Feline enteritis has significant clinical issues that have an impact on their health. We conducted this study on 30 cats suffering from various types of enteritis affection, including viral, bacterial, and parasitic. The study aimed to assess the clinical, hematological and biochemical alterations in cats with various forms of enteritis. The most prevalent clinical signs seen in all forms of enteritis were diarrhea, vomiting, dehydration, and anemia. Hematological changes revealed a significant reduction in hemoglobin content and red blood cell count than control values in viral and bacterial enteritis. WBCs count and granulocytes were significantly increased in bacterial enteritis. In viral enteritis, there was a significant decrease in lymphocytes and granulocytes, while in parasitic enteritis, there was a significant increase in eosinophils. Different types of enteritis showed significant increases in total protein, globulin, ALP, and AST, as well as BUN and creatinine, and significant decreases in Ca, P, Na, Cl, and K ions. There was a significant increase in antioxidant enzyme levels, including GSH-Px and SOD, and a significant increase in MDA, inflammatory cytokines, including IL-2 and IL-6, and acute phase proteins, including HP and CRP, in all affections. These results highlight the complexity of feline enteritis and the demand for specialized treatment strategies to meet the wide range of clinical, hematological and biochemical changes.

1. INTRODUCTION

In cats, the digestive system is a critical organ that is susceptible to fatal illnesses. Disorders of this system can be caused by infectious or non-infectious agents (Indarjulianto et al., 2022). Numerous infectious agents can affect the gastrointestinal tract. Viruses, bacteria, and parasites have been demonstrated to induce different degrees of gastroenteritis. The most typical symptoms of gastroenteritis are anorexia, diarrhea, and vomiting. When a cat shows symptoms of acute gastroenteritis, the extent of diagnostic testing varies depending on factors such as clinical signs, history, and the need to check fecal samples for bacterial and parasitic illnesses. A comprehensive assessment has to involve a full blood count and biochemical test (Trotman, 2015).

Feline panleukopenia, a deadly viral illness, puts cats at risk for sepsis and organ failure. Hematobiochemical tests are important for identifying early indications of disease complications because they produce a wide range of clinical symptoms. Fever up to 41°C, lethargy, anorexia, vomiting, diarrhea, and severe dehydration is the most typical clinical manifestations of feline panleukopenia (Kruse et al., 2010). Hemogram examination showed that panleukopenic cats had lower numbers of leukocytes, lymphocytes, granulocytes, erythrocytes, and hemoglobin content (Hb) than healthy cats (Gülersoy et al., 2023). The oxidative biomarkers alterations in cats affected by feline panleukopenia virus include a significant decrease in glutathione peroxidase (GSH-Px), and a significant increase in malondihyde dehydrogenase (MDA) concentration in cats with feline panleukopenia infection compared with healthy animals (Khoshvaghti and Nojaba, 2022). Significantly higher MDA and lower GSH-Px were observed in cases of the feline panleukopenia virus, which is typically caused by oxidative stress and may be linked to the virus's activity, which the body's antioxidant system responds to. (Khoshvaghti and Nojaba, 2022). The host's acute phase response to the feline panleukopenia virus was linked to elevated C-reactive protein (CRP) levels in panleukopenic cats as compared to healthy cats. The panleukopenic cats' elevated blood urea nitrogen (BUN) and creatinine levels may be linked to hypoperfusion brought on by malnourishment and dehydration (Gülersoy et al., 2023). Salmonella is an invasive type of bacteria that damages mucosa, resulting in bleeding, exudation, inflammation, and mucus secretion (Sherding and Johnson, 2006). The primary cause of enteritis is salmonella, a facultative anaerobic bacillus that is gram-negative, motile, and non-sporoforming. It is a member of the enterobacteriaceae family (Weese, 2011). Of the primary enteropathogenic bacteria, salmonella species is found in the feline intestinal tract (Paris et al., 2014). The majority of bacterial enteropathogens are linked to self-limiting diarrhea (Marks et al., 2011). Salmoneleosis should be suspected in hospitalized dogs and cats developing fever and acute enterocolitis (Carter and Quinn, 2000). The hematological changes in cats affected by feline salmonellosis include normochromic microcytic anemia, and decreased hemoglobin (Ramadhani et al., 2021). Abnormal leucogram alterations in cats affected by feline salmonellosis include leukocytosis, which is
characterized by neutrophilia (Giacometti et al., 2017). Cats affected by feline salmonellosis showed elevated aspartate aminotransferase (AST), alanine aminotransferase (ALT), and low levels of serum calcium (Ca) and serum proteins (Giacometti et al., 2017).

Intestinal helminths are one of the most common pathogenic agents in cats (Papazahariadou et al., 2007; Bridger and Whitney, 2009). The main parasites that affect cats and cause severe gastroenteritis include Dipylidium caninum, Isospora felis, and Toxascaris leonina (Pumama et al., 2019). The diagnosis of Dipylidium caninum is performed by the parasitological study of the feces, observing the characteristics of the gravid proglottids (Cabello et al., 2011). The gastrointestinal parasites can harm a cat's health, resulting in symptoms like anemia, vomitting, diarrhea, dull hair, listlessness, and occasionally even death, particularly in kittens (Traversa, 2012). No hematological alterations in cats affected by feline parasitic enteritis include red blood cells (RBCs) or hemoglobin (Mohamed et al., 2021). Abnormal leucogram alterations in cats affected by parasitic enteritis are eosinophilia frequently encountered in cats with parasitic enteritis (Maria and Lo, 2016). Kidney enzymes alterations in cats affected with feline parasitic enteritis include high levels of serum BUN and creatinine (Atata et al., 2019). The purpose of this study was to evaluate hematological, biochemical, and clinical alterations in various forms of feline enteritis.

2. MATERIAL AND METHODS

2.1. Animals:
This study was applied to 100 cats of different sexes (56 male and 44 female), ages (4 months–4 years), and breeds, including Shiraz (n = 59) and Baladi (n = 41), admitted to private pet animal clinics located in Cairo governorate and El Fayoum governorate, Egypt, during the period from November 2021 to March 2023. Thirty cats were selected based on virological, bacteriological, and parasitological examinations and classified into viral enteritis (n = 10), bacterial enteritis (n = 10), and parasitic enteritis (n = 10). These cats were of different sexes (16 male and 14 female), ages (4 months–4 years), and breeds, including Shiraz (n = 19) and Baladi (n = 11). Ten healthy cats were used as controls (5 males and 5 females, 5 Shiraz and 5 Baladi Shiraz breeds). Detailed history gathering, including symptoms duration, dietary background, vaccination status, and recent animal interactions. The physical examination focused on signs like abdominal discomfort, diarrhoea characteristics (consistency, colour, presence of blood or mucus), dehydration, body condition, and any accompanying symptoms.

2.2. Ethical approval:
All examinations were done after the approval of the ethics committee of Benha University, with the approval number BUVTM05-05-23. All samples were collected after the owner consented.

2.3. Samples:
2.3.1. Faecal samples
One faecal sample from each cat suffering from enteritis was used for isolation, and identification of the causative agents was submitted for virological, bacteriological, and parasitological microscopic examinations.

2.3.2. Blood samples
Two sets of blood samples were collected from the cephalic veins of cats from different groups. The first blood sample was collected on a labelled test tube with an anticoagulant (potassium salt of EDTA) for the determination of hematological parameters. The second blood sample was collected without anticoagulant, clotted at room temperature for 20 min, centrifuged at 3,000 rpm for 10 min, and then clear non-hemolyzed serum samples were separated and stored at -20 c until subsequent biochemical analysis.

2.4. Haematological examination:
Total red blood cells (RBCs), haemoglobin concentration, packed cell volume (PCV), total white blood cells (WBCs), differential leukocytic counts, and platelets were determined by a haematological analyzer (Biotec Hema 21) on freshly collected blood samples with anticoagulant.

2.5. Biochemical analysis:
The obtained serum samples were used for the spectrophotometric determination of serum concentrations of total proteins (TP) and globulin, utilising test kits from Spectrum Diagnostics, Egypt. The TP, BUN, creatinine, ALT, alkaline phosphatase (ALP), AST, MDA, superoxide dismutase (SOD), and GSH-Px were analysed using specific kits according to manufacturer instructions (Spectrum Diagnostic Kits, Egypt). The concentration of interleukin-2 (IL-2) and interleukin-6 (IL-6) was calculated using the canine IL-6 duoset enzyme-linked immunosorbent assay (ELISA) (catalogue number DY1609; R&D Systems, Inc.). The analysis included plate preparation, and the assay procedure was performed according to the manufacturer’s ELISA protocol. Finally, the microtiter plate was read using a microtiter reader (SLT Spectra, Tecan) at 450 nm (correction wavelength 540 nm). The serum CRP concentration was measured by an ELISA kit according to the method described by Idoate et al. (2015). The following commercial kits were used according to the standard protocol of the suppliers to quantify each MDA (Biodiagnostics, Egypt). Ca (BioMed, Egypt), REF: CAL103100; phosphorus (P) and magnesium (Mg) (Bio-Diagnostic, Giza, Egypt); sodium (Na), potassium (K), and chloride (Cl) levels (Spectrum Company, Egypt) were determined on a selective chemistry analyzer (Apple 302, USA).

2.6. Virological examination (real-time polymerase chain reaction identification):
The obtained faecal samples were used for viral identification using real-time polymerase chain reaction (RT PCR). The deoxyribonucleic acid (DNA) of the virus was isolated using the GeneJet genomic DNA extraction kit according to the manufacturer’s instructions and the guidelines of Green and Sambrook (2012). Feline panleukopenia virus primers used were: FPV-F 5'-aaacagaaactactataaatatat3', FPV-R5'-aatgtgaccttccgataaat-3'. FPV-Plam5'-tggtcttactcataataagatc-3' (Decaro et al., 2008).

2.7. Parasitological and microscopical examinations:
Faecal samples were collected from cases of diarrhoea (5 cats) for bacterial culture. The isolates recovered were subcultured and further identified using biochemical tests (Alton et al., 1996). The assay for the biochemical properties of the bacterial isolates was conducted according to MacFaddin (2000).

2.8. Bacteriological examination:
Faecal samples were collected from cases suffering from diarrhoea for parasitic microscopic examinations. The faecal flotation technique was used for diagnosis (Kaufmann., 1996).
2.8. Statistical analysis:
The obtained results were expressed as mean ± SE and analysed using one-way ANOVA to define the significant variance between different groups, followed by pairwise comparison using the Tukey post hoc test (SPSS Statistics for Windows, version 28.0; Armonk, NY: IBM Corp.). A statistically significant difference was considered at a p-value < 0.05.

3. RESULTS

Virological findings:
The real-time PCR test on virus DNA showed that the virus DNA found in the 10 cats with viral enteritis was feline panleukopenia virus DNA.

Bacteriological findings
The bacterial isolation test showed that the pathogen found in the bacterial enteritis group of 10 cats was a salmonella species. These were grown on salmonella and shigella agar media and showed up as colorless colonies with a black center. They were identified biochemically on the VITEK system device.

Parasitological and microscopic findings
The microscopic examination results revealed that the most common parasitic eggs detected in the parasitic enteritis group (10 cats) were Dipylidium caninum capsule, Toxascaris leonina egg, and the unsporulated oocyst of Isospora felis (Fig. 1).

![Fig (1): Fecal microscopical examination showed (A) Dipylidium caninum egg capsule containing numerous eggs (B) Egg of Toxascaris leonina and (C) Unsporulated oocyst of Isospora felis.](image)

Cats suffering from viral enteritis were admitted with a history of bloody diarrhoea, severe vomiting (Fig. 2), anorexia, melena, high fever, severe dehydration, lethargy, and severe depression. There was no history of previous vaccinations. Clinical examination revealed that temperature was significantly increased while respiratory rate was significantly increased (P<0.05) (Table 1).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control (N=10)</th>
<th>Viral enteritis (N=10)</th>
<th>Bacterial enteritis (N=10)</th>
<th>Parasitic enteritis (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>38.2±0.11</td>
<td>40.5±0.16</td>
<td>39.7±0.09</td>
<td>37.8±0.20</td>
</tr>
<tr>
<td>Pulse rate (Beat/Minute)</td>
<td>157±0.14</td>
<td>135±0.01</td>
<td>135±0.18</td>
<td>138±0.02</td>
</tr>
<tr>
<td>Respiratory rate (Breath/Minute)</td>
<td>24±0.10</td>
<td>31±0.18</td>
<td>31±0.18</td>
<td>26±0.07</td>
</tr>
</tbody>
</table>

Data are presented as (Mean ± S.E). S.E = Standard error.

Mean values with different superscript letters in the same row are significantly different at (P<0.05).

Haematological findings:
The mean value of RBC count was significantly decreased (P<0.05) in viral enteritis and bacterial enteritis and non-significant change in parasitic enteritis. The mean values of Hb content were significantly decreased (P<0.05) in viral enteritis but not significantly changed in bacterial enteritis or parasitic enteritis. The mean values of PCV% were significantly increased (P<0.05) in viral enteritis, bacterial enteritis, and parasitic enteritis. The mean values of WBC count were significantly decreased (P<0.05) in viral enteritis, significantly increased (P<0.05) in bacterial enteritis, and not significantly changed in parasitic enteritis. The mean values of lymphocytes (%) were significantly decreased (P<0.05) in viral enteritis and not significantly changed in bacterial enteritis and parasitic. The mean values of granulocytes% were significantly decreased (P<0.05) in viral enteritis, significantly increased (P<0.05) in bacterial enteritis, and non-significantly changed in parasitic enteritis. The mean values of eosinophils% and monocytes% were not significantly changed in viral enteritis and bacterial enteritis while significantly increased (P<0.05) in parasitic enteritis (Table 2).

Pale, visible mucous membranes (Fig. 3) and enlarged superficial lymph nodes were observed.

![Fig (2): Male Shiraz cat suffered from viral enteritis showing vomiting](image)

![Fig (3): Female baladi cat suffered from viral enteritis showing pale mucous membrane](image)

Cats suffering from bacterial enteritis were admitted with a history of mild fever, dehydration, mild self-limiting diarrhoea (Fig. 4), and nausea. Physical examination revealed that temperature and respiratory rate were significantly increased (P<0.05) (Table 1). Congested visible mucous membranes and enlarged superficial lymph nodes were observed.

Cats suffering from parasitic enteritis were admitted with a history of macroscopic worms visible in fecal matter in heavy infestation (Fig. 5), constipation, sometimes diarrhoea, abdominal discomfort, weight loss, vomiting, and anorexia. The cats had no prior history of deworming and showed no signs of age susceptibility. The physical examination showed no significant changes in temperature, pulse rate, or respiratory rate (Table 1). Pale, visible mucous membranes and normal superficial lymph nodes were observed.

![Fig (4): Male shirez cat suffered from bacterial enteritis showing yellowish watery diarrhea around anus](image)

![Fig (5): Female shirez cat with protruding of dipylidium caninum around perium region](image)
Biochemical parameters:
The mean values of total protein, globulin, and AST were not significantly changed in viral enteritis, bacterial enteritis, or parasitic enteritis. The mean value of ALT was significantly increased (P<0.05) in viral enteritis and not significantly changed in bacterial enteritis or parasitic enteritis. The mean values of ALP were significantly increased (P<0.05) in viral enteritis, bacterial enteritis, and parasitic enteritis. The mean values of urea and creatinine were significantly increased (P<0.05) in viral enteritis and bacterial enteritis and non-significantly changed in parasitic enteritis. (Table 3).

Table (3): Biochemical changes of liver and kidney functions in feline viral, bacterial and parasitic enteritis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control (N=10)</th>
<th>Viral enteritis (N=10)</th>
<th>Bacterial enteritis (N=10)</th>
<th>Parasitic enteritis (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Protein (g/dl)</td>
<td>8.05±0.27a</td>
<td>7.18±0.46b</td>
<td>7.53±0.18c</td>
<td>7.59±0.21b</td>
</tr>
<tr>
<td>Globulin (g/dl)</td>
<td>4.24±0.22a</td>
<td>3.67±0.31a</td>
<td>4.03±0.12b</td>
<td>4.25±0.16c</td>
</tr>
<tr>
<td>AST (u/l)</td>
<td>22.19±1.75a</td>
<td>26.49±1.61a</td>
<td>24.62±2.79a</td>
<td>24.04±1.63a</td>
</tr>
<tr>
<td>ALT (u/l)</td>
<td>28.76±1.77a</td>
<td>68.43±2.95a</td>
<td>33.55±1.95a</td>
<td>28.94±1.24b</td>
</tr>
<tr>
<td>ALP (u/l)</td>
<td>26.97±2.58a</td>
<td>72.26±2.59a</td>
<td>43.45±2.20a</td>
<td>38.41±3.4b</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>41.18±3.08a</td>
<td>72.42±2.17a</td>
<td>65.12±5.14a</td>
<td>51.39±6.39a</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>0.90±0.04a</td>
<td>2.06±0.21b</td>
<td>1.66±0.21a</td>
<td>0.99±0.23a</td>
</tr>
</tbody>
</table>

The mean values of K and P were significantly decreased (P<0.05) in viral enteritis and non-significantly changed in bacterial enteritis and parasitic enteritis. (Table 4).

Table (4): Biochemical changes of minerals and electrolytes in feline viral, bacterial and parasitic enteritis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control (N=10)</th>
<th>Viral enteritis (N=10)</th>
<th>Bacterial enteritis (N=10)</th>
<th>Parasitic enteritis (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca (mg/dl)</td>
<td>9.14±0.13a</td>
<td>6.75±0.44b</td>
<td>7.01±0.23b</td>
<td>7.00±0.23a</td>
</tr>
<tr>
<td>P (mg/dl)</td>
<td>6.32±0.24a</td>
<td>5.15±0.19a</td>
<td>6.11±0.14a</td>
<td>6.08±0.19a</td>
</tr>
<tr>
<td>Na (mEq/l)</td>
<td>142.5±3.18a</td>
<td>115.7±4.78b</td>
<td>119.5±6.34b</td>
<td>125.7±5.77c</td>
</tr>
<tr>
<td>K (mEq/l)</td>
<td>6.50±0.35a</td>
<td>3.90±0.42b</td>
<td>5.92±0.33b</td>
<td>5.40±0.22b</td>
</tr>
<tr>
<td>CL (mEq/l)</td>
<td>117.8±4.32a</td>
<td>91.6±4.49b</td>
<td>92.3±2.72b</td>
<td>92.2±4.70b</td>
</tr>
</tbody>
</table>

The mean values of GSH-Px and SOD were significantly decreased (P<0.05) in viral enteritis, bacterial enteritis, and parasitic enteritis. The mean values of haptoglobin (HP) were significantly increased (P<0.05) in viral enteritis while not significantly changed in bacterial enteritis or parasitic enteritis. The mean values of MDA, CRP, and IL6 were significantly increased (P<0.05) in viral enteritis, bacterial enteritis, and parasitic enteritis. The mean values of IL2 were significantly increased (P<0.05) in viral enteritis and bacterial enteritis, while they were not significantly changed in parasitic enteritis (Table 5).

Table (5): Biochemical changes of antioxidants, acute phase proteins and inflammatory cytokines in feline viral, bacterial and parasitic enteritis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control (N=10)</th>
<th>Viral enteritis (N=10)</th>
<th>Bacterial enteritis (N=10)</th>
<th>Parasitic enteritis (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSH-Px (u/mg)</td>
<td>6.55±0.91a</td>
<td>3.25±0.16b</td>
<td>3.33±0.18b</td>
<td>4.18±0.24a</td>
</tr>
<tr>
<td>HP (mg/dl)</td>
<td>39.3±3.7b</td>
<td>60.8±2.14a</td>
<td>52.7±4.77a</td>
<td>43.9±1.13b</td>
</tr>
<tr>
<td>SOD (u/mg)</td>
<td>16.96±2.7a</td>
<td>10.3±0.46b</td>
<td>11.35±0.61b</td>
<td>11.65±1.00c</td>
</tr>
<tr>
<td>MDA (mmol/ml)</td>
<td>11.85±1.26a</td>
<td>52.2±2.59a</td>
<td>34.4±8.69a</td>
<td>29.06±2.04a</td>
</tr>
<tr>
<td>CRP (mg/dl)</td>
<td>0.20±0.19a</td>
<td>11.19±0.58a</td>
<td>10.13±0.19a</td>
<td>5.66±1.12a</td>
</tr>
<tr>
<td>IL2 (pg/ml)</td>
<td>0.33±0.07b</td>
<td>1.3±0.16a</td>
<td>1.01±0.19a</td>
<td>0.77±0.23a</td>
</tr>
<tr>
<td>IL6 (pg/ml)</td>
<td>1.93±0.32b</td>
<td>5.4±0.39a</td>
<td>4.96±0.33a</td>
<td>4.47±0.27b</td>
</tr>
</tbody>
</table>

Data are presented as (Mean ± S.E). S.E = Standard error. Mean values with different superscript letters in the same row are significantly different at (P<0.05).

4. DISCUSSION

A range of infectious pathogens can impact the gastrointestinal tract. Different Microorganisms, such as bacteria, fungi, viruses, and parasites, have been found to cause different degrees of gastroenteritis (Troton, 2015). The cats infected with the virus in this study displayed symptoms of fever, lethargy, anorexia, vomiting, severe dehydration, and diarrhea, which might be attributed to the panleukopenia virus infecting the epithelium of the crypts, destroying any new cells, and ultimately causing the blunting of the villus and denuding of the lamina propria. The severe enteric indications that are typically associated with this condition are caused by the destruction and inflammation of tissue, as well as the resulting decrease in epithelial surface area. These factors significantly impair the small intestine’s capacity for absorption and digestion (Tuzio, 2021).
Clinical findings in cats suffering from infectious (viral) enteritis include severe vomiting, bloody diarrhea, anorexia, melena, high fever, severe dehydration, lethargy, and severe depression. Clinical examination revealed that temperature was significantly increased, pulse rate was not significantly changed, and respiratory rate was significantly increased with pale mucous membranes and enlarged superficial lymph nodes. This result agreed with those of Nahla et al. (2023). In the current investigation, the feline salmonellosis–affected cats showed symptoms of fever, malaise, and anorexia, followed by frequent episodes of vomiting, abdominal pain, and diarrhea. Diarrhea is usually mucoid or watery, but in extreme situations, it can turn bloody. Each cat is different when it comes to the severity of their infection, and these findings agree with Marks et al. (2011). The symptoms of the illness in the present study, which could potentially be attributed to gastroenteritis and septicemia, were agreeable with Stiver et al. (2003). The physical examination of cats affected by feline salmonellosis in the present study showed mild fever, congested mucous membranes, and enlarged superficial lymph nodes, and these findings were agreeable with Giacometti et al. (2017). The cats affected by isospora felis in the present study showed signs of vomiting, mental depression, and ultimately death, especially if immunocompromised, and watery diarrhea, which may sometimes turn bloody. These findings were in agreement with Mitchell et al. (2007) and Barutzki and Schaper (2013). Watery diarrhea is typically caused by Isospora spp., which enter the colon and invade the intestinal mucosa, destroying the intestines and causing malabsorption that results in watery diarrhea (Capári et al., 2013).

The feline panleukopenia virus causes hematological changes in cats, such as decreased red blood cells and hemoglobin levels, and these findings were agreeable with Gülersoy et al. (2023). Anemia has been observed to develop in 50% of cases with the feline panleukopenia virus, and it is usually attributed to the long lifespan of erythrocytes unless there is severe gastrointestinal blood loss (Barrs, 2019). There are other possible reasons for lower RBC and Hb counts, such as changes in the bone marrow caused by cytokines or the direct cytotoxic effects of the feline panleukopenia virus (Hartmann, 2010). The hematological alterations in cats affected by feline salmonellosis include normochromic microcytic anemia and decreased hemoglobin, and these findings were agreeable with Ramadhan et al. (2021). Another hematological alteration is elevated PCV, which might be attributed to hemoconcentration from gastrointestinal fluid loss (Sherding and Johnson 2006). No hematological alterations in cats affected by feline parasitic enteritis include RBCs and hemoglobin, and these findings were agreeable with Mohamed et al. (2021). Cats infected with the feline panleukopenia virus often exhibit abnormal leukogram changes, such as leukopenia, which is typified by neutropenia and lymphopenia, and these findings were agreeable with Barrs (2020). The abnormal leukogram patterns detected in the present study can be attributed to the direct cytotoxic effects of the feline panleukopenia virus on the bone marrow (Gülersoy et al., 2023). Abnormal leukogram alterations in cats affected by feline salmonellosis include leukocytosis, which is characterized by neutrophilia, which was agreeable with Giacometti et al. (2017). Abnormal leukogram alterations in cats affected by parasitic enteritis are eosinophilia frequently encountered in cats with parasitic enteritis, and these findings were agreeable with Maria and Lo (2016). The abnormal leukogram patterns detected in the present study, which might be attributed to parasites that invade the tissues, including those that migrate through them, induce greater eosinophilia (Maria and Lo, 2016). The lack of variations in the counts of white blood cells and granulocytes between the groups infected with isospora could perhaps suggest that these endoparasites only induce immunosuppression in chronic cases (Atata et al., 2019).

The cats affected by the feline panleukopenia virus in the present study showed hypogobulinemia, and these findings were agreeable with Sykes (2014). The elevated AST, ALT, total bilirubin levels of the panleukopenic cats in the present study can be associated with hepatic function loss; feline panleukopenia–related gastroenteritis causing diarrhea, dehydration, malnutrition, and circulatory and metabolic dysfunction can contribute to the elevation of the aforementioned parameters (Hartmann, 2010). The cats affected by feline salmonellosis in the present study showed elevated AST, ALT, and low levels of serum Ca and serum proteins, and these findings were agreeable with Giacometti et al. (2017). Liver enzyme alterations in cats affected by feline parasitic enteritis include high ALP levels and ALT, and these findings were agreeable with Giacometti et al. (2017). The panleukopenic cats in this study had elevated BUN and creatinine levels, which may have been related to hypoperfusion brought on by dehydration and anemia (Gülersoy et al., 2023). Kidney enzyme alterations in cats affected by feline parasitic enteritis include high levels of serum BUN and creatinine, and these findings were agreeable with those of Atata et al. (2019). High kidney enzyme levels might be associated with higher fluid loss and tissue hypoperfusion (Nwoha et al., 2013). Moreover, in situations of cytopathic effect, it could be linked to more severe malabsorption and fluid loss via villous atrophy (Behera et al., 2020). Feline parasitic enteritis was associated with decreased serum albumin levels, which might be explained by the fact that more severe mucosal injury occurs and more protein is lost in secretory diarrhea (Armstrong, 2013). Additionally, the inflammatory process's negative acute phase response could corroborate this finding (Kanno et al., 2019).

Electrolyte alterations in cats affected by the feline panleukopenia virus include significant hypokalemia in cats with feline panleukopenia infection, and these findings were agreeable with Kruse et al. (2010). Electrolyte alterations in cats affected by the feline panleukopenia virus include significant hypernatremia, hypochloremia, and hypocalcemia in cats with feline panleukopenia infection compared with healthy animals, and these findings were agreeable with Sykes (2014). It was reported that a significant decrease in potassium in feline panleukopenia can be explained by anoxia, vomiting, increased gastrointestinal potassium losses, fluid therapy, or a possible refeeding syndrome, which most likely reflects the severity of enteritis (Kruse et al., 2010). The oxidative biomarker alterations in cats affected by feline panleukopenia virus include a significant decrease in GSH-Px and a significant increase in MDA concentration in cats with feline panleukopenia infection compared with healthy animals, and these findings were agreeable with Khoshvaghti and Nojaba (2022), which might be attributed to...
to the condition of oxidative stress that appears in feline panleukopenia infection disease, possibly associated with feline panleukopenia virus activity that is well responded to by the body’s antioxidant system. The host's acute phase response to the feline panleukopenia virus was linked to elevated CRP levels in panleukopenic cats as compared to healthy cats (Gülersoy et al., 2023), which might be attributed to It is an acute marker for inflammation, and its levels have been shown to increase in viral infections (Hartmann, 2010). The serum CRP levels of the infectious enteritis groups in the present study were high, but the viral enteritis group had the highest CRP level. These results might be attributed to the degree of intestinal inflammatory damage and the existence of a severe inflammatory response (Candellone et al., 2020). IL-6 was significantly increased in feline enteritis, which coincided with Kuhn et al. (2014), who reported that IL-6 is increased to promote intestinal epithelial proliferation.

5. CONCLUSIONS

These findings demonstrate the complexity of feline enteritis and the need for customized therapeutic approaches to address the various clinical, hematological, and biochemical changes that may occur.

6. REFERENCES