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Review on Canine Chronic Enteropathy

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ABSTRACT

A review of literature revealed that diarrhoea and vomition in dogs were frequent reasons for veterinarians to examine dogs, as well as an increase in the occurrence of canine gastrointestinal issues. CE is a set of chronic intestinal diseases distinguished by persistent or recurring clinical symptoms such as diarrhea, vomition, loss of weight, and appetite abnormalities. It is diagnosed after eliminating out other possible causes, such as parasites, infections, or other systemic disorders. Dogs with chronic enteropathy, a phrase that refers to variety of intestinal tract inflammatory disorders and intestinal diseases, independent of their etiology or pathogenesis which was a set of complexes, non-specific gastrointestinal (GI) disorders in dogs that had symptoms that last three weeks or more and were unrelated to other conditions has been reviewed. One of the most crucial aspects of treating this condition is controlling nutrition. Prebiotics help dogs absorb nutrients more effectively, reduce inflammation, and boost their immunological response by promoting a healthy gut microbiome. To fully utilize the potential of prebiotics and symbiotics in canine nutrition, collaboration among veterinarians, animal nutritionists, and researchers is required. CE is frequently a lifelong condition that requires continual management. Working closely with a veterinarian is essential for an accurate diagnosis and efficient treatment. Dietary management is an important aspect in managing many cases. Early diagnosis and treatment can help the dog's quality of life.

KEYWORDS: Canine, chronic, enteropathy, gastric, inflammatory, intestinal

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1. INTRODUCTION

In veterinary medicine, Chronic Enteropathy (CE) is a more common term for a disorder that was once known as inflammatory bowel disease (IBD). The word "CE" refers to intestinal disorders, irrespective of their cause or pathogenesis. The word is widely used to describe the disease in canines with chronic gastrointestinal complaints, and when the intestinal inflammation is suspected but not confirmed or when no biopsies have been taken. CE is preferred to IBD because it recognises the differences between these disorders in humans, and in animals (Dandrieux, 2016).

The term "chronic enteropathy" refers to a set of complexes, non-specific gastrointestinal (GI) disorders in dogs that have symptoms that last three weeks or more, and are unrelated to any other conditions. It is generally acknowledged that the intricate interplay of the host's genetics, the intestinal microenvironment, which mostly consists of bacteria and food components, the immune system, and environmental factors that produce intestinal inflammation results in CE (Dandrieux and Mansfield, 2019).

Vuori et al. (2023) explained that CE is characterized by recurrent or persistent gastrointestinal symptoms, such as vomiting, diarrhea, appetite loss, and weight loss, that continue longer than three weeks. Although the exact pathophysiology of CE is unknown, it is thought to include a complex interaction between the host's genetic composition, intestinal microenvironmental influences, and the immune system. The importance of host genetics has been confirmed by the discovery that some breeds are susceptible to CE. After checking out other conditions such parasitic or viral disease, endocrine, hepatic, pancreatic, renal, or mechanical blockage that could cause recurrent gastrointestinal symptoms, CE is diagnosed.

Canine diet is critical for their well-being. In recent years, there has been a paradigm shift toward understanding the complex relationship between nutrition and health consequences in dogs. This transition has resulted in a surge of interest in researching novel dietary therapies, with a particular emphasis on components that can positively modify gut microbiota and improve immune function. The non-digestible food ingredients known as prebiotics help the host by specifically increasing the proliferation and/or activity of one or a few bacteria in the colon, have emerged as significant players in this field. These compounds, which are frequently found in fibre-rich foods including fruits, vegetables, and whole grains, act as fuel for healthy gut bacteria, increasing their multiplication and diversity (Kumar and Sharma2024; Greeshma et al., 2022).

Prebiotic-enriched pet meals show potential for controlling IBD in dogs by modifying gut microbiota dynamics, providing a pathway to reduce symptoms and improve overall well-being (Cai et al., 2020; So et al., 2018;). Inflammation is a problem for dogs with IBD, but new research indicates that stem cells and nutrition can help alleviate symptoms and regulate immunity (Cristóbal et al., 2021; An et al., 2020). Additionally, faecal microbiota transplantation (FMT) emerges as a potential strategy, targeting the dysbiosis associated in pathogenesis of canine IBD (Niina et al., 2021; Chaitman and Gaschen, 2021). However, to ascertain the long-term effectiveness and safety of FMT in treating gastrointestinal disorders in dogs, more research is required. (Froebel et al., 2020; Gal et al., 2021). The combination of novel therapeutic methods, such as mesenchymal stem cell transplantation (Koh et al., 2016), nutritional treatments, and faecal microbiota transplantation (Mendis et al., 2017), has marked a new era in the course of treatment of IBD (Xiao and Bai 2019). The study's goal was to find out how common canine chronic enteropathy (CCE) is in dogs using various diagnostic methods based on body weight, age, sex, and breed distribution was the aim of this study.

2. ETIOLOGY OF CE

Similar to IBD in humans, the aetiology of CE in most dogs is still unknown. Due to aberrant host reactions against the commensal microbiota, the research of canine CE shows that the disease's development depends critically on the interaction between intestinal bacteria and genetic determinants (Jergens and Heilmann, 2022).

While the precise etiology of CE remains unclear, increasing data from animal models suggests that a change in the interplay between gut bacteria and the mucosal immune system in a vulnerable host is what causes intestinal inflammation. The most common intestinal illness groups associated with persistent small bowel diarrhea include intestinal structural abnormalities, nongastrointestinal disorders, exocrine pancreatic insufficiency, and mild CE, excluding viral or parasite agents (Hu et al., 2019).

Studies revealed that a complex microbial population, the GI microbiota has been shown to play a crucial role in intestinal health and may be linked to immunologic activity, metabolism, and gastrointestinal (GI) disorders (Huang et al., 2020).

According to Ni et al. (2017) their studied reported that there was growing evidence that the gut health is significantly influenced by the gastrointestinal microbiota, particularly in dogs with CE. Due to its potential for etiopathologic involvement in the health of the host, disease, the GI microbiota had attracted a lot of attention. A change in the diversity, and the gut microbiota's composition was referred

to as intestinal dysbiosis. Intestinal dysbiosis had been linked in studies on veterinary species to a number of GI conditions, including acute diarrhoea, CE, granulomatous colitis, and colorectal polyps.

According to Eissa et al. (2019) current theories, a dysregulation of mucosal immunity in susceptible animals is what leads to the development of CE in dogs. One of the processes that have received the greatest attention for explaining the loss of tolerance to antigens, such as food and intestinal bacteria, is the cause of persistent intestinal inflammation. Specific mutations have been found in some dog breeds, suggesting that genetic factors may possibly play a substantial role.

Irving et al. (2023) reported that canine idiopathic IBD was one of the most prevalent causes of long-term gastrointestinal disease in dogs, and refers to a group of CE with unknown causes that were characterized by inflammatory cells infiltrating the intestinal mucosa.

Manchester et al. (2023) revealed that CE was a common complaint that was brought up in practice, but the loss of immunologic tolerance to luminal antigens was probably a major factor brought on by weakened immunity, an abnormal mucosal barrier, and the effects of the intestinal environment (such as food and bacteria). Dietary modification, immune system control, and alteration of the intestinal microbiota were all essential elements of therapy. Food allergies, parasitic or bacterial infections, inflammatory, and malignant conditions, as well as bacterial infections, were potential causes of chronic diarrhoea in dogs.

Toxin production, disturbance of the normal intestinal microbiota, suppression of the normal enterocyte enzymatic function, ddeterioration of the microvilli, abnormalities of intestinal motility, intestinal epithelial cell death, and inflammation of intestines are some of the pathogenic mechanisms that are caused by *Giardia duodenalis* infections (Perrucci et al., 2020).

CE could include chronic diseases of small intestine such as lymphocytic-plasmacytic enteritis (LPE), eosinophilic enteritis, and eosinophilic gastro-enteritis (EGE), protein-losing enteropathies (PLE), also known as chronic enteropathies with hypoalbuminemia, are a possible outcome of CE (Rana, 2022).

3. PATHOGENESIS OF CANINE CHRONIC ENTEROPATHY

Martínez-López (2021) recited that most experts agreed that CE pathogenesis involved various multiple factors. An imbalance of the gastro-intestinal immune system in genetically vulnerable individuals might cause abnormal responses to dietary or luminal microbiological antigens, according to a currently recognized theory in humans, and dogs, and an inflammation of the intestinal tract was a significant contributor to the pathogenesis of CE.

The development of CE was significantly influenced by inflammation. When the intestinal barrier interacts with the inflammatory cells, phagocytes, and tight connections in the epithelium, oral tolerance to GI and dietary microbial antigens were attained. Uncontrolled inflammation was brought on by the loss of oral tolerance, and was a result of the numerous effects or pathways being activated. Inflammation might then result in architectural disruption, which would have a negative impact on function (Marchetti et al., 2021).

Toresson et al. (2023) mentioned that members of the families *Enterobacteriaceae,* and *Clostridiaceae* were found in the intestine in dogs. Significant changes in the makeup of the gut bacteria were observed in dogs with lower serum cobalamin levels. Changes in gut flora are indicated by low serum cobalamin levels.

Food intolerance was a major factor in the pathogenesis of CE, which was a common disorder in dogs. Adverse food reactions (ARF) played a part in the pathogenesis of every phenotype of the disease. The two main categories of ARF were immunologic (such as dietary sensitivity where an abnormal immune response was included), and non-immunologic (like dietary indiscretion and food intolerance) could both be a common cause of GI symptoms. Food intolerance or allergy was thought to be caused by a loss of oral tolerance. Initiating factors that caused oral tolerance to decline or not develop had not been described in canines, and they were still poorly understood in all species. The loss of integrity of mucosa (due to trauma or inflammation, for example), parasites, or dysbiosis might be the causes. Inability to tolerate dietary antigens could result in an abnormal immune response against the antigen, cause inflammation at a different anatomical location or locally (such as a cutaneous manifestation or otitis externa), and cause inflammation generally (Kawano et al., 2016).

According to Olivry and Mueller (2020) food allergies (FA) can contribute to a variety of dermatological and GI symptoms in dogs. Unknown was the precise occurence of FA. However, the term "allergy" was frequently used in a negligent manner. The wall of the digestive tract was the greatest part of the body exposed to the environment. The GI tract must distinguish between nutrients, and potentially harmful agents (bacteria, viruses, and parasites), which must be tolerated and eliminated (immunity), respectively.

According to Minamoto et al. (2015) it was reported that there was increasing proof that intestine health is significantly influenced by the GI microbiota, particularly in dogs with CE. Due to its potential for etiopathologic involvement in host health condition, and illness, the GI

microbiota has attracted a lot of attention. A change in the diversity, and the gut microbiota's composition was referred to as intestinal dysbiosis. Intestinal dysbiosis had been linked in studies on veterinary species to a number of GI conditions, including acute diarrhoea, CE, granulomatous of the colon, and colon and rectal polyps. Since dysbiosis would result from inflammation, there was likely overlap. Additionally, recent functional studies had shown that the presence of dysbiosis was a risk factor that could make inflammation worse in people with certain genetic predispositions.

4. COMMON CLINICAL SIGNS OF CANINE CHRONIC ENTEROPATHY

Vomiting and diarrhoea, which were commonly accompanied by a decreased appetite, and loss of weight, were the most common and frequent clinical signs. Chronic idiopathic enteropathy was a common condition in underfed dogs. Large intestine diarrhoea with blood, mucus, and straining was caused by colonic involvement, whereas vomiting and small bowel diarrhoea was linked to gastric and duodenal inflammation. An illness that affects both the small and large intestines was indicated by the presence of mixed gastrointestinal symptoms (Tolbert et al., 2022).

Allenspach et al. (2016) also studied that the common clinical symptoms include diarrhoea, and defecation abnormalities, vomition, weight loss, appetite changes. The clinical signs of CE in dogs could range from mild to serious, with potentially life-threatening GI signs. It was not yet clearly reported that the intensity of the clinical symptoms (such as diarrhoea, vomition, or loss of weight) predicts reaction to therapy or the prognosis, or the seriousness of the disease. In some reports, severity of the condition at diagnosis varied considerably among phenotypes, with FRE exhibiting milder clinical symptoms than ARE or IRE.

Vomiting was mostly seen in dog with CE, but it was always accompanied by diarrhoea, and was less severe. Vomiting was frequently the most prominent symptoms of small intestinal IBD in cats than in dogs (Lyngby et al., 2025).

The most typical clinical symptoms in animals with CE that largely affected the small intestine were chronic vomiting, weight loss, diarrhoea, and appetite loss. When compared to human with chronic colitis, which affected the large intestine primarily, present with diarrhoea that might or might not contain blood, and mucus, as well as with increased need to urinate, and occasional vomiting (Volkmann et al., 2017).

Dogs with CE might exhibit any combination, and degree of GI symptoms, including chronic intermittent diarrhoea, and occasionally vomition, loss of weight, changes in appetite, borborygmus, nausea, and discomfort of the abdomen. One or more gastrointestinal tract segments might be damaged (Dandrieux and Mansfield, 2019).

Whitehead et al. (2016) revealed that the contents of the vomit, its correlation with food, signs of nausea, and the appetite were all necessary for localizing the disease (e.g., gastric, colonic, or esophageal disorders, or systemic disease), and understanding the initiation of vomiting (e.g., inflammatory process rather than dysmotility). Regurgitation was usually linked with esophageal disorders, but it could also occur in CE as a result of diseases of dysmotility.

Ferguson et al. (2016) narrated that hematemesis was typically associated with more severe disease that resulted in erosion or ulceration of the mucosa. Syndrome of bilious vomiting was a comparatively frequent occurrence in dogs, and it was believed that mucosal irritation resulted from duodenal fluid refluxing into the stomach lumen. GI tract inflammation, as well as motility issues, can make dogs susceptible to this syndrome. When dogs with syndrome of bilious vomiting fast, they tend to vomit a yellow-colored vomit of bile. Despite being the most prevalent sign of gastrointestinal problems, diarrhea could also be absent (Bota et al., 2016).

Fritsch et al. (2022) reported that consistency of stool, frequency of stool, the presence of blood or mucus, or changes in the defecation (such as tenesmus, dyschezia, or urgency) allow clinicians to pinpoint the GI problem. Watery diarrhoea was characteristic of small bowel illness, and was frequently associated with loss of weight, and in some cases, vomiting. Large bowel diarrhoea, in contrast, was distinguished by a higher frequency of passing tiny volumes of faces, which were commonly combined with tenesmus, urgency, and mucus or fresh blood (hematochezia).

Other symptoms include anorexia, mild to serious loss of weight, and ascites which were connected to an undesirable outcome. Weight loss in GI disorders was caused by under nutrition, also known as malnutrition. Malnutrition can cause cachexia, which could result in serious consequences for the patient, and severe weight loss was also found to be a detrimental prognostic factor. Appetite changes in CE could be variable, with some cases exhibiting polyphagia, others displaying varying degrees of anorexia, and the majority exhibiting no appetite changes. According to some study, a reduce in appetite was a detrimental prognostic factor in dogs with enteritis caused by lymphocytic plasmocytic. Dogs with CE frequently exhibited atypical chewing behaviors, foreign body ingestion, and pica (ingestion of non-nutritive objects) (Demontigny-Bédard et al., 2016).

The animal might exhibit symptoms such as melena (suggesting upper GI bleeding, and ulceration), dyschezia, localization of small intestinal (large volume diarrhoea,

weight loss, and vomiting), and localization of large intestinal (dyschezia, tenesmus, increased frequency of defecation, small volume of faeces, mucous, and blood) lesions (Kent, 2017).

4.1. Less common clinical signs of canine chronic enteropathy

According to Allenspach and Iennarella-Servantez (2021), it was reported that the other clinical indicators include ascites, pleural effusion, and peripheral edemas. Ascites was commonly associated with PLE, and was caused by a drop in oncotic pressure when the level of serum albumin drops below 1.5 g l^{-1}. PLE fluid was typically pure or modified transudates, but chylous ascites was also noted. There might be peripheral oedema, such as oedema pitting of the limbs, scrotum, or face. According to some literature, this clinical sign appeared to be less common, but no studies have been conducted to assess the prevalence of this clinical sign (Jablonski, 2022).

Craven and Washabau (2019) revealed PLE was a unique type of CE in dogs, which could result from a severe progression of widespread intestinal disease that obstructs lymphatic vessels [such as lymphoplasmacytic enteritis with steroid responsive enteropathy (SRE) immunosuppression responsive enteropathy (IRE)] or from intestinal lymphatic system dysfunction caused by primary intestinal lymphangiectasia.

Lecoindre et al. (2016) reported that additional kind of PLE in dogs was focal lipogranulomatous lymphangitis (FLL), it was not clinically different from chronic idiopathic enteropathy (CIE), and PLE. However, ultrasonography of abdomen typically revealed an increased in wall thickness of the distal small intestine (jejunum, ileum, or both), along having single or localized mass-like serosal lesions that may spread to the mesentery.

Dermatological symptoms were common in Adverse Food Reaction (AFR). Non-seasonal pruritus was the most common AFR symptom (Mueller and Unterer, 2018). Pruritus could be generalized or restricted to the face, ears, paws, axillae, inguinal region, or perineum. Other symptoms included seborrhoea, pododermatitis, erythema excoriations, hyperpigmentation, epidermal collarettes, and papules.

5. DIAGNOSIS OF CANINE CHRONIC ENTEROPATHY

A standardised diagnostic approach to CE was presented that offers a logical way to look into cases: Exclusion of any extra-gastrointestinal disease; characterization of the nature, and severity of the disease, and selection of the appropriate treatment based on the severity assessment. Instrumental diagnostics were important, and often crucial in the diagnosis of CE, even though only the latter of methods that are most frequently employed, namely radiology (X-R), and ultrasonography (USG) provides more precise details for the diagnosis of CE. Because the importance of thickening of the intestinal wall in dogs with IBD had just been reevaluated, endoscopy, and USG (which provide important information on layering of the gut, and thickness of the wall) appeared to be more beneficial in ruling out other potential reasons (Holmberg et al., 2022).

Studies showed that abdominal ultrasonography was better when compared to abdominal radiography in expressing the diffuse GI mucosal disease, thickness of the intestinal wall, and lymphadenopathy of the mesentery seen with CE, and other infiltrative (e.g., lymphoma) disorders (Ivasovic et al., 2022). Wall thickening was a common finding in inflammatory diseases, but it was not specific to inflammatory diseases (Penninck and d'Anjou, 2015). Symmetry, extent of wall thickening, and layer identification could help distinguish inflammation from neoplasia.

In identifying mucosal disease: focused versus diffuse, the thickness of the intestinal wall, and the lymphadenopathy of the mesentery associated with CE together with additional infiltrative (such as lymphoma) disorders, ultrasound of the abdomen was was better when compared to radiology (Simeoni et al., 2020).

Diagnosis of CE could be currently defined by (1) chronic (i.e., lasting longer than three weeks) persistent or frequent problems related to the digestive system; (2) evidence from histopathology of the inflammation of the mucosa; (3) failure to record additional sources of inflammation in the gastrointestinal tract; (4) insufficient reaction to anthelmintic, antibiotic, and nutritional treatments alone; and (5) clinical reaction to immunosuppressive or anti-inflammatory drug. The clinical symptoms which include vomition, diarrhoea of the small bowel, diarrhoea of large bowel, loss of weight, and changes in appetite) were due to inflammatory mediators and mucosal cellular infiltrations, and dysmotility of the intestines and enterocyte dysfunction linked to inflammation (Procoli, 2020).

The evaluation of extra-alimentary tract illnesses that cause gastroenteritis was best served by using diagnostic imaging, such as abdominal radiography. When distinguishing between focal, and widespread mucosal illness, thickness of the intestinal wall, and lymphadenopathy of the mesentery, abdominal ultrasonography was much more accurate than radiography. For cytologic investigation, samples from enlarged lymph nodes and focal wall thickening could be obtained by tiny needle aspiration during an ultrasonographic examination (Calabrese et al., 2016).

The biomarkers might be tissue-derived, present in urine, and faeces, or serological. Abdominal ultrasonography,

serological markers, and faecal markers were examples of potential monitoring methods. One biomarker, however, could not reliably forecast the severity of the disease, its course, how well it would respond to treatment, or the clinical results. Concentrations of the serum albumin were regularly assessed in canine patients who were being investigated for GI disorder; cobalamin or Vitamin B12, which is a water-soluble vitamin, was of significance of diagnosis and treatment in CE. Serological markers such as dogs' C-reactive Protein (CRP), a member of the acute-phase reactant protein family and an integrated indicator of systemic inflammation, were also routinely measured (Malin and Witkowska-Piłaszewicz, 2022).

Serum biochemistry and specialized serologies could be used to identify hypoalbuminemia in dogs, which was correlated with unfavorable outcomes. Data from hematology, and blood analysis in a numerical laboratory was divided into three categories: CRP, leukocytes, creatinine, urea, and alanine aminotransferase were above, albumin, total protein, leukocytes, and hematocrit were below, and within reference interval (Holmberg et al., 2022).

The gold standard for identifying intestinal inflammation continues to be an assessment of the intestinal mucosa. Since cobalamin was absorbed in the ileum, hypocobalaminemia might be used to determine whether or not an ileoscopy was necessary (Pérez-Merino et al., 2022).

To rule out any alternate reasons, a thorough study was needed to confirm the diagnosis of CE. Biomarkers which were non-invasive instruments could be used to monitor the gastrointestinal inflammation, assess the clinical outcomes, ascertain whether the illness is present, and track its natural development, evaluate the gastro-intestinal function, and predict the therapy response (Sacoor et al., 2020).

Ohta et al. (2021) narrated that small animal with persistent vomiting, and diarrhoea could have their GIT examined using USG. In one study, researchers created an ultrasound score that, when the diagnosis was made, was discovered to be connected with Canine inflammatory bowel disease activity disease (CIBDAI) but not after treatment. In order to diagnose GI disorders, several writers have assessed the value of the diagnosis of ultrasound of the abdomen.

The strategy could also be further divided into the following adaptable diagnostic algorithm: clinical examination, endoparasite detection, diagnostic imaging, pathological testing, clinical staging based on disease activity index, and therapeutic trials using diet and antibiotics; faecal markers, serological markers (Mehain et al., 2019).

Other laboratory tests that were advised for the diagnosis of GI disorders included the following laboratory tests: serum TLI-Trypsin like immune-reactivity, serum folate, intestinal permeability, and faecal alpha-1- protease inhibitor. For the purpose of assessing the clinical manifestation of illness in dogs with chronic enteropathy, the Canine Chronic Enteropathy Clinical Activity Index (CCECAI) was created. Faecal Calprotectin (FC) could also be used as an immediate indicator of inflammation of the mucosa of the intestine. Because of neutrophil degranulation, this protein was produced in the cytosol of neutrophils (Ministro and Martins, 2017).

Biomarkers that could be tested in canines with CE include the following biomarkers: functional biomarkers like cobalamin, methylmalonic acid, folate, 1-proteinase inhibitor, immunoglobulin A, biochemical biomarkers including C-reactive protein, perinuclear anti-neutrophilic cytoplasmic antibodies, N-methyl histamine, calprotectin, S100A12, soluble receptor of advanced glycation end products, cytokines (regulatory T cells) (Heilmann and Steiner, 2018).

CRP was a positive type II acute phase protein that was exhibited from the liver's reaction to inflammation, infection, or cancer, as well as the level of CRP in the blood was a nonspecific indicator of inflammation (Oliveira et al., 2024).

Yirsa et al. (2025) narrated that GI parasites were a typical contributor to canine chronic GI disorders. An early diagnostic evaluation for an animal with GI disease should always include a routine faecal examination for parasites. A course of treatment with anthelmintics that are broad-spectrum, such as fenbendazole, was constantly advised, regardless of the findings of faecal parasitology. Some methods for examining faeces included direct faecal smears, which helped to see motile trophozoites (e.g., Giardia) also to identify eggs, oocysts, cysts, and it could also be identified through faecal flotation, with or without centrifugation.

Garcia et al. (2018) reported that patients with significantly weakened immune systems usually had more serious illness with parasitic infestation while infections by the parasites did not often causes illness in individual with immune competence. A positive diagnostic test, on the other hand, does not demonstrate that the parasite was the disease's cause. A typical zoonotic GI parasite that could cause gastroenteritis, and be spread through tainted food, water, or direct physical contact was *Giardia* spp. A precise diagnosis of CE and its potential for zoonotic depended on the detection of this infection. Although the predominance in dogs appears to be elevated, it was essential to keep in mind that the frequently employed techniques for identifying Giardia could produce a lot of false positive results. Giardia infection recurrence also appeared to be a common feature of CE, despite the lack of studies to support this association.

6. INCIDENCE OF CANINE CHRONIC ENTEROPATHY BASED ON BREED, AGE AND SEX DISTRIBUTION OF CHRONIC ENTEROPATHY

6.1. Breed distribution

It was not fully understood how CE in dogs was inherited, and it was possible that breeds of dogs had different inheritance patterns. In canine chronic GI disorders, a variety of breed-specific traits had been identified, which was compelled evidence that host genetics might play a part. GSD, Boxer, Weimaraner, and Rottweiler were high-risk canine breeds for CE (Furukawa et al., 2022).

Arslan et al. (2017) reported the findings that some dog breeds were susceptible to idiopathic IBD. Nevertheless, only a small number of causal genetic flaws had currently been identified. A possible interplay between immunity of the host, and the microbiota could be inferred from the relationship between particular breeds such as Boxers, and German shepherd dogs (GSD) and their clinical reaction to antibiotics. Following the elimination of invasive of the mucosa *E. coli* that were similar to an adherent in phylogeny, and pathotype invasion seen with Crohn's ileitis, Boxer dogs, and Granulomatous colitis (GC) in French Bulldogs goes into long-term remission.

6.2. Age distribution

In contrast to SRE, ARE, and FRE characteristics appeared to be more common in younger canines, despite the fact that there was no clearly documented age preference for CE. Although the average age of FRE dogs in many studies was higher than one year, ARF was very frequent in canines younger than a year. Large-breed, middle-aged dogs were typically affected by ARE, and tylosin responsive enteropathy. However, dogs that are middle-aged to elderly were more likely to develop SRE or PLE, even though in some breeds it could happen to younger people. It was important to remember that food responsive diarrhea (FRD), ARE, or steroid responsive diarrhea (SRD) could happen at any age in a clinical setting, even though the presentation of age could assist in differentiating the CE phenotype. Compared to dogs with other CIE subclasses, dogs with FRE are usually younger and have less severe clinical symptoms. FRE is the most common category of CIE in dogs, accounting for 50–65% of cases (Jergens and Heilmann, 2022).

6.3. Sex distribution

In dogs with CE, there was no proven sex predisposition. Even though a female predisposition was described in certain breeds like Yorkshire terrier with PLE12, and Soft-coated wheaten terrier (SCWT) dogs. There was a division on this issue because more male than female was affected by CE in a different study. Furthermore, neutering was linked, according to a recent study, to a higher risk of developing some autoimmune diseases, including IBD. In human autoimmune disorders, and additional acquired autoimmune diseases in canines, female inclination was well established. Female predominance in IBD was not a universal trait in people, unlike other autoimmune conditions, that only affect women, and when it was present, it varies greatly geographically. Geographical variations in the female and male ratio seen in various IBD populations might be clarified by variations by being exposed to risk factors for the disease in the environment (antibiotic use and infectious agents) (Rustgi et al., 2012).

7. TREATMENT OF CANINE CHRONIC ENTEROPATHY WITH THERAPEUTIC PROTOCOLS

Studies showed that the primary challenges in treating dogs with CE, as in human medicine, stem from a lack of knowledge regarding the pathophysiological causes of these illnesses; it was therefore not surprising that medicinal techniques were often adapted from human use (Baritugo et al., 2023).

Generally, prebiotics, probiotics, antibiotics, and corticosteroids were typically used as the first line of treatment for dogs with CE after some dietary changes, and dietary modifications were made. Antibiotics was regarded as the first line of defense, and the gold standard for treating acute or chronic inflammation of the intestine, and they continued to be one of the mainstays of sequential therapy for CE in canines. The most popular antibiotics prescribed to treat GI diseases were metronidazole, and tylosin. Metronidazole was a significant medicinal substance due to its immunomodulatory and antibacterial qualities. Depending on the molecule, as an alternative or in addition to the steroids, additional immunomodulatory or anti-inflammatory medications such azathioprine, cyclosporin, chlorambucil, cyclophosphamide, and 5-aminosalicylates could be used. It was also crucial to address any possible imbalances and incorporate symptomatic treatment approaches, such as motility modulators, antiemetics, and gastroprotectors, while treating a dog with CE (for example, through supplementing with electrolytes or cobalamin). Given that understanding the patterns of cytokines in people with IBD was a crucial instrument for creating novel therapeutics, techniques as well as new therapeutic instrument in veterinary medicine (Alessandri et al., 2020).

Many dogs with CE might be benefitted from nutritional intervention, but not all dogs responded to the same diet or dietary management strategy. Very easily digested and low in residue (i.e., low-fiber) diets, diets prepared with novel or hydrolyzed ingredients of protein, diets based on

amino acids (i.e., elemental) diets, and diets low in fat were examples of common dietary approaches diets rich in fibre (Rudinsky, 2018).

The majority of medical treatment for inducing clinical remission was empirical, and consisted of dietary management, and the use of any anti-inflammatory drugs, along with corticosteroids which could provide the most consistent benefit (Isidori et al., 2022).

Treatment for CE was empirical, and involved a combination of dietary and pharmaceutical interventions. Only dogs with a moderate Chronic Enteropathy Clinical Activity Index (CCECAI) score progression of the disease were candidates for therapies that solely focused on dietary modification. There was only one source of protein in the suggested diet. A restricted diet or elimination of diet that contained proteins, and carbohydrates that were previously absent from the animal's nutritional regimen were advised because CE might be brought on by a reaction to food antigens (Meineri et al., 2022).

Due to the disease's unknown aetiology, treating CE was fraught with challenges. 5-aminosalicylic acid (mesalazine or olsalazine) derivatives might be administered to patients with CE that was progressing moderately. Immunosuppressive medications, antibiotics, and elimination diets were typically used to treat patients with severe illness symptoms (Kaga et al., 2024).

The effectiveness of other treatments was decreased by hypocobalaminaemia, so cobalamin supplementation was also a crucial part of treatment. Antacids, antiemetics, prokinetics, and mucosal were a few examples of short-term supportive therapies that might be helpful in certain circumstances. Current treatment protocols advised parenteral supplementation because cobalamin deficiency was frequently linked to CE in dogs. Cobalamin administration via parenteral and oral routes was equally effective according to several studies (Toresson et al., 2016).

The theory behind nutritional dietary therapy was that reducing exposure to antigens (dietary proteins) recognized to cause sensitivity will lessen heightened host reactions, and inflammation of the intestine. When the large intestine was affected by the inflammatory process, high-fiber diets were prescribed. Dietary modification might involve cutting out foods or adopting a novel protein diet or a highly digestible diet. Dietary therapy should be used in conjunction with an antibiotic course, at least initially (Rudinsky et al., 2018).

The two most frequently prescribed antibiotics were metronidazole (10 mg kg^{-1} every 12 h PO), and tylosin (25 mg kg^{-1} every 12 h PO). In the majority of cases, first-line treatment involved the use of glucocorticoids, typically prednisolone at 1–2 mg kg^{-1} day^{-1}. The most popular antibiotics were Ciclosporin (5 mg kg^{-1} every 12 to 24 h), and chlorambucil (4–6 mg m^{-2} day^{-1} initially), both of which could be tapered over several months. Additionally, metronidazole could be given, including in conjunction with corticosteroids (dogs: 10–20 mg kg^{-1} twice daily PO for 10–14 days, then once daily for 10–14 days). The medication inhibits cell-mediated immunity, and had bactericidal and antiprotozoan effects on anaerobic bacteria (Tamura, 2025).

7.1. Treatment of canine chronic enteropathy along with probiotic

If diet modification alone did not provided patients with mild disease symptoms with satisfactory results, probiotics might be added to the treatment. Probiotic use in veterinary medicine had grown in past few years, owing partly to improve knowledge about the microbiota, and partly due to an unwillingness to use antibiotics on a long-term basis. When administered in sufficient amounts, probiotics were active microorganisms that provided a health advantages to the host (Yang and Wu, 2023).

Live microorganisms were the definition of probiotics that, when consumed in adequate amounts, enhance the wellness of the host. Prebiotics were defined as ingredients that have been selectively fermented, and that do so in a way that altered the makeup or activity of the microbiota in the stomach while additionally helping the host organism. These were disaccharides (lactulose and tagatose), oligo- or polysaccharides [fructooligosaccharides (FOS), mannan oligosaccharides (MOS), xylooligosaccharides, polydextrose, galacto oligosaccharides], or long-chain prebiotics like inulin were a few of these, and preparations combining probiotics, and prebiotics were known as symbiotic (Schmitz and Suchodolski, 2016).

Grzeskowiak et al. (2015) reported that probiotic strains might modulate gut function, and treat a number of GI disorders. Probiotics were living microorganisms that give the host health benefits when consumed in sufficient amounts. Probiotics were gaining popularity in small animal medicine, and had a positive impact on the microbiota. They could compete with pathogenic bacteria, and have anti-inflammatory effects, making it harder for bacteria to stick to the mucosa of the intestine, and spread disorder. Probiotics have been shown to have a number of health benefits, but the exact mechanisms by which they work were still unclear, like dogs with CE were treated with probiotics containing *Saccharomyces boulardii,* studies were unable to discover any information in the literature about the use of *S. boulardii* in canines. Human acute and chronic enteropathies were treated with *S. boulardii*, non-pathogenic yeast. Studies recently completed that showed *S. boulardii* could be given to dogs safely, and could be useful as a therapeutic adjunct for CE, and also PLE.

Xia et al. (2024) reported that utilizing of prebiotics improved the composition of the microbiota of the intestine, lowers the levels of protein catabolites, and increased short chain fatty acid (SCFA) production in the canine intestine, among other positive effects. Additionally, there was a proof that some of the benefits of prebiotics for dogs might be increased if they were combined with particular probiotic strains, or synbiotically. Prebiotics clinical effects were studied in both human and animal models, but there was little proof that prebiotics could treat diseases in dogs.

For canines with CE, the most popularly prescribed therapies aimed to suppress the overactive immune responses that were the source of the symptoms. Non-immunosuppressive therapies, on the other hand, could play a significant role in helping patients achieve a better balance between risk, and benefit. They could reduce mucosal inflammation, combat microbial dysbiosis, and more. As a result of this need, probiotics, prebiotics, and synbiotics had been clinically evaluated for the treatment of CE (Makielski et al., 2019).

Nakashima et al. (2015) revealed that the prognosis for PLE was guarded that the main negative prognostic variables at the time of diagnosis were elevated BUN levels and clonal rearrangement of lymphocyte antigen receptor genes.

8. CONCLUSION

Chronic enteropathy can be diagnosed by using X-Ray, USG, and CCECAI along with other supportive test including physical examination, haematological examination, and serum biochemistry. Treatment can be given with combination of Metronidazole and Prednisolone with other supportive therapy including probiotic.

8. REFERENCES

Alessandri, G., Argentini, C., Milani, C., Turroni, F., Cristina Ossiprandi, M., van Sinderen, D., Ventura, M., 2020. Catching a glimpse of the bacterial gut community of companion animals: a canine and feline perspective. Microbial Biotechnology 13(6), 1708–1732.

Allenspach, K., Culverwell, C., Chan, D., 2016. Long-term outcome in dogs with chronic enteropathies: 203 cases. Veterinary Record 178(15), 368.

Allenspach, K., Iennarella-Servantez, C., 2021. Canine protein losing enteropathies and systemic complications. Veterinary Clinics: Small Animal Practice 51(1), 111–122.

An, J.H., Li, Q., Bhang, D.H., Song, W.J., Youn, H.Y., 2020. TNF-α and INF-γ primed canine stem cell-derived extracellular vesicles alleviate experimental murine colitis. Scientific Reports 10(1), 2115

Arslan, H.H., Kulluk, E., 2017. Inflammatory bowel disease and current treatment options in dogs. American Journal of Animal and Veterinary Sciences 12(3), 150–158.

Baritugo, K.A., Bakhsh, A., Kim, B., Park, S., 2023. Perspectives on functional foods for improvement of canine health and treatment of diseases. Journal of Functional Foods 109, 105744.

Bota, D., Lecoindre, A., Poujade, A., Chevalier, M., Lecoindre, P., Baptista, F., Gomes, E., Hernandez, J., 2016. Protein losing enteropathy in Yorkshire Terriers-retrospective study in 31 dogs. Revue de Medecine Veterinaire 167(1–2), 2–9.

Cai, Y., Folkerts, J., Folkerts, G., Maurer, M., Braber, S., 2020. Microbiota-dependent and-independent effects of dietary fibre on human health. British Journal of Pharmacology 177(6), 1363–1381.

Calabrese, E., Maaser, C., Zorzi, F., Kannengiesser, K., Hanauer, S.B., Bruining, D.H., Iacucci, M., Maconi, G., Novak, K.L., Panaccione, R., Strobel, D., 2016. Bowel ultrasonography in the management of Crohn's disease. A review with recommendations of an international panel of experts. Inflammatory Bowel Diseases 22(5), 1168–1183. https://academic.oup.com/ibdjournal/article-abstract/22/5/1168/4561844. Accessed on 22/03/2025.

Chaitman, J., Gaschen, F., 2021. Fecal microbiota transplantation in dogs. Veterinary Clinics: Small Animal Practice 51(1), 219–233

Craven, M.D., Washabau, R.J., 2019. Comparative pathophysiology and management of protein-losing enteropathy. Journal of Veterinary Internal Medicine 33(2), 383–402.

Cristóbal, J.I., Duque, F.J., Usón-Casaús, J.M., Ruiz, P., Nieto, E.L., Pérez-Merino, E.M., 2021. Effects of allogeneic mesenchymal stem cell transplantation in dogs with inflammatory bowel disease treated with and without corticosteroids. Animals 11(7), 2061.

Dandrieux, J.R.S., 2016. Inflammatory bowel disease versus chronic enteropathy in dogs: are they one and the same? Journal of Small Animal Practice 57(11), 589–599.

Dandrieux, J.R.S., Mansfield, C.S., 2019. Chronic enteropathy in canines: prevalence, impact and management strategies. Veterinary Medicine: Research and Reports, 203–214.

Demontigny-Bédard, I., Beauchamp, G., Bélanger, M.C., Frank, D., 2016. Characterization of pica and chewing behaviors in privately owned cats: a case-control study. Journal of Feline Medicine and Surgery 18(8), 652–657.

Eissa, N., Kittana, H., Gomes-Neto, J.C., Hussein, H., 2019. Mucosal immunity and gut microbiota in dogs

with chronic enteropathy. Research in Veterinary Science 122, 156–164.

Ferguson, L., Wennogle, S.A., Webb, C.B., 2016. Bilious vomiting syndrome in dogs: retrospective study of 20 cases (2002–2012). Journal of the American Animal Hospital Association 52(3), 157–161.

Fritsch, D.A., Wernimont, S.M., Jackson, M.I., MacLeay, J.M., Gross, K.L., 2022. A prospective multicenter study of the efficacy of a fiber-supplemented dietary intervention in dogs with chronic large bowel diarrhea. BMC Veterinary Research 18(1), 244.

Froebel, L.K., Froebel, L.E., Duong, T., 2020. Refined functional carbohydrates reduce adhesion of Salmonella and Campylobacter to poultry epithelial cells *in vitro*. Poultry Science 99(12), 7027–7034.

Furukawa, R., Takahashi, K., Hara, Y., Nishimura, R., Furuya, K., Shingaki, T., Ohmori, K., 2022. Clinical characteristics of dogs presenting with vomiting as a gastrointestinal sign of chronic enteropathy. Veterinary and Animal Science 17, 100255.

Gal, A., Barko, P.C., Biggs, P.J., Gedye, K.R., Midwinter, A.C., Williams, D.A., Pazzi, P., 2021. One dog's waste is another dog's wealth: A pilot study of fecal microbiota transplantation in dogs with acute hemorrhagic diarrhea syndrome. PLoS One 16(4), e0250344.

Garcia, L.S., Arrowood, M., Kokoskin, E., Paltridge, G.P., Pillai, D.R., Procop, G.W., Visvesvara, G., 2018. Practical guidance for clinical microbiology laboratories: laboratory diagnosis of parasites from the gastrointestinal tract. Clinical Microbiology Reviews 31(1), 10–1128.

Greeshma, K., Deokar, C.D., Raghuwanshi, K.S., Bhalerao, V.K., 2022. Morphological and molecular characterization of isolated probiotic yeast. International Journal of Bio-resource and Stress Management 13(5), 472-480.

Grzeskowiak, L., Endo, A., Beasley, S., Salminen, S., 2015. Microbiota and probiotics in canine and feline welfare. Anaerobe 34, 14–23.

Heilmann, R.M., Steiner, J.M., 2018. Clinical utility of currently available biomarkers in inflammatory enteropathies of dogs. Journal of Veterinary Internal Medicine 32(5), 1495–1508.

Holmberg, J., Pelander, L., Ljungvall, I., Harlos, C., Spillmann, T., Haggstrom, J., 2022. Chronic enteropathy in dogs-Epidemiologic aspects and clinical characteristics of dogs presenting at two swedish animal hospitals. Animals 12(12), 1507.

Hu, P., He, H., Dai, N., Zhang, S., Deng, L., 2019. Chronic enteropathy associated with SLCO2A1 gene: a case report and literature review. Clinics and Research in Hepatology and Gastroenterology 43(5), e68–e72.

Huang, Z., Pan, Z., Yang, R., Bi, Y., Xiong, X., 2020. The canine gastrointestinal microbiota: early studies and research frontiers. Gut Microbes 11(4), 635–654.

Irving, J.R., Hiron, T.K., Davison, L.J., Xia, D., Beck, S., Werling, D., Williams, J., 2023. Characterization of canine intestinal microRNA expression in inflammatory bowel disease and T-cell lymphoma. Journal of Comparative Pathology 204, 23–29.

Isidori, M., Corbee, R.J., Trabalza-Marinucci, M., 2022. Nonpharmacological treatment strategies for the management of canine chronic inflammatory enteropathy-A narrative review. Veterinary Sciences 9(2), 37.

Ivasovic, F., Ruetten, M., Kook, P.H., 2022. Prevalence of inflammatory versus neoplastic lesions in dogs with chronic gastrointestinal signs undergoing gastroduodenoscopy: 195 cases (2007–2015). Research in Veterinary Science 146, 28–33.

Jablonski, S.A., 2022. Pathophysiology, diagnosis, and management of canine intestinal lymphangiectasia: a comparative review. Animals 12(20), 2791.

Jergens, A.E., Heilmann, R.M., 2022. Canine chronic enteropathy-current state-of-the-art and emerging concepts. Frontiers in Veterinary Science 9, 923013.

Kaga, C., Kakiyama, S., Hokkyo, A., Ogata, Y., Shibata, J., Nagahara, T., Mizusawa, N., 2024. Characterization of faecal microbiota and serum inflammatory markers in dogs diagnosed with chronic enteropathy or small-cell lymphoma: a pilot study. Scientific Reports 14(1), 19387.

Kawano, K., Shimakura, H., Nagata, N., Masashi, Y., Suto, A., Suto, Y., Uto, S., Ueno, H., Hasegawa, T., Ushigusa, T., Nagai, T., 2016. Prevalence of food-responsive enteropathy among dogs with chronic enteropathy in Japan. Journal of Veterinary Medical Science 78(8), 1377–1380.

Kent, A., 2017. Canine chronic enteropathy. Vet Times, p.47. Available at: https://www.vettimes.com/news/vets/small-animal-vets/canine-chronic-enteropathy.

Koh, A., De Vadder, F., Kovatcheva-Datchary, P., Backhed, F., 2016. From dietary fiber to host physiology: Short-chain fatty acids as key bacterial metabolites. Cell 165, 1332–1345.

Kumar, R., Sharma, A., 2024. Prebiotic-driven gut microbiota dynamics: enhancing canine health via pet food formulation. International Journal of Bio-resource and Stress Management 15(6), 01–15.

Lecoindre, A., Lecoindre, P., Cadoré, J. L., Chevallier, M., Guerret, S., Derré, G., Simpson, K.W., 2016. Focal intestinal lipogranulomatous lymphangitis in 10 dogs. Journal of Small Animal Practice 57(9), 465–471.

Lyngby, J.G.H., Nielsen, L.N., Ankerkilde, S., Bentzen, A.W., Bjørnvad, C., Lund, T.B., Sandøe, P., 2025. Chronic enteropathy in dogs affects the quality of life in both dogs and their owners-are veterinarians proficient in handling the caregiver burden? Frontiers in Veterinary Science 11, 1488917.

Makielski, K., Cullen, J., O'Connor, A., Jergens, A.E., 2018. Narrative review of therapies for chronic enteropathies in dogs and cats. Journal of Veterinary Internal Medicine 33(1), 11–22.

Malin, K., Witkowska-Piłaszewicz, O., 2022. C-reactive protein as a diagnostic marker in dogs: a review. Animals 12(20), 2888.

Manchester, A.C., Dow, S., Chow, L., Gagne, J., Lappin, M.R., 2023. Efficacy of an elemental diet in achieving clinical remission in dogs with chronic enteropathy. Journal of Veterinary Internal Medicine 37(6), 2322–2333.

Marchetti, V., Gori, E., Mariotti, V., Gazzano, A., Mariti, C., 2021. The impact of chronic inflammatory enteropathy on dogs' quality of life and dog-owner relationship. Veterinary Sciences 8(8), 166.

Martínez-López, L.M., Perez-Gonzalez, A., Washington, E.A., Woodward, A.P., Roth-Schulze, A.J., Dandrieux, J.R., Mansfield, C., 2021. Hierarchical modelling of immunoglobulin coated bacteria in dogs with chronic enteropathy shows reduction in coating with disease remission but marked inter-individual and treatment-response variability. Plos One 16(8), e0255012.

Mehain, S.O., Haines, J.M., Lee, P.M., 2019. Platelet indices as biomarkers for characterization and determination of severity in canine chronic enteropathy. The Veterinary Journal 248, 37–41.

Meineri, G., Martello, E., Radice, E., Bruni, N., Saettone, V., Atuahene, D., Ribaldone, D.G., 2022. Chronic intestinal disorders in humans and pets: Current management and the potential of nutraceutical antioxidants as alternatives. Animals 12(7), 812.

Mendis, M., Leclerc, E., Simsek, S., 2017. Arabinoxylan hydrolyzates as immunomodulators in Caco-2 and HT-29 colon cancer cell lines. Food & Function 8, 220–231.

Minamoto, Y., Otoni, C.C., Steelman, S.M., Buyukleblebici, O., Steiner, J.M., Jergens, A.E., Suchodolski, J.S., 2015. Alteration of the fecal microbiota and serum metabolite profiles in dogs with idiopathic inflammatory bowel disease. Gut Microbes 6(1), 33–47.

Ministro, P., Martins, D., 2017. Fecal biomarkers in inflammatory bowel disease: how, when and why? Expert Review of Gastroenterology & Hepatology 11(4), 317–328.

Mueller, R.S., Unterer, S., 2018. Adverse food reactions: Pathogenesis, clinical signs, diagnosis and alternatives to elimination diets. The Veterinary Journal 236, 89–95.

Nakashima, K., Hiyoshi, S., Ohno, K., Uchida, K., Goto-Koshino, Y., Maeda, S., Tsujimoto, H., 2015. Prognostic factors in dogs with protein-losing enteropathy. The Veterinary Journal 205(1), 28–32.

Ni, J., Wu, G.D., Albenberg, L., Tomov, V.T., 2017. Gut microbiota and IBD: causation or correlation? Nature Reviews Gastroenterology & Hepatology 14(10), 573–584.

Niina, A., Kibe, R., Suzuki, R., Yuchi, Y., Teshima, T., Matsumoto, H., Koyama, H., 2021. Fecal microbiota transplantation as a new treatment for canine inflammatory bowel disease. Bioscience of Microbiota, Food and Health 40(2), 98–104

Ohta, H., Nagata, N., Yokoyama, N., Osuga, T., Sasaki, N., Morishita, K., Takiguchi, M., 2021. Prognostic value of small intestinal dilatation in dogs with protein-losing enteropathy. Journal of Veterinary Medical Science 83(3), 378–384.

Oliveira, I.M., Ribeiro, R.R., Cardoso Cysneiros, M.E., Torres, L.B., Moraes, V.R., Ferreira, L.R., Borges, N.C., 2024. Intestinal biomarkers and their importance in canine enteropathies. Veterinary Medicine International 2024(1), 7409482.

Olivry, T., Mueller, R.S., 2020. Critically appraised topic on adverse food reactions of companion animals (9): time to flare of cutaneous signs after a dietary challenge in dogs and cats with food allergies. BMC Veterinary Research 16, 1–4.

Penninck, D., d'Anjou, M.A., 2015. Atlas of small animal ultrasonography. John Wiley & Sons, 259.

Pérez-Merino, E.M., Cristóbal-Verdejo, I., Duque-Carrasco, F.J., Espadas-González, L., Pastor-Sirvent, N., Usón-Casaús, J.M., 2022. Relationship between serum cobalamin concentration and endoscopic ileal appearance and histology in dogs with chronic inflammatory enteropathy. Journal of Veterinary Internal Medicine 36(3), 957–965.

Perrucci, S., Berrilli, F., Procopio, C., Di Filippo, M.M., Pierini, A., Marchetti, V., 2020. Giardia duodenalis infection in dogs affected by primary chronic enteropathy. Open Veterinary Journal 10(1), 74–79.

Procoli, F., 2020. Inflammatory bowel disease, food-responsive, antibiotic-responsive diarrhoea, protein losing enteropathy: Acronyms, clinical staging, and treatment of chronic inflammatory enteropathy in dogs. Advances in Small Animal Care 1, 127–141.

Rana, T., 2022. Influence and implications of the molecular paradigm of nitric oxide underlying inflammatory reactions of the gastrointestinal tract of dog: a major

hallmark of inflammatory bowel disease. Inflammatory Bowel Diseases 28(8), 1280–1288. https://pubmed.ncbi.nlm.nih.gov/35312776/. Accessed on 22/03/2025.

Rudinsky, A.J., 2018. Dietary considerations for dogs with chronic enteropathies. Veterinary Focus, 28.3

Rustgi, S.D., Kayal, M., Shah, S.C., 2020. Sex-based differences in inflammatory bowel diseases: a review. Therapeutic Advances in Gastroenterology 13, 1756284820915043.

Sacoor, C., Barros, L.M., Montezinho, L., 2020. What are the potential biomarkers that should be considered in diagnosing and managing canine chronic inflammatory enteropathies? Open Veterinary Journal 10(4), 412–430.

Schmitz, S., Suchodolski, J., 2016. Understanding the canine intestinal microbiota and its modification by pro-, pre-and synbiotics-what is the evidence? Veterinary Medicine and Science 2(2), 71–94.

Simeoni, F., Signore, F.D., Terragni, R., Tamburro, R., Aste, G., Vignoli, M., 2020. Diagnostic imaging of gastrointestinal tumours in dogs and cats: a review. American Journal of Animal and Veterinary Sciences 15(2), 89–101.

So, D., Whelan, K., Rossi, M., Morrison, M., Holtmann, G., Kelly, J.T., Campbell, K.L., 2018. Dietary fiber intervention on gut microbiota composition in healthy adults: A systematic review and meta-analysis. The American Journal of Clinical Nutrition 107, 965–983

Tamura, Y., 2025. Chronic Enteropathy and Vitamins in Dogs. Animals 15(5), 649.

Tolbert, M.K., Murphy, M., Gaylord, L., Witzel-Rollins, A., 2022. Dietary management of chronic enteropathy in dogs. Journal of Small Animal Practice 63(6), 425–434.

Toresson, L., Steiner, J.M., Suchodolski, J.S., Spillmann, T., 2016. Oral cobalamin supplementation in dogs with chronic enteropathies and hypocobalaminemia. Journal of Veterinary Internal Medicine 30(1), 101–107.

Toresson, L., Suchodolski, J.S., Spillmann, T., Lopes, B.C., Shih, J., Steiner, J.M., Pilla, R., 2023. The intestinal microbiome in dogs with chronic enteropathies and cobalamin deficiency or normocobalaminemia-a comparative study. Animals 13(8), 1378.

Volkmann, M., Steiner, J.M., Fosgate, G.T., Zentek, J., Hartmann, S., Kohn, B., 2017. Chronic diarrhea in dogs-retrospective study in 136 cases. Journal of Veterinary Internal Medicine 31(4), 1043–1055.

Vuori, K.A., Hemida, M., Moore, R., Salin, S., Rosendahl, S., Anturaniemi, J., Hielm-Björkman, A., 2023. The effect of puppyhood and adolescent diet on the incidence of chronic enteropathy in dogs later in life. Scientific reports 13(1), 1830.

Whitehead, K., Cortes, Y., Eirmann, L., 2016. Gastrointestinal dysmotility disorders in critically ill dogs and cats. Journal of Veterinary Emergency and Critical Care 26(2), 234–253.

Xia, J., Cui, Y., Guo, Y., Liu, Y., Deng, B., Han, S., 2024. The function of probiotics and prebiotics on canine intestinal health and their evaluation criteria. Microorganisms 12(6), 1248.

Xiao, J., Bai, W., 2019. Bioactive phytochemicals. Critical Reviews in Food Science and Nutrition 59(6), 827–829

Yang, Q., Wu, Z., 2023. Gut probiotics and health of dogs and cats: benefits, applications, and underlying mechanisms. Microorganisms 11(10), 2452.

Yirsa, T., Bihone, A., Teshager, G., Muktar, Y., Berihun, A., 2025. Prevalence of gastrointestinal nematode parasites of dogs and associated risk factors in Gondar town, Northwest Ethiopia. Heliyon 11(2).