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Omega Fatty Acids and Its Role in Amelioration of Canine Dermatological Disorders

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Omega-3 and omega-6 fatty acids (FA) are crucial dietary components for dogs, playing a vital role in maintaining healthy skin. Omega-3 FA possess anti-inflammatory properties, potentially aiding in managing conditions like allergies and atopic dermatitis that cause itching and irritation. Omega-6

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FA contribute to healthy skin barrier function, protecting against environmental allergens and pathogens. However, excessive omega-6 intake can promote inflammation. An optimal ratio of omega-3 to omega-6 fatty acids in a dog's diet is essential. Omega-3s are found in fatty fish (salmon, mackerel) and fish oil, while omega-6s are abundant in vegetable oils (sunflower, soybean). If homemade foods are not properly balanced, they may easily be deficient in many essential nutrients. Various skin problems like alopecia, scaly skin, dry, pruritic and skin infections can result from this. Proper dietary management with balanced omega-3 and omega-6 intake can significantly benefit dogs suffering from skin conditions. A well-balanced diet is essential for maintaining the health of the skin.

Keywords: Canine; skin; fatty acids; omega 3; omega 6.

1. INTRODUCTION

Canine skin is the largest organ of the body and is constantly in contact with a wide range of internal and external irritants. Skin is the most important immunological structures, has high dietary needs for proper physiological function. This means that even minor alterations in the nutrition or immunological status of the skin can have a significant effect on the conditioning of the skin and coat. The term "canine dermatological disorders" refers to abnormalities of the skin that are typically caused by immunological factors, physical or chemical irritants, bacteria, and hormonal imbalances (Marchegiani et al. 2020). Changes in the skin leads to dull coat, delayed hair growth, brittle hairs, erythema, scale and crust formation. Canines are susceptible to a wide variety of inflammatory skin disorders. Inflammatory skin conditions are linked with Type1 hypersensitivity reactions mediated by immunoglobin E (IgE). These reactions are due to alterations in the amounts of dietary fatty acids. The therapy of inflammatory skin diseases in dogs involves supplementation of fatty acids. As percurrent studies, consuming more polyunsaturated fatty acids (PUFAs) may help to improve the skin epidermal barrier function (Macri et al. 2017).

The fatty acid is considered as essential is because animals are not able to synthesized it in large amounts to meet their metabolic requirements. Functionally, the fatty acid must make a substantial contribution to wellbeing and health., they contain at least two double bonds in their structure. This precise molecular structure of fatty acids allows it to fold over itself in three dimensions, allowing it to take part in physiologic processes and cell membrane functions crucial to good health. These fatty acids have a major impact on numerous membrane properties including fluidity, compressibility, permeability and fusion, after they are 4 esterified into phospholipids. Both omega-6 and omega-3 fatty acids meet these criteria (Bauer 2008). Omega-3 polyunsaturated fatty acids (PUFAs) are primarily categorized into three representative lipids: alpha-linoleic acids (ALA), docosahexaenoic acid (DHA), and eicosapentaenoic acid (EPA). They are made up of 18 or more carbon chains and contain double bonds at the final three group atoms. ALA is enzymatically transformed to EPA and subsequently to DHA in the liver (Sawada et al. 2011). Omega-3 fatty acids are obtained from fatty fish (salmon, mackerel) and fish oil. Omega-6 fatty acids are widely distributed in food of vegetables. Most oils particularly corn, peanut, and sunflower oil are very rich in linoleic acid (LA) (Beynen 2021).

Supplementation of dietary fatty acids in dogs and cats is 5 most commonly recommended for pruritic skin diseases related to hypersensitivity reactions, such as atopic dermatitis (AD), flea allergic dermatitis, food-associated hypersensitivity, and idiopathic pruritus, along with eosinophilic granuloma complex in cats (Kaur et al. 2020). In order to treat dogs with pruritic skin conditions, omega 3 fatty acids are now increasingly frequently employed. It is thought that these fatty acids work by altering the arachidonic acid cascade, which results in the production of mediators that are less inflammatory (Rees et al. 2001). Atopic dermatosis can result in pruritus, self-trauma, yeast infection, or secondary bacterial infection. Persistent otitis externa may also be observed; however, a thorough examination of the history and clinical signs is necessary to establish this diagnosis. Certain breeds like Irish setters, Chinese Shar Peis, Labrador Retrievers, Dalmatians, various terrier varieties, and toy breeds, are more prone. Clinical symptoms start to appear, when the dog is exposed to IgE-sensitive mast cells, which degranulate and produce a host inflammatory response. Histamine, heparin, proteolytic enzymes,

chemotactic factors, and different forms of eicosanoids are examples of the inflammatory mediators (Case et al. 2010).

One of the main causes of hair loss has been shown to be an essential fatty acid (EFA) deficit. ALA and LA are significant in this context. One of the most exciting methods for the treatment of skin diseases is by using omega 3 and omega 6 fatty acid supplementation. These are EFAs and very much important for the structural integrity of membranes, for the maintenance of the epidermal barrier, for transport of cholesterol, and for formation of eicosanoids especially the leukotrienes and prostaglandins. The regulation of cutaneous inflammation, epidermal proliferation and immune system modulation are all influenced by eicosanoids. Thus, supplementation with these fatty acids should be considered, when such alopecia is likely to occur (Chakrabarti 2002).

The objective of this review is to find out the epidemiological and other causes leading to dermatoses and their nutritional management. Review has been arranged in such a way recording the works in different parts in the world, the importance of essential fatty acid and its effect in ameliorating the skin problems by supplementing it.

2. METHODOLOGY

The review has been prepared by careful analysis of the available literature excluding the and irrelevant and the review has been arranged in the most presentable way.

3. OMEGA FATTY ACIDS DEFICIENCY IN CANINE DERMATOSES

Dermatitis is a primary defect in the epidermal barrier causes more allergens and microorganisms to penetrate the skin that overstimulate the innate and adaptive immunity. The release of inflammatory mediators in response to such severe stimulation exacerbates the barrier dysfunction (Santoro et al. 2015). According to Duclos et al. (2008) dogs can develop interdigital dermatitis, (pododermatitis, pedal folliculitis and furunculosis) and it has a variety of causes, including exogenous foreign bodies, contact irritants, hypersensitivity reactions, parasitism (demodicosis, hookworm dermatitis, and dermatitis), infections with yeast, fungi, and bacteria, and conditions associated with immunosuppression. Different types of traumas are thought to play a role, including self-trauma from licking associated to allergic skin condition and external contact with uneven or abrasive surfaces like vegetation or gravel. Increased IgE synthesis against environmental or dietary antigens, an increase in the numbers and activity of inflammatory cells in the skin, and alterations in the epidermis' composition that compromise the barrier function are the causes of the multifactorial disease condition known as atopic dermatitis (AD) (Tretter and Mueller 2011).

Cerrato et al. (2013) stated that impaired skin permits allergens and germs to penetrate excessively, perhaps triggering the acute and chronic inflammatory responses associated with Atopic Dermatitis. Skin barrier defects can be produced by a variety of factors, including a decrease in lipid matrix formation from the stratum corneum (SC) or changes in the interactions between the three SC main lipids (ceramides (CER), FA, and cholesterol (CHO). AD has also been linked to epidermal ultrastructural alterations such as aberrant inter-corneocyte connections and improper cellular maturation and differentiation. Dietary deficits of essential fatty acids can occur in dogs and cats fed poor quality, low fat dry foods or improperly formulated home-prepared meals. Levels of PUFA in food may also be decreased due to oxidative damage caused by prolonged storage or insufficient antioxidants such as vitamin E.

Cutaneous indications may appear within 2-3 months of consuming a poor diet. Initially, surface lipid production is reduced, resulting in a dull, dry coat with fine scale. Prolonged deficiency causes baldness, greasy skin, especially on the ears and between the toes, and secondary pyoderma (Saseendran et al. 2016).

Schumann et al. (2014) viewed that unsaturated fatty acids affect many cells involved in the etiology of CAD. These cells include keratinocytes, dendritic cells, T lymphocytes, and mast cells. It appears that dietary PUFA are easily incorporated into cell membranes, changing the characteristics of lipid bilayers. As a result, membrane microdomains reorganize, particularly lipid bilayers. This results in functional alterations of membrane-associated proteins such as the PLD. Phospholipases D, unsaturated fatty acid targets, play an important role in the regulation of mast cell exocytosis processes and contribute to the pathogenesis of CAD. The PUFA enrichment of mast cells alters both their location and function.

4. MECHANISM OF OMEGA FATTY ACIDS IN DERMATOLOGICAL DISORDER

It is recorded that omega-3 fatty acids work by directing the arachidonic acid (AA) cascade to create less inflammatory mediators such prostaglandins and leukotrienes (Rees et al. 2001). The function of the epidermal barrier depends on the n-6 fatty linoleic acid (LA), and diets containing LA have been shown to significantly reduce trans-epidermal water loss. It has been demonstrated that the families of docosahexaenoic acid (DHA) and EPA have immunomodulatory and anti-inflammatory effects on skin. They reduce the synthesis of pro-inflammatory cytokines and alter the generation of eicosanoid molecules by competing with arachidonic acid (AA), which causes a shift from pro-inflammatory molecules to leukotriens with anti-inflammatory properties (Marchegiani et al. 2020).

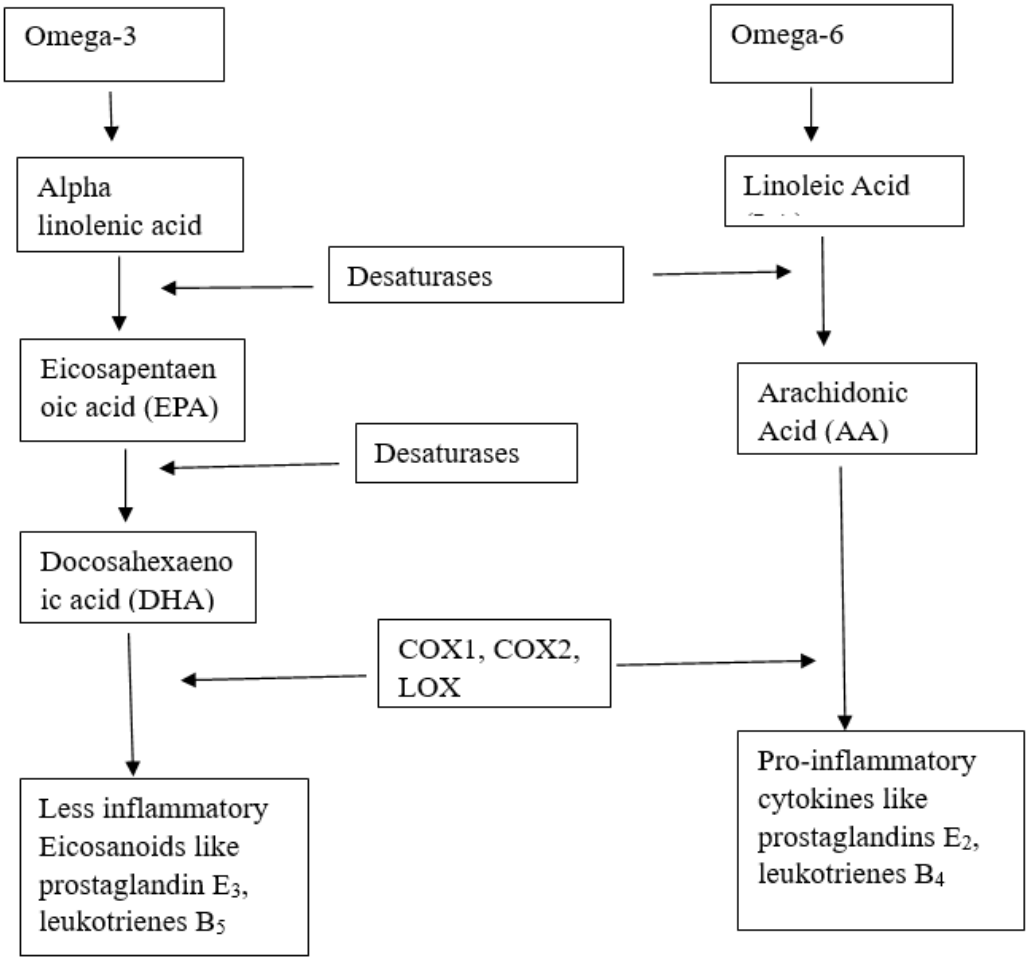

Fig. 1. Mechanism of omega fatty acids (Fabian et al. 2015)

5. CLINICAL SYMPTOMS DUE TO DEFICIENCY OF OMEGA FATTY ACIDS

Dogs with EFA deficit have matted coat and unkempt appearance. include poor growth; infertility; a thin, discoloured coat, scaly skin; sebaceous gland hypertrophy with increased sebum viscosity, increase in epidermal turnover rate, weak cutaneous blood vessels that are easily ruptured, reduction in wound healing are clinical signs of EFA deficiency (Kirby et al. 2007). Clinical signs due to fatty acid deficiency may not be observed for several months and usually begin with mild scaling and loss of lustre of the hair coat. The severity of seborrhoea worsens over time, the skin becomes greasier and more thickened, and pruritis and secondary skin diseases occur (Hensel 2010). The major symptoms are cutaneous abnormalities, such as dermatitis, skin hyperproliferation and decreased skin barrier function against trans-epidermal water loss (Lajoinie et al. 2014).

Dogs with an EFA deficit will typically exhibit hair loss, a dry, dull coat, and occasionally itching. An omega-6 polyunsaturated fatty acid like LA helps to maintain the cutaneous water permeability barrier, which reduces the loss of water through evaporation. The omega-3 fatty acids like EPA and DHA have been demonstrated to be helpful in treating atopic dermatitis and other skin conditions (Tanprasertsuk et al. 2022). EFAs regulate membrane fluidity, metabolism, the trans epidermal water barrier, and eicosanoid production. Dogs with essential fatty acid deficiency exhibit clinical indications such as a thin, discoloured coat, scaly skin, sebaceous gland enlargement, and increased trans epidermal water loss. Dietary linoleic acid may be effective for enhancing skin and coat quality, and omega-3 fatty acids may be useful for dogs with pruritus and inflammatory skin disease (Johnson eta l. 2015).

Clinical consequences are pruritus, dry skin, and skin lesions, which can reduce the quality-of-life and needs life-long therapy. Omega 6 fatty acid, such as linoleic acid, as it is a component of ceramide can be used to modulate the conformation of lipid barriers, which is decreased in canine AD. Studies have shown that linoleate-enriched diets influence the skin barrier. Omega-3 fatty acids, such as EPA and DHA, modulate eicosanoid synthesis, by decreasing pro-inflammatory and increasing anti-inflammatory eicosanoids. PUFA inhibit cellular activation and pro-inflammatory cytokine secretion. Oral supplementation with EFAs can reduce the dose of various medications (prednisolone, ciclosporin and antihistamines) used for control of pruritus associated with AD (Schäfer and Thom 2024). Omega-6 is required for the good health of the skin and hair coat as it is a vital structural component of cell membrane phospholipids and the stratum corneum intercellular lipid barrier. As a result, dietary supplementation with LA-rich oils (sunflower, safflower, soy, maize, etc.) has been recommended for dry, scaly skin diseases known as seborrhoea sicca. This syndrome might be idiopathic or related with poor diets, extremely dry settings, underlying endocrinopathies such hypothyroidism (Kwochka 2016).

6. DETECTION OF OMEGA FATTY ACIDS DEFICIENCY IN CANINE DERMATOSES

Popa et al. (2018) narrated that the effects of dietary linoleic acid on canine stratum corneum (SC) lipids were investigated by feeding two groups of five dogs varying amounts of LA for three months. SC was extracted via tape stripping, and lipids were evaluated using thin-layer chromatography and mass spectrometry. The dogs fed the highest dose of LA showed significant increases in linoleic acid and free ceramides in the SC, whereas protein-bound ceramide content remained unaltered. Serum fatty acid concentrations were measured using gas chromatography after 0, 6, 12, and 24 weeks of consuming the control and test diets. At weeks 6, 12, and 24, dogs fed the test diet had significantly higher concentrations of total omega-3 fatty acids, including EPA and DHA, but significantly lower quantities of AA compared to dogs fed the control diet. The most significant change in serum concentrations compared to baseline values was a 15-fold rise in mean EPA levels for dogs fed the test diet. Throughout the trial, dogs fed the control diet showed no significant changes in blood fatty acid concentrations (Roush et al. 2010).

The impact of a fatty acid supplement on the levels of important fatty acids in the skin and plasma of dogs suffering from atopic dermatitis. In a randomized, double-blind research, 29 dogs with nonseasonal atopic dermatitis were given flax oil capsules, 3V Caps with EPA and DHA, or mineral oil as a placebo at 1 capsule/5 kg once day for 10 weeks. Blood samples and skin biopsies were collected prior to and after 10 weeks of supplementation. The total daily intake of omega-3 and -6 fatty acids was estimated for each patient before and after supplementation. Gas chromatography was used to evaluate plasma and skin levels of LA, ALA, AA, EPA, and DHA (Mueller et al. 2004). Canine hair samples were extracted for total lipids. Thin layer chromatography on silica gel 60 coated glass plates can satisfactorily resolve the majority of sebum's lipid classes for both quantitative and qualitative analysis. Plates were dried between solvents in a nitrogen gas flow box. The lipid extracts were separated with hexane first, then benzene, and finally hexane: ether: acetic acid (50:50:1). Each plate had authentic standards that were used to identify lipid classes. Charred patches indicated individual lipid classes. Lipids were quantified using densitometry and external standardization with standard curves established for free cholesterol, wax diester, and cholesteryl ester (Kirby et al. 2009). By the work of Angelbeck-Schulze et al. (2014) a minimally invasive epidermal lipid sampling method called skin scrub, which achieved reproducible and comparable results to skin scraping. The aim of

that study is to investigating regional variations in canine epidermal lipid composition using the skin scrub technique and its suitability for collecting skin lipids in dogs suffering from certain skin diseases. Eight different body sites (5 highly and 3 lowly predisposed for atopic lesions) were sampled by skin scrub in 8 control dogs with normal skin. Additionally, lesional and non-lesional skin was sampled from atopic dogs and dogs with other skin diseases by skin scrub. Lipid fractions were separated by high performance thin layer chromatography and analysed densitometrically.

7. TREATMENT OF OMEGA FATTY ACID DEFICIENCY IN CANINE DERMATOSES

Essential fatty acid supplementation has a steroid sparing effect, enhancing skin healing in atopic dogs and resulting in much lower glucocorticoid administration. The topical application of specially formulated lipid mixes, which aid in the regeneration of skin lipid bilayers, has improved clinical outcomes for canine atopic dermatitis (CAD) (Padmanabhan and Krishnamoorthy 2010). Symptomatic treatment used for CAD are mostly systemic or topical glucocorticoids, calcineurin inhibitors, antihistamines, fatty acid supplementation, and topical therapies. Due to frequent adverse effects to glucocorticoid therapy, recently more attention has been paid to comparatively safe treatments such as antihistamines and PUFA supplementation. PUFA can modify the inflammatory response and oral fatty acid supplementation has been shown to benefit the inflammation and pruritus associated with CAD (Stehle et al. 2010). Using a spot-on comprising PUFAs and essential oils improved clinical symptoms of CAD. Given that complete remission was not reached in the vast majority of dogs, it appears to be most effective as an adjunct therapy in this disease. This study found that clinical indications of atopic dermatitis in dogs with stable CAD who satisfied the trial's entrance criteria improved considerably following eight weekly topical treatments with a commercially available product comprising PUFAs and essential oils (Blaskovic et al. 2014).

In a double-blind, placebo-controlled randomized research, 10-20% of dogs with atopic dermatitis were in complete remission, and 40% improved significantly following PUFA supplementation [34]. Demodicosis is one of the recurring skin infections in most of dogs, leading to skin lesions and immunosuppression. They noted cutaneous alopecia with follicular pustules, moist and haemorrhagic exudation throughout the entire face and forelimbs surrounding the ears and eyes, and pustules with draining tract in the interdigital region. Ivermectin was administered subcutaneously once a week for six weeks, and antibiotics to prevent subsequent bacterial infections. In order to reduce pruritis, supportive therapy includes oral Omega3, Omega-6, EPA, and DHA supplementation for 20 days. The health of the skin can be maintained by giving essential fatty acids (de Santiago et al. 2021).

Dogs and cats suffering from skin and coat conditions like hair loss, poor coat quality, odour, dull coat, scaling, oily skin, seborrhoea, sensitive or itchy skin, and hair loss could all be improved with a spot-on formulation that contains a synergy of essential oils and polyunsaturated fatty acids of omega 3 and omega 6. Topical products are now offered as supplemental care to assist medical professionals in treating skin conditions such seborrheic diseases or scaling (Bensignor et al. 2010). Linoleate is an intrinsic component of some ceramides; it is well known to be an important omega-6 PUFA that is crucial for preserving the structural integrity of the epidermal barrier. Furthermore, it's been demonstrated that linoleic acid consumption affects both the lipid content of dogs' skin and the function of their integument. Taurine plays a role in keratinocyte hydration, which in turn

Table 1. Minimum requirements of essential fatty acids in grams /1000 kcal (Kar et al. 2023)

	Dogs (Growth)	Dogs (Adult Maintenance)
Total fat	21.3	13.8
Linoleic Acid	3.3	2.8
Arachidonic Acid	0.08	ND
Alpha-linoleic acid	0.2	0.11
EPA+DHA	0.13	0.11

Dose rate of Alpha linolenic acid was 300 mg/Kg/day and the dose rates were calculated as per the recommendations of recommendations of Association of American Feed Control Officials (AAFCO) (Beynen 2020) as per the method described by Beynen, (AAFCO 2023)

enhances barrier function. The test diet is having three main ingredients—omega 3 fatty acids, turmeric, and licorice—provide immunomodulatory activity. EPA and DHA, two omega-3 fatty acids, may have a part in treating canine skin inflammation (Watson et al. 2022). Similar to human medicine, lipid formulations applied topically or administered orally may be able to repair some of the cutaneous irregularities in dogs. It has long been understood that diet plays a significant role in skin health. Oral essential fatty acid supplementation is known to increase skin essential fatty acids, decrease TEWL, and enhance skin barrier function. Combining topical and systemic therapy (e.g., oral essential fatty acids) could enhance the skin barrier (Marsella et al. 2011).

8. CONTROL OF OMEGA FATTY ACID DEFICIENCY IN CANINE DERMATOSES

PUFAs have immunomodulatory and anti-inflammatory effects. Omega-3 PUFAs exert their effects by modulating signal transduction, gene expression, or both within inflammatory and immune cells. Fish oils are rich in the omega-3 PUFAs, EPA and DHA. Fish oils supplementation decreases, T cell-mediated cytotoxicity, natural killer cell activity, macrophage-mediated cytotoxicity, lymphocyte proliferation, monocyte and neutrophil chemotaxis, major histocompatibility class II expression and antigen presentation, production of proinflammatory cytokines [interleukin (IL-1), IL-6, and tumour necrosis factor, and adhesion molecule expression. Fish oil feeding also reduces cell-mediated immune responses (Hall et al. 2003). Improvements in clinical symptoms, particularly a decrease in pruritus, following topical administration of a new therapy including Glycosaminoglycans (GAGs) and sphingolipids for eight weeks in dogs with AD. Increased PUFA skin levels following therapy may also point to improved skin barrier function. In fact, aberrant fatty acid profiles have been documented in AD patients, and long chain omega-3 PUFAs may modify both the skin's epidermal barrier and cutaneous inflammation (Marsella et al. 2020).

Dogs with AD, oral supplementation with n-3 and n-6 fatty acids has been used to reduce the production of pro-inflammatory eicosanoid mediators, prevent the activation of inflammatory cells and the release of cytokines, correct lipid metabolism abnormalities, and eventually normalize the stratum corneum. Linoleic acid which is an omega 6 fatty acids are present in the epidermis, which are then combined to form ceramides. Although clinical efficacy takes time to manifest and can take weeks to notice any improvement, EFA supplementation is usually regarded as safe. Because of these factors, fatty acid supplementation is only recommended as an adjunct therapy for long-term treatment of AD (Saridomichelakis and Olivry 2016). Omega 3 fatty acids, such as DHA and EPA, have an important function in the prevention or treatment of lesions, including inflammatory condition. Increasing the amount of EPA and DHA in the diet reduces the development of inflammatory mediators. Supplementation with fish oil high in DHA and EPA lowers the rise in serum levels of prostaglandin E2 and interleukin 1 and 6. Too less fatty acid reduce the integrity of the hair coat and cause skin weakness, particularly linoleic acid deficiency (Kepinska-Pacelik and Biel 2023).

Fatty acid content of the feed developed from tuna red meat. Among the PUFAs, LA acid was found to be dominant, followed by DHA and EPA. It is recommended that minimum levels of 1.30–1.53 g LA acid per 100 g dry matter are required. Separate minimum requirements for EPA+DHA (0.05 g per 100 g dry matter), AA (30 mg per 100 g dry matter), and ALA (0.08 g per 100 g dry matter) have also been specified. LA acid is considered essential in a dog’s diet and is involved in the maintenance of the cutaneous water permeability barrier (Yathavamoorthi et al. 2020). Dietary PUFAs are crucial in canine diets because they serve as an efficient energy source, supplying twice as much energy as carbohydrates and protein. Supplementing the canine diet with PUFAs such as omega-3 fatty acids promotes decreased generation of inflammatory mediators, which reduces inflammation. Because of their role as precursors in the development of vital organ systems, PUFAs serve a variety of important activities. Linoleic acid is crucial for canine coat health because it helps maintain the cutaneous water barrier (Baritugo et al. 2023).

9. PREVENTION OF OMEGA FATTY ACID DEFICIENCY IN CANINE DERMATOSES

EFAs, particularly omega-3 and omega-6, have immunomodulatory and anti-inflammatory effects on the skin. It has been discovered that oral EFA supplementation or enriched diets are helpful in reducing the clinical signs of CAD. EFAs are also

known to influence the lipids in the surface skin, enhancing the quality and shine of coats. Topical lipid compositions help dogs with AD recover damage to their stratum corneum lipid barrier (Telci et al. 2023). Based on a clinical score, it was shown that supplementing dogs with fish oil, a rich source of EPA and DHA, improved the quality of their skin and hair coats from baseline, with the greatest improvement happening after 8 weeks. An increased total lipid in the hair changes is assumed to be the cause of the beneficial effects on the health of the skin and coat. Regarding its impact on the quality of the coat, the circulating inflammatory and oxidative indicators, and the function of the skin barrier, camelina oil is similar to that of canola and flaxseed oils (Richards et al. 2024).

Fish oil, which contains omega-3 fatty acids has a low-risk treatment option for symmetrical onychomadesis. Giving fish oil to dogs increases the amount of EPA and DHA that neutrophils and macrophages have in their cell membranes. By modifying the immune response, this may help reduce the production of strong inflammatory mediators. Animals given an omega-3 fatty acid-rich diet also exhibit a decrease in MHC class I and II expression on their cell surfaces (Ziener and Nødtvedt 2014). Veterinary dermatology, PUFAs have been utilized to treat a variety of skin conditions, including epitheliotropic lymphoma, discoid lupus erythematosus, dermatomyositis, seborrhoea sicca, and allergic or pruritic dermatitides. The effectiveness of PUFAs in treating pruritus has been reported to range from 11% to 70%. The minimal duration of administration should be three weeks, and that hair texture, shine and coat conditions are improved. Orally administered PUFAs are able to decrease cutaneous reactivity observed with intradermal allergy testing, they are able to decrease cutaneous production of the proinflammatory leukotrienes LTB4 and LTB5 following stimulation with the inflammatory mediator lipopolysaccharide (Noli et al. 2007).

EPA plays an important anti-inflammatory role, whereas DHA contributes to function and development of the retina and brain. The study indicated that decreased clinical signs and inflammation, as well as increased numbers of goblet cells after treatment with an oral formulation of omega-3 containing a higher proportion of EPA than DHA. This formulation of omega-3 fatty acids enhances the effectiveness of topical tacrolimus 0.03% in treating canine keratoconjunctivitis sicca (Silva et al. 2018). Consuming foods high in omega-3 PUFAs have benefits like anti-inflammatory and possibly anti-thrombotic properties. More omega-3 fatty acids in particular may be beneficial, particularly for dogs suffering from inflammatory diseases like pruritus. It has been demonstrated that skin diseases can benefit from the anti-inflammatory and immunomodulatory actions of EFAs from the omega 6 and omega 3 families. Moreover, PUFA in food appears to influence behavioural changes in animals. Indeed, it is well recognized that learning, emotions, and impulse control are significantly influenced by the brain's dopaminergic and serotonergic systems. Given that PUFA is known to have an impact on both of these systems, it is imperative that animals receive an appropriate diet rich in PUFAs (Vastolo et al. 2021).

10. CONCLUSION

Omega fatty acids are essential fatty acids because animals are not able to synthesize it in large amounts to meet their metabolic requirements. They help to modulate the immune response, reducing inflammatory mediators and promoting skin barrier function mainly omega 3 and omega 6 FAs.Omega-3 FA possess anti-inflammatory properties, potentially aiding in managing conditions like allergies and atopic dermatitis that cause itching and irritation. Omega-6 FA contributes to healthy skin barrier function, protecting against environmental allergens and pathogens. Dogs with EFA deficit have matted coat and unkempt appearance. include poor growth; infertility; a thin, discoloured coat. Therefore, they are often recommended as an adjunct therapy against various canine dermatoses.

DISCLAMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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