RESEARCH ARTICLE

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A New Era Under Soil Based Probiotics for Anti-Pruritic Combat Among Cats with Feline Atopic Skin Syndrome

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Abstract

Present research was conducted at the University of Aydin Adnan Menderes, Faculty of Veterinary. In a total of 10 cats with pruritic dermatoses were allocated, classified [Feline atopic skin syndrome (FaSs)] and adapted to the retrospective case controlled study on the basis of Polycheck in vitro Allergy Test, clinical signs, dermatoscopic and cytological examination. No prior drug prescription, nor immunosuppressive treatment were evident, which was an inclusion criteria. Complete blood count, serum biochemistry, and endocrine panels were all deemed available on days 0 and 21 for all cats involved. The Feline Dermatitis Extent and Severity Index (FeDESI) and a 10 cm visual analog scale (VAS) were deemed available as relevant prognostic parameters. A three strain invoving soil-based probiotic used via rectal route significantly decreased FEDESI and VAS pruritus scores after 10 days of rectal use. Pre-treament day 0 FEDESI scores (median ± SD) (106.3 ± 41.38), were significantly higher than scores on day 10 (15.3 ± 10.53) switching the severity of the disease to mild status in all cases. Furthermore, day 0 VAS pruritus scores were 7.4 ± 1.78 (mean ± SD) (prior to treatment), whereas owner VAS pruritus score was decreased to 1.3 ± 1.06 (mean ± SD) significantly (p=0.005). It should not be unwise to draw preliminary conclusion that 3 chained soil-based Bacillus probiotic was capable of short term cure for FaSs. Bacillus probiotics with safety usage should be added to therapeutical armamentarium of FaSs.

Keywords: Atopic skin syndrome, feline, soil-based probiotic.

INTRODUCTION

Terminology in veterinary dermatology era has been changing time to time. Feline atopic syndrome (FaS), novel proposal remarking allergic dermatoses, composed gastorintestinal and respiratory issues among cats (Mueller et al., 2021). Under this classification Feline atopic skin syndrome (FaSs) denotes allergic cutaneous disorders in relationship with environmental allergy (Halliwell et al., 2021a,b; Santoro et al., 2021). Allergic reflection involving dermatitis in cats involve several cutaneous reactions in relationship with food, environmental or insect allergens. The latter include self-induced alopecia/hypotrichosis, miliary dermatitis, excoriation/ulcer on the head/neck and eosinophilic granuloma complex (Halliwell et al., 2021a,b; Santoro et al., 2021). Therefore, therapeutical approach should be directed to etiology. On the other hand, there is no time for unsatisfactory animal owner, rounding around several clinics with similar approaches. Due to unmet and satisfactory solutions, the aim of the present authors were to use rectal route for soil-based probiotics as an anti-pruritic combat among cats with FaSs.

MATERIALS AND METHODS

Diagnostic tree

Diagnosis was based on the diagnostic algorithm involving clinical signs with FaSs. The vast majority of cats with FaSs originally exhibit one/more cutaneous reaction patterns including as miliary dermatitis, alopecia or hypotrichosis, head and neck pruritis shown in Figure 1 (Santoro et al., 2021) below.

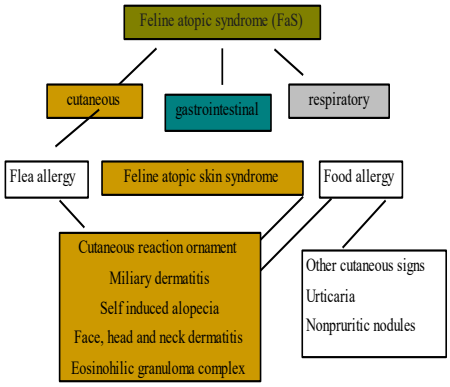

Figure 1. Algorithm showing the clinical signs associated with feline atopic syndrome (adapted from Santoro et al., 2021).

In an attempt to make specific (and thereof differential) diagnosis for FaSs, relevant literature was carefully elucidated (Santoro et al., 2021) in parallel line with other relevant/significant ones (Diesel et al., 2011; Favrot et al., 2014, Ravens et al., 2014).

In diagnosis of FASs, it should be considered that many the differential approaches due to variable clinical presentation of the disease (Fig. 1). Many other cutaneous and non-cutaneous diseases also may present with encrusted papules, alopecia, head/neck pruritus and

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cutaneous eroded plaques (Diesel et al., 2011; Favrot et al., 2014, Ravens et al., 2014).

Inclusion Criteria

The present research was conducted at the Aydin Adnan Menderes University, Faculty of Veterinary, Department of Internal Medicine. In a total of 10 cats with pruritic dermatoses had presumably forced us for interpretation of allergy based on Polycheck in vitro Allergy Test, clinical signs, dermatoscopic and cytological examination through with microbiological laboratory work for exclusion of other relevant secondary diseases. Anti-parasitic routine application was evident in all cats. During trial, all cats were subjected to the lowest carbohydrate involving commercial cat food (Virbac Gastro-1- Digestive, Support, Virbac, Turkey) for at least 6 weeks. No prior drug prescription, nor immunosuppressive treatment were evident, which was an inclusion criteria. Complete blood count, serum biochemistry, and endocrine panels were all deemed available on days 0 and 21 for all cats involved.

Scoring system preferred

The Feline Dermatitis Extent and Severity Index (FeDESI) was preferentially optional in an attempt to make scoring of relevant clinical signs [excoriations/erosions, erythema and self-induced alopecia (Nuttall et al., 2004). The owners were shortly educated to assess pruritus by use of a 10 cm visual analog scale (VAS) (Hill et al., 2007) similar to previous study (Schmidt et al., 2012).

Probiotic enema treatment methodology

Soil based probiotic formulation (Figure 2) was prescribed as rectal enema involving 3 different Bacillus strains (Algeapro Triogermila-I, veterinary side distributor RDA Group, Istanbul, Turkey). Briefly each vial (6 x 10^9 CFU) was poured and then dissolved in 10 ml sterile water, which was then rectally administered as an enema model. Therapeutical application involved 10 days, and each owner was advised to enter at the clinic everyday exactly at similar duration. Methodology of and proposed mechanism of efficacy was shown in Figure 3 below.

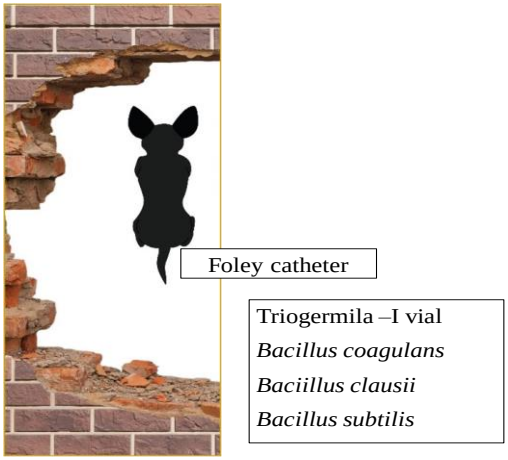

Figure 2. Cartoon depicting rectal enema usage of a soil based probiotic combination of 3 different *Bacillus* strains. Briefly foley catheter was inserted 15 cm from the rectum and one vial was prescribed in each session.

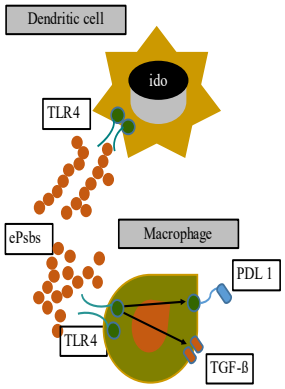

Figure 3. Probable molecular and cellular efficacy of anti-inflammatory probiotic exopolysaccharide (ePs) exhibited by *B. subtilis* against disease induced inflammation, adapted from (Zamora-Pineda et al., 2022).

Statistical analysis

Descriptive statistics of the obtained data were tabulated to indicate the mean and standard deviations. Wilcoxon test was used to determine the statistical differences of FeDESI and VAS score before and after treatment. A p value of < 0.05 was considered significant by using the SPSS 26.0 program (IBM, USA) in all analyzes.

RESULTS

FEDESI and VAS pruritus scores

Both FeDESI and VAS pruritus scores were changed in FaSs cases. Pre-treament day 0 FeDESI scores (median ± SD) (106.3 ± 41.38), were significantly higher than scores on day 10 (15.3 ± 10.53) switching the severity of the disease to mild status in all cases. Furthermore, day 0 VAS pruritus scores were 7.4 ± 1.78 (mean ± SD) (prior to treatment), whereas owner VAS pruritus score was decreased to 1.3 ± 1.06 (mean ± SD) significantly (p=0.005) (Table 1). Figures 4 and 5 showed FEDESI and VAS pruritus scores alterations before and after treatment. There were no side effects attributable to treatment applications. All cases were monitored for 6 months after completion of treatment in which no recurrence was observed.

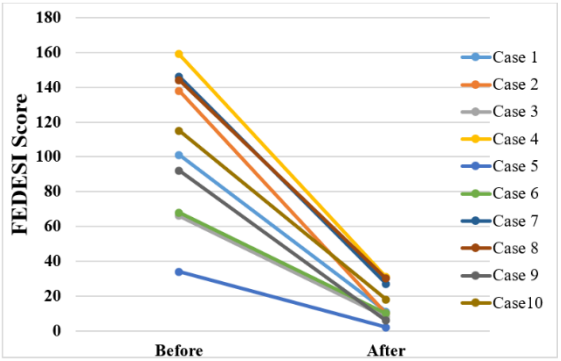

Figure 4. FEDESI score alterations before and after treatment.

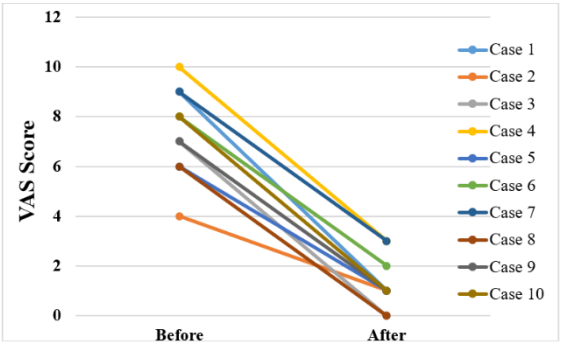

Figure 5. VAS score alterations before and after treatment.

Table 1. FEDESI and VAS pruritus scores of enrolled cats in the present study.

Score	Before Treatment ($\bar{X} \pm Sd$)	After Treatment ($\bar{X} \pm Sd$)	*P value*
FEDESI	106.3 ± 41.38	15.3 ± 10.53	0.005
VAS	7.4 ± 1.78	1.3 ± 1.06	0.005

Demographic findings

Cutaneous patterns described miliary dermatitis (n=2), self-induced alopecia (n=2), head and neck pruritus (n=4) and eosinophilic granuloma complex (EGC) (n=2). Either alone or in combination, and after excluding other possible causes, these patterns are consistent with a diagnosis of FaSs. Clinical photographs of selected case were shown in Figures 6 and 7, denoting before and after treatment.

Figure 6. Head and neck dermatitis under FaSs respond to the probiotic treatment used in this study.

Figure 7. Eosinophilic granuloma complex in relationship with FaSs in a 2 years old British short hair cat. Evidence of proof involve before and after probiotic treatment. This case was additionally on oral same Bacillus strain probiotic consumption for additional 11 days.

DISCUSSION AND CONCLUSION

Direct-fed microbials (dFm) as was elucidated as the feed product composed of naturally-existing live microbes, [i.e. Bacillus genus, as was the subject of treatment in the present study], were given as subject of nutritional strategies for improving dogs' intestinal functionality and faecal quality. Even if prescribed in the diet, these latter microorganisms may esteem non-pathogenic bacteria (Feliciano et al., 2009; Félix et al., 2010). Bacteria of the Bacillus genus, involving facultative anaerobic *B. subtillis* and *B. licheniformis*, are capable of sporulation, making them more resistant to acidic gastric pH (Hoa et al., 2000; Coppola and Gil-Turnes, 2004; Moir, 2006). *B. subtilis* and *B. licheniformis* are frequently detected as spores in the soil. The spores are dehydrated, even if disclose to proper nutrients and moisture, then would probably germinate in the small intestine, recommence their cell vegetative growth (Tam et al., 2006). Prior research presented that *B. subtilis* and *B. licheniformis* could alter faecal odour and decline gas formation in the intestine of dogs (Paap et al., 2016). Herein at the present study 3 different Bacillus strains were used which were all soil based probiotics. Mechanism of action was shown in fig.3 involving probable molecular and cellular efficacy of anti-inflammatory probiotic exopolysaccharide (ePs) exhibited by those strains (Zamora-Pineda et al., 2022).

Bacillus species supply their beneficial effects originally through the production of digestive enzymes (Danilova and Sharipova, 2020). In a prior study the fungal activity of cyclic lipopeptides (cLpS) derived from *B. subtilis* for inhibiting *M. canis* growth, was analyzed. In vitro, *Bacillus* cLp exhibited an inhibitory effect on *M. canis* growth proposed it as an alternative strategy for controlling the growth of *M. canis* by use of metabolites obtained from *B. subtilis* as a biomedicine envoy with antifungal activity (Tunsagool et al., 2021). In the present study although fungal analytes were not available, preferred strains might exist antifungal efficacy. Another 11 years study analyzed efficacy of oral *B. subtilis* PTA 6737 usage on fecal microbial populations, in which researchers concluded study *B. subtilis* could be safely and orally administered to domestic cats (Kerr et al., 2011). There were no side effects observed at this study.

Bioactive probiotic molecules possessing anti-inflammatory efficacy compose i) exopolysaccharides, ii) cell envelope molecules, iii) secreted proteins. In a recent and interesting review article the authors briefly denoted cell envelope-associated probiotic molecules, along with secreted protein and carbohydrate probiotic molecules, and discussed anti-inflammatory probiotic exopolysaccharide (ePs) exhibited by *B. subtilis* (Zamora-Pineda et al., 2022). *B. subtilis* exhibited anti-inflammatory efficacy and caused protection in several T cell-mediated diseases, alleviated disorders related to enteric/blood-borne pathogens, allergic eosinophilia etc. and also for prophylaxy (Jones and Knight, 2012; Jones et al., 2014; Paynich et al., 2017; Paik et al., 2019; Swartzendruber et al., 2019; Zamora-Pineda et al., 2022). The latter ePs inhibited *C. rodentium* induced colitis, (Paynich et a., 2017), denoting that ePs might play a therapeutic role, also in acute diarrhea. We may claim that ePs, as exhibited by probiotic strains used at this study, could be of beneficial for displaying anti-inflammatory efficacy at least for cats involved.

Homogenously to Lactobacillus, *B. coagulans* displayed immunoregulatoric efficacy preferiantly alter skin health. Peripheral blood mononuclear/ polymorphonuclear cells were incubated with *B. coagulans* particles boosted antigen-presenting cells and suppressed inhibited reactive oxygen species formation (Jensen et al., 2010; Benson et al., 2012). Given reactive oxygen species and oxidative stress participate within the

pathogenesis of acne, the latter hypothesis could be of benecial for treatment of acne (Bowe and Logan, 2010). Apart from acne, as FaSs cases were involved in this study, *B. coagulans* strain augment antigen-presenting cells and probably conquer reactive oxygen species formation (Jensen et al., 2010; Benson et al., 2012).

Integumentary system, specifically the skin, shares traits within the gut, for instance being merged into the overall immune system. It should therefore not be unwise to draw the idea that skin co-morbidities with gut disorders (O'Neill et al., 2016) should participate. Intriguingly perception of skin-gut connections goes back to 1930s even if Dr. Pillsbury and Dr. Stokes hypothesized gastrointestinal mechanism for skin alterations like acne (Stokes and Pillsbury, 1930; Bowe and Logan, 2011). Accoding to them intestinal microflora alterations caused by stress resulted in skin inflammation (Bowe and Logan, 2011). Today at 21st century, several aspects of "gut-skin axis" have been well reconized with both murine and human studies. Regarding atopic dermatitis in humans impaired intestinal mucosal barrier seemed to be involved within the pathogenesis (Majamaa and Isolauri, 1996; Rosenfeldt et al., 2004). In children with atopic dermatitis increased transfer of intact and degraded proteins against the barrier, was a proof of elevated antigenic load (Majamaa and Isolauri, 1996). Selected triggers of zonulin release are i) small intestinal exposure to bacteria and gluten (Fasano, 2011), wheat ingestion (Varionen et al., 2000), and coeliac disease (Ciacci et al., 2004). It is not surprising that dermatological lesions, in general, were more incident in people with coeliac disease (Saarialho-Kere, 2004; Ojetti et al., 2006; Fasano and Catassi, 2012). On the other hand, small intestinal bacterial overgrowth has aroused interest for probably causing dermatological disorders (Bowe, 2011). Supposed etiology for skin lesion development associated to composed i) disabled immune-system functioning, ii) altered lipid metabolism, iii) damaged gut associated lymphoid tissue, iv) nutritional insufficency, v) elevated intestinal permeability, and bacterial translocation damaging epidermal structure and barrier function (Guo et al., 2013; Kell and Pretorius, 2015). Diseased epidermal barrier function and immune system functioning participated for disase activity in human and canine AD (Nimmo Wilkie et al., 1991; Marsella et al., 2011). All aforementioned data herein supported the efficacy of soil based probiotic strains used succesfully in this study. Evidenced gut-brain-skin axis was also supported within this results, as selected Bacillus strains firstly and probably corrected intestinal barrier damage, even if existed, in the present cats of this study. As underlying small intestinal bacterial overgrowth was withdrawn, via rectal enema soil based probiotic combination in this study.

Conflict of Interest

The authors declare that they have no competing interests.

Authorship contributions

Concept: K.U., Data Collection or Processing: K.U., H.E., S.E., Analysis or Interpretation: K.U., H.E., S.E., Literature Search: K.U., H.E., Writing: K.U., H.E., S.E.

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REFERENCES

Benson KF, Redman KA, Carter SG, Keller D, Farmer S, Endres JR, Jensen GS. 2012 Probiotic metabolites from Bacillus coagulans GanedenBC30TM support maturation of antigen-presenting cells in vitro. World journal of gastroenterology, 18(16): 1875.

Bowe WP, Logan AC. 2010. Clinical implications of lipid peroxidation in acne vulgaris: old wine in new bottles. Lipids in health and disease, 9(1): 1-11.

Ciacci C, Cavallaro R, Iovino P, Sabbatini F, Palumbo A, Amoruso D, Mazzacca G. 2004. Allergy prevalence in adult celiac disease. Journal of allergy and clinical immunology, 113(6): 1199–1203.

Coppola MDM, Gil-Turnes C. 2004. Probiotics and immune response. Ciência rural, 34: 1297–12303.

Danilova I, Sharipova M. 2020. The practical potential of Bacilli and their enzymes for industrial production. Frontiers in microbiology, 11: 1782.

Diesel A, DeBoer DJ. 2011. Serum allergen-specific immunoglobulin E in atopic and healthy cats: comparison of a rapid screening immunoassay and complete-panel analysis. Veterinary dermatology. 22(1): 39– 45.

Fasano A. 2011. Zonulin and its regulation of intestinal barrier function: the biological door to inflammation, autoimmunity, and cancer. Physiological reviews, 91: 151–175.

Fasano A, Catassi C. 2012. Celiac disease. The new england journal of medicine, 367(25): 2419-2426.

Favrot C, Rostaher A, Fischer N. 2014. Clinical symptoms, diagnosis and therapy of feline allergic dermatitis. Schweizer archive für tierheilkunde, 156: 327–335.

Feliciano MAR, Saad FMOB, Logato PVR, Aquino AA, José VA, Roque NC. 2009. Effects of probiotics on digestibility, faecal score, and haematologic characteristics in dogs. Arquivo Brasileiro de medicine veterinaria e zootecnia, 61: 1268–1274.

Félix AP, Netto MVT, Murakami FY, Brito CBMD, Oliveira SGD, Maiorka A. 2010. Digestibility and faecal characteristics of dogs fed with Bacillus subtilis in diet. Ciência rural, 40: 2169–2173.

Guo S, Al-Sadi R, Siad HM, Ma TY. 2013. Lipopolysaccharide causes an increase in intestinal tight junction permeability in vitro and in vivo by inducing enterocyte membrane expression and localization of TLR-4 and CD14. American Journal of Pathology, 182(2): 375–387.

Halliwell R, Banovic F, Mueller RS, Olivry T. 2021. Immunopathogenesis of the feline atopic syndrome. Veterinary dermatology, 32(1): 13– 25.

Halliwell R, Pucheu-Haston CM, Olivry T, Prost C, Jackson H, Banovic F, Mueller RS. 2021a. Feline allergic diseases: introduction and proposed nomenclature. Veterinary dermatology, 32(1): 8.

Hill PB, Lau P, Rybnicek J. 2007. Development of an owner-assessed scale to measure the severity of pruritus in dogs. Veterinary dermatology, 18(5): 301-308.

Hoa NT, Baccigalupi L, Huxham A, Smertenko A, Van PH, Ammendola S, Cutting SM. 2000. Caracterização de espécies de Bacillus utilizadas para bacterioterapia oral e bacterioprofilaxia de desordens gastrointestinalis. Journal of applied environmental microbiology, 66: 5241–5247.

Jensen GS, Benson KF, Carter SG, Endres JR. 2010. GanedenBC30™ cell wall and metabolites: anti-inflammatory and immune modulating effects in vitro. BMC Immunology, 11(1): 1-14.

Jones SE, Knight KL. 2012. Bacillus subtilis-mediated protection from Citrobacter rodentium-associated enteric disease requires espH and functional flagella. Infection and immunity, 80(2): 710–719.

Jones SE, Paynich ML, Kearns DB, Knight KL. 2014. Protection from intestinal inflammation by bacterial exopolysaccharides. The journal of immunology, 192(10): 4813–4820.

Kell DP, Pretorius E. 2015. On the translocation of bacteria and their lipopolysaccharides between blood and periperhal locations in chronic inflammatory diseases: the central roles of LPS and LPS-induced cell death. Integrative biology, 7(11): 1339-1377.

Kerr KR, Cutler S, Burke M, Swanson KS. 2011. Evaluation of Bacillus subtilis PTA 6737 in domestic cats. The federation of American societies for experimental biology journal, 25: 217-7.

Majamaa H, Isolauri E. 1996. Evaluation of the gut mucosal barrier: evidence for increased antigen transfer in children with atopic eczema. Journal of allergy and clinical immunology, 97: 985–990.

Marsella R Olivry T, Carlotti DN. 2011. International task force on canine atopic dermatitis: Current evidence of skin barrier dysfunction in human and canine atopic dermatitis. Veterinary dermatology, 22: 239–248.

Moir A. 2006. How do spores germinate? Journal of applied microbiology, 101: 526–530.

Mueller RS, Nuttall T, Prost C, Schulz B Bizikova, P. 2021. Treatment of the feline atopic syndrome – a systematic review. Veterinary dermatology, 32: 43-48.

Nimmo Wilkie JS, Yager J, Wilkie BN. 1991. Abnormal cutaneous response to mitogens and a contact allergen in dogs with atopic dermatitis. Veterinary immunology and immunopathology, 28: 97–106.

Nuttall TJ, Steen RV, Cawood MI, Houghton CA. 2004. FC-49 feline dermatitis extent and severity index: A pilot study. Veterinary dermatology, 15: 36-36.

Ojetti V, De Simone C, Aguilar Sanchez J, Capizzi R, Migneco A, Guerriero C, Gasbarrini A. 2006. Malabsorption in psoriatic patients: cause or consequence? Scandinavian journal of gastroenterology, 41(11): 1267-1271.

O'Neill CA, Monteleone G, McLaughlin JT, Paus R. 2016. The gut-skin axis in health and disease: A paradigm with therapeutic implications. Bioessays, 38(11): 1167–1176.

Paap PM, Laak VDL, Smit JI, Nakamura N, Beynen AC. 2016. Administration of Bacillus subtilis C-3102 (Calsporin®) may improve faeces consistency in dogs with chronic diarrhea. Research opinions in animal and veterinary science, 6: 256–260.

Paik W, Alonzo F, Knight KL. 2019. Probiotic Exopolysaccharide Protects against Systemic Staphylococcus aureus Infection, Inducing Dual-Functioning Macrophages That Restrict Bacterial Growth and Limit Inflammation. Infection and immunity, 87: 791-818.

Paynich ML, Jones-Burrage SE, Knight KL. 2017. Exopolysaccharide from Bacillus subtilis Induces Anti-Inflammatory M2 Macrophages That Prevent T Cell-Mediated Disease. The journal of immunology, 198: 2689–2698.

Ravens PA, Xu BJ, Vogelnest LJ. 2014. Feline atopic dermatitis: a retrospective study of 45 cases (2001–2012). Veterinary dermatology, 25(2), 95- e28.

Saarialho-Kere U. 2004. The gut skin axis. J Pediatr Gastroenterol Nutr. 39(3): 734–735.

Santoro D, Pucheu-Haston CM, Prost C, Mueller RS, Jackson H. 2021. Clinical signs and diagnosis of feline atopic syndrome: detailed guidelines for a correct diagnosis. Veterinary dermatology, 32(1): 26-e6.

Schmidt V, Buckley LM, Mcewan NA, Rème CA, Nuttall TJ. 2012. Efficacy of a 0.0584% hydrocortisone aceponate spray in presumed feline allergic dermatitis: An open label pilot study. Veterinary dermatology, 23: 11-16.

Stokes JH, Pillsbury DM. 1930. The Effect on the Skin of emotional and nervous states: iii. Theoretical and practical consideration of a gastro-intestinal mechanism. Archives of dermatology and syphilology, 22(6): 962–993.

Swartzendruber JA, Incrocci RW, Wolf SA, Jung A, Knight KL. 2019. Bacillus subtilis exopolysaccharide prevents allergic eosinophilia. Allergy, 74(4): 819.

Tam NK, Uyen NQ, Hong HA, Duc LH, Hoa TT, Serra CR, Cutting SM. 2006. O ciclo de vida intestinal de Bacillus subtilis e parentes próximos. Journal of bacteriology, 188: 2692–2700.

Tunsagool P, Ploypetch S, Jaresitthikunchai J, Roytrakul S, Choowongkomon K, Rattanasrisomporn J. 2021. Efficacy of cyclic lipopeptides obtained from Bacillus subtilis to inhibit the growth of Microsporum canis isolated from cats. Heliyon, 7(9): e07980.

Varionen E, Vainio E, Kalimo K. 2000. Antigliadin IgE-indicator of wheat allergy in atopic dermatitis. Allergy, 55: 386–391.

Zamora-Pineda J, Kalinina O, Osborne BA, Knight KL. 2022. Probiotic Molecules That Inhibit Inflammatory Diseases. Applied sciences, 12(3): 1147.s