
Beta 2	0.57 ± 0.02^{a}	0.42 ± 0.03^{b}	0.46 ± 0.02^{b}
Gamma 1	0.90 ± 0.03^{b}	1.15 ± 0.01^{a}	1.07 ± 0.03^{a}
Gamma 2	0.33 ± 0.03^{a}	0.24 ± 0.00^{b}	0.27 ± 0.00^{ab}

Results are represented as (Mean±SE); (n = 4 cats); Mean value in the same raw with different letter is significantly different at ($P < 0.05$)
Group 1: apparently healthy
Group 2: chronic oral inflammation gp before treatment
Group 3: the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp).

Table 5. Serum values of testosterone and estradiol in cats suffering from chronic oral inflammation..

Groups Parameters	Group 1	Group 2	Group 3
Testosterone (ng/ml)	1.41 ± 0.089^{a}	0.27 ± 0.082^{b}	1.39 ± 0.050^{a}
Estradiol (pg/ml)	18.75 ± 3.00^{b}	58.20 ± 5.31^{a}	14.74 ± 3.35^{b}

Results are represented as (Mean±SE); (n = 4 cats); Mean value in the same raw with different letter is significantly different at ($P < 0.05$)
Group 1: apparently healthy
Group 2: chronic oral inflammation gp before treatment
Group 3: the same oral inflammated cats treated by clindamycin for 7 days (clindamycin treated gp).

DISCUSSION

Home oral hygiene and diet management and are considered critical factors that impact periodontal health **(Cleland 2000)**. Unfortunately, there is limited information regarding the relationships between periodontal disorder and the general health of pet animals in Egypt. The present study unveils the adverse impact of bad oral hygiene on the periodontal and general health of cats. This is confirmed through evaluating oxidative stress, antioxidants, hepato-renal function, and some reproductive hormones. There is no information about the relationship between bad oral hygiene and reproductive hormones in cats. In the present study, the three studied groups were not markedly different in terms of age or gender, and the average age of all male cats was less than 2.5 years. The reason for choosing young cats was to inhibit as much as possible the presence of diseases that elevate with age **(Moosavian et al. 2024)**. Additionally, if any clinical or laboratory evidence of diseases other than periodontitis was noted, the cats was excluded from the current study.

The results of current study showed that, chronic oral inflammation group displayed a noticeable increase in serum MDA compared

to apparently healthy cats. These results in the same line with **Moosavian et al. (2024)** who recommended that, serum total oxidant status and oxidative stress index were significantly increase in cats suffering from periodontal disease compared with healthy controls. MDA has been suggested to be a sensitive indicator of oxidative stress in several inflammatory disease conditions involving periodontitis **(Akalin et al. 2007; Wei et al. 2010)**. Periodontitis is an inflammatory disorder resulting from plaque biofilm and is established by inflammation or destruction of the supporting tissues surrounding the teeth. This process involves overproduction of reactive oxygen species (ROS), causing oxidative stress, a critical factor in both local and systemic pathological disorders **(Chapple et al. 2007)**. Oxidative stress occurs when there is an imbalance between the release and accumulation of ROS in cells. Recently, oxidative stress has been proposed as a vital link between periodontitis and systemic diseases in cats **(Moosavian et al. 2024)**. In contrast, there were noticeable decreases in TAC, CAT, SOD, GSH, VIT A, and VIT E in the chronic oral inflammation group compared to apparently healthy cats. Similarly, **Moosavian et al. (2024)** displayed that serum TAC was significantly decreased in cats suffering from periodontal disease compared with healthy controls. These results may be nearly similar to **Panjamurthy et al. (2005)** who noted a decrease plasma VIT E, GSH, and TAC concentrations in periodontitis patients. Also, **Canakci et al. (2009)** reported that levels of salivary antioxidants (SOD, GSH, and VIT E) were noted to be decreasing in periodontitis patients.

Additionally, Krol's investigation of total antioxidant status in periodontitis showed a significant decrease in serum TAC when compared with controls. He recommended that oxidative stress in periodontitis expressed by increased ROS concentration and associated with suppression of antioxidant activity in gingival blood may promote the formation of damage in periodontal tissues **(Krol 2004)**. Deficiencies in VIT A and VIT E have been linked with gingival disease **(Logan et al. 2010)**. VIT E is a vital defense molecule against oxidant-induced membrane damage **(Matic 2018)**. Low levels of VIT A or C also increased the risk of gum disease **(Nishida et al. 2000)**.

Chronic periodontal disease in cats is related to high local inflammation and is suspected to impact systemic responses and organ function **(Cave et al. 2012)**. In current study chronic oral inflammation group displayed a noticeable increase in serum AST, ALP, ALT, LDH, CPK, urea, and glucose compared to apparently healthy cats.

Similarly, **Cave et al. (2012**) suggested that dental disease in cats induces hepatic alters that might be inflammatory, causing hepatocellular enzyme leakage leading to an increase in ALT and AST. Also, **Moosavian et al. (2024)** recorded that serum ALT, AST, urea, creatinine, and glucose was not significantly increased in cats suffering from periodontal disease compared with healthy controls. These results may be nearly similar to **Estarreja et al. (2024)** who reported a remarkable increase in ALT, AST, ALP, LDH, and CPK in experimental periodontitis in female rodents as compared with control groups. The increased levels of these biomarkers are resulting from extensive tissue damage **(Jeyasree et al. 2018; Koppolu et al. 2021)**. Moreover, **Hall et al. (2021)** reported that, periodontitis has been identified as a high risk factor for the development of impaired renal function in cats. The present study hypothesized that cats with recorded chronic oral inflammation disease have a higher probability of liver, renal, and cardiac disorders as comorbid diagnoses. The results may by nearly similar to **Pavlica (2008) and DeBowes et al. (1996)** they suggested that dogs with periodontal disease show 1.92 times the probability of chronic kidney failure and 2.32 times the probability of cardiac dysrhythmia. Regarding the increase in concentration of CPK, an enzyme included in energy metabolism and generally used to screen for muscle destruction, it was suggested to observe a noticeable increase in the periodontitis groups as compared with the healthy controls **(Di Lenardo et al. 2019)**, which can be related to the initial stage of the periodontal inflammatory response, translated into significant tissue damage **(Estarreja et al. 2024)**.

Additionally, a higher concentration of LDH is commonly associated with tissue dam-

age and cell necrosis, which are closely linked with the pathogenesis of this disease **(Moghadam et al. 2022)**. Our results displayed that a noticeable increase in LDH level was observed in chronic oral inflammation cats, which may be due to oxidative stress **(Veena et al. 2008)**.

In the present study, results showed a steep decrease in t. protein, albumin, total beta, A:G ratio, alpha 2, beta1,2 and gamma 2, while, there were noticeable increases in total alpha, total gamma, alpha 1, and gamma 1 in chronic oral inflammation gp before treatment compared to the apparently healthy group. These results are nearly similar to those of **Moosavian et al. (2024)**, who recorded that serum albumin and A:G ratio were significantly decreased and associated with a significant decrease in globulin in cats suffering from periodontal disease compared with healthy controls.

The A/G ratio is critical to clinical pathologists because it enables systematic classification of the electrophoretic profile and diagnosis of dysproteinemias **(Kaneko et al. 2008)**. Also, albumin, as the most important negative acute-phase protein in cats, displays reduced blood concentration during inflammation. These declined can be belonged to a shift in amino acid utilization towards the synthesis of positive acute-phase proteins **(Cray et al. 2009; Paltrinieri 2008)**. In the present study, the increase in total gamma and gamma 1 in chronic oral inflammation cats may be related to liver damage. Chronic active hepatitis is usually associated with increases in gamma fractions. Additionally, hypoproteinemias can arise from severe hepatic insufficiency, chronic infections, and protein-losing conditions of the gastrointestinal tract or renal. In any of these instances, depending on the basic conditions of hepatic protein synthesis versus activation of the antigen response. Persistence and progression of hypoproteinemia over time is considered an indication of grave prognosis **(Werner and Reavill 1999**).

The obtained data clarified that a significant increase in serum testosterone as well as decrease estradiol level in chronic oral inflammation cats as compared to apparently healthy group. There are little information directly linking oral inflammation to changes in testosterone and estradiol levels in cats, but despite these limitations, this research can be seen as a step toward this direction. Periodontitis associated with increased oxidative stress **(Moosavian et al. 2024)**, inflammation can activate the body's stress, cortisol is known as one of the primary hormones that define stress conditions, as it has been recorded that it increases during stress conditions (**Dinse et al. 2017)** and will be impacted by the decreased testosterone level (**Dutta et al. 2017).** These results probability similar to **Hidayatik et al. (2021)** who found that, rats exposed to chronic variable stress recorded a noticeable decrease in testosterone and increase cortisol compared to control group.

In contrast to the cortisol level, testosterone level was declined during the stress condition. Stress impacts the reproductive function through the activation of the hypothalamic-pituitary-adrenal (HPA) axis. HPA activation decreases the efficiency of the hypothalamus-pituitary-gonad axis (**Ostner et al. 2008)**.

Generally, our study showed that there's a relationship between chronic poor dental hygiene and systemic diseases in cats, resulting in cats being more susceptible to infectious diseases that might transfer to breeders and affect their health **(O'Neill et al. 2023).** Further studies are needed to support this hypothesis. On the other hand, clindamycin treatment oral infections related to dental disease played a beneficial role in improving oxidative status, thus showed improvement in most of biochemical parameters

CONCLUSION

The present study has identified oral disease as the main commonly diagnosed specific disease in cats resulting from chronic poor mouth and dental hygiene. Our study has also shown that chronic oral disease is related to systemic diseases in cats that can be improved by treatment. Furthermore, our results concluded that oxidative stress plays a critical role in the development of oral inflam-

mation in male cats. Additionally, there are changes in some serum reproductive hormones during oral diseases. However, further studies in male and female cats are needed to confirm the relationship between reproductive hormone disorders and periodontal diseases. Also, it is clear that there is still a need to increase awareness of oral health problems in cats and to educate owners in the advantages of a daily oral care regimen.

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