SYNBIOTICS THE FUTURE FEED SUPPLEMENT FOR COMPANION ANIMALS

Abstract

Synbiotics are complex compounds containing a beneficial combination of probiotics and prebiotic. This symbiotic combination along with many other possible number of combinations depending upon the availability and the purpose to be used may confer many beneficial effect to the host animals. With increasing awareness among the owners for their pet health and general care pursuit for newer feed additive is increasing day by day. Synbiotics has been reported to confer health benefits and upregulation of many antioxidant activities and immunological responses in various categories of livestock animals. These findings has increased the interest of animal nutritionist to use extend the use of synbiotics for the benefit of companion animals. They may modulate the general gut health biomarkers and may improves the general health and expand the longilivity of companion animals. The combined benefits of probiotics and prebiotics may also modify the intestinal microbial architect for the health benefits of host animals. The scientific urge has led to develop many new research activities across the world to reap out other hidden benefits and development of better plan. This chapter tried to summarize and consolidate those scientific corroborations related to health benefits of synbiotics for companion animals so that their use can be suggested and incorporated in regular food of its usage as therapeutic agent as a substitute to indiscriminate use of antibiotics in clinical condition.

Keywords: Synbiotics, Companion Animals, Health Benefits, Gut health, Immunity.

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I. INTRODUCTION

The companion animals are fed to promote their lifelong health for their owners at the same time to economize the balanced ration for their good health. Nutritional needs of the animals are influenced by their life style as well as life stage. Balancing the diet for companion animal are very bewildering because of the different tangled factors. Since these animals are very particular and sensitive for their feed but mostly they are fed as per the dietary preference of their owners. Meeting the nutritional requirement together with maintaining the overall health and precisely the gut health possess great challenge to the nutritionist. There are many challenging stages in the life of companion animals where they need extra attention particularly in obese, geriatric and sick animals. In this regards synbiotics has emerged as one of the potent alternative for meeting the various expectation of meeting all challenges. Synbiotics in animal feeding context may be defined as the mixture embracing probiotics (live microorganisms) and prebiotics (selectively digestible nutrients/substrates) and confers beneficial effect to the host animals by promoting growth of beneficial bacteria in their colon. Broadly these synbiotics may be categorised into (a) Complementary synbiotics: with independent probiotics and prebiotics combination, and (b) Synergistic synbiotics: Related prebiotics and probiotics combination (Swanson et al., 2020).

The advantage of using synbiotic may to cater the beneficial effect of both probiotics and prebiotics simultaneously as the prebiotics may provide the substrate and environment necessary for colonization and growth of probiotic microorganism and their rapid multiplication (Sekhon and Jairath 2010; Malik et al.,2016). Therefore, a proper consortium of both probiotic and prebiotic in a single product should results in better effect, in comparison to their activity alone. A large permutation and combination combinations, provides a large number of possible promising synbiotics for their application in human and other animals for the modulation of gut microbiota and other beneficial effects (Kearney and Gibbons 2018). The commonly used probiotic microorganisms include different strains of *Enterococcus, Streptococcus, Bifidobacterium, Lactobacillus*, species along with yeast *Saccharomyces boulardii*. (Pandey et al. 2015; Malik et al. 2016; Ojha et al., 2020). Nevertheless, with advancement in technology along with intensive research many new strains and genera of probiotics have been emerged and raised. These advancement has opened new avenues for the nutritionist and clinicians for the betterment of health and performances.

The commonly used prebiotics are inulin sources obtained from Jerusalem antichoke, Chicory roots, raw oats, and nondigestible oligosaccharides. They mainly contain complex carbohydrate which include Fructooligosaccharides (FOS), Galactooligosaccharides (GOS), Transgalactosylated-oligosaccharides (TOS). Mannan- oligosaccharides (MOS) and lactulose. Recently, some more substrates are being investigated and included in the list as emerging prebiotics like Genti-oligosaccharides, Glucooligosaccharides, Lactosucrose, Levans, Pectic, Oligosaccharides, resistant starch, and Xylooligosaccharides (XOS) (Anadon et al. 2010; Pandey et al. 2015; Singh et al.,2017). These prebiotics mostly indigestible in the upper digestive tract may got fermentation in the colon thereby increasing the population of *Bifidobacterium* which synthesis compounds that inhibit potential pathogens, as they tends to lower blood ammonia levels and produces digestive enzymes (Malik et al. 2016).

The application of synbiotics provides a potential substitute to the antibiotics and reduces the chance of resistance problem arising now a days. It has synergistic benefits over other alternative including probiotics and prebiotics being used alone. The noteworthy enhancement in the short chain fatty acid (SCFA), along with decrease in the concentration of ammonia, branched chain fatty acids biogenic amines phenols indoles etc. due to the supplementation of synbiotics has further strengthened its candidature to be used as promising alternative and supplement for animal conferring health-benefits (Vitali et al. 2010). In the recent time research studies are emerging for testing the benefits of synbiotics with objective of their application as health promoter and theraputive agent. Additionally, synbiotics have been verified by many researchers for their effect on other indices such as growth rate, nutrient absorption, and quality of their product. Synbiotics inclusion may tends to improve the intestinal homeostasis in terms of survivality of the probiotic microbiota during the passage through the upper intestinal tract in consort with maintenance and improvement of immune function and intestinal morphology to confer health for the host. This chapter describes the current knowledge and research activities conducted or going on to extract the effects of synbiotics on the health and performance. The mode of action, beneficial effects, and demonstrated study results proving the efficacy of synbiotics in companion animals are explained.

II. SYNBIOTIC FOR ANIMALS

The colonized microbes present in the intestine of animals benefits the host animal in ways ranging from nutritional, physiological along with some others like immunological and host defence and supposed to get influenced directly by the food of the animals. The synbiotic has got the attention to be used as a potent component for livestock and poultry feed which could administer health effects modify gut micro biome together with enhancing growth performance, feed conversion ratio, haematological and immunological parameters and many times found to perform better than either probiotic or prebiotic alone. Synbiotics supplementation reported to modify the population of the beneficial microorganism at the same time promoting the general health parameters of gut. Even though the availability of research data are very limited for multifaceted role performed by synbiotics application on livestock health and performance, however, its affect are greatly influenced by synbiotic combination (Scavuzzi et al. 2014). The mode of action is a synergy between probiotics and prebiotics and explained in figure no 1.

III. EFFECT OF SYNBIOTICS

The effect of synbiotics directly get influenced by selecting the most appropriate combination of both prebiotics and probiotics. The probiotics organism selectively attach and ferment the prebiotic thereby deliberating their beneficial effect for the host animals. The use of synbiotic are barely studied especially among the domestic canine and feline species. The use of Canine-derived strain *Lactobacillus fermentum* CCM 7421 and inulin combination has been demonstarted to confer positive health benefits like modulation of intestinal bacteria mainly *Lactobacillus* and decrease in faecal ammonia concentration (Strompfova et al., 2013). Further, Ogué-Bon et al. (2010) tested different strains of *Bifidobacterium* and *Lactobacillus* with the combination of some established prebiotics like FOS, GOS, and inulin. After the *in vitro* experiment they inferred that the synbiotic combination greatly modify the faecal microbial count of beneficial bacteria as compared to probiotics and

prebiotics alone. Recently, Schmitz and Allenspach (2017) in an *in vitro* study investigated the growth properties for different strains of *Enterococcus*, *Bifidobacterium* with the addition of FOS and MOS alone and FOS plus gum Arabic. They observed growth of *bifidobacteria* was maximum when they were used with FOS and gum arabic combination and this synbiotics reported to modify the gut microbial population of healthy bacteria in dogs. White et al.,2017 studied the effects of *Lactobacillus acidophilus* NCFM, FOS, or their combination in healthy dogs and observed rise in the population of beneficial bacteria (e.g., *bifidobacteria, lactobacilli*) and decline in the population of harmful bacteria (e.g., *Clostridium perfringens*). Moreover, augmentation in the end product of fermentation like butyrate, lactate, other SCFAs and nutrient digestibilities was also reported. *Lactobacillus acidophilus* in combination with FOS was found to be effective in tumbling the level of ammonia, branched chain fatty acids biogenic amines phenols indoles etc. in dog faeces (Swanson et al. 2002). Even though supplemental synbiotics may be useful in improving beneficial bacterial populations, evidences for extension of the same in treatment for clinical cases like diarrhoea and other gastrointestinal upsets are very limited in companion animals. Gagné et al. (2013) demonstrated that supplementation of synbiotic (*Enterococcus faecium* SF68, *Bacillus coagulans*, and *Lactobacillus acidophilus* along with FOS and MOS) resulted in proliferation of *Lactobacillaceae*, together with SCFAs (like butyrate) concentration, faecal score improvement along with overall reduction in the prevalence of diarrhoea in dogs. On the other hand, unaltered bacterial population together with intestinal health and immunological indicators were reported after administration of synbiotics having multiple combination different probiotic species of *Enterococcus*, *Streptococcus*, *Bifidobacterium*, *Lactobacillus* and a blend of FOS and arabinogalactans daily for 21 days in healthy dogs and cats (Garcia-Mazcorro et al. 2011). Recently, Rose et al. (2017) examined the efficacy of synbiotic (*Enterococcus faecium* NCIMB 10415 4b1707 and FOS) supplement on the incidence of diarrhoea in dogs and reported significant reduction in the number of incidences. Hart et al. (2012) assessed the outcome of a of synbiotics having multiple combination different probiotic species of *Enterococcus, Streptococcus, Bifidobacterium, Lactobacillus* and two prebiotics in adult cats and reported improvement in the faecal score from 6.0 to 4.4 at the same time decreasing the occurrence of diarrhoea in cats. Stokes et al. (2017) demonstrated that synbiotics application led to the improvement of gastrointestinal disorders suggesting their use as an alternative to antibiotics as therapeutic agent in cats suffering from clindamycin induced hyporexia and vomiting. Some more effect of synbiotics application and their potential effect has been summarised in table no 1.

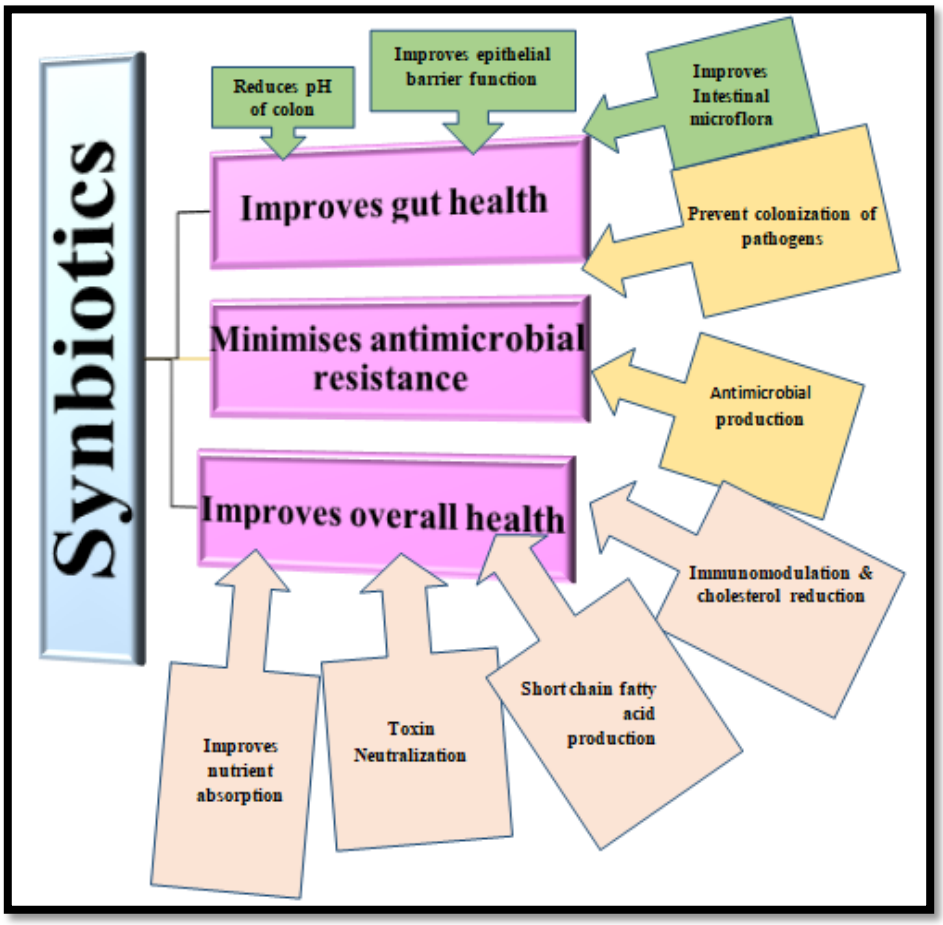

Figure 1: Mode of Action of Synbiotics

Synbiotics produces synergistic effect of prebiotics and probiotics as they improve gut health by improving the gut barrier function by modulating the intestinal growth along with modification of colonic microbiome and altering the pH. They also secret antimicrobial component like bacteriocin, nicin etc. and prevent colonization of harmful bacteria either by competitive inhibition of substrate consumption. They also improve general health as they are reported to enhance immune modulation, enhances concentration of short chain fatty acids like butyrate responsible for enterocytes growth and proliferation. Reports of increased nutrient absorption *viz* iron, zinc, and calcium and toxin neutralization has also been recorded as they tends to increase the villus height and alter their morphology. Synbiotics may also reported to enhance the expression of chemokine and cytokines like IL-2. IL-10 and interferon (IFN)-γ as they are recognized by protein coupled receptors (GPR) present on enterocytes and entero-endocrine cells.

Table 1: Effects of some synbiotics on performance of companion animals

Synbiotic	Main outcome	References
Dogs*:* *Enterococcus faecium* (EF) and fructooligo-saccharides	There was increase in beneficial microbiota taxonomic composition	Pilla et al., 2019.
Synbiotic containing 1 x 10^{10} CFU of *Saccharomyces boulardii* and the prebiotic beta- glucan	Lowering of irregularity in mean food intake of tested dogs. Faecal score improvement.	Whittemore et al., 2019.
Cast: Proviable- DC, a marketed synbiotics	Decrease in incidence of antibiotic induced reduction in food intake and vomiting in healthy cats. Easing of gastrointestinal disturbances caused by antibiotics usages.	Stokes et al.,2017
Synbiotics prepared from Lactobacillus acidophilus D2/CSL (CECT 4529) and FOS	Improvement of faecal parameters of dogs, Maintenance of healthy intestinal biome.	Bruni et al.,2020
Dogs: Synbiotic prepared by mixing *Lactobacillus acidophilus* NCDC15 and Cichorium intybus root powder	The digestibility of crude fibre increases. The population of *lactobacilli* and *bifidobacteria* bacterium reported to increased. Reduction in faecal ammonia and population of *clostridia* and *coliform*. The delayed- type hypersensitivity response showed improved immune status	Kumar et al.,2021
Dogs: The synbiotic used is Proviable R -Forte, a commercial preparation	Decreased antibiotic-induced gastrointestinal disorders in dogs	Whittemore et al.,2021
Dogs: Inulin plus different strains of *Lactobacillus*	Decrease in incidence rate of diarrohea. Increase in β-diversity of gut microbiota for *Lactobacillai*	Tanprasertsuk et al.,2021

IV. CONCLUSIONS

There are indications suggesting beneficial effects of synbiotic in the companion animals. Available research database indicates some beneficial effect conferred by synbiotic evident by proliferation of beneficial intestinal microbiota of companion animals and overall improvement in performance and optimal health. Moreover, they also tend to enhance immunological and anti-inflammatory responses. However, their dose optimization with varying breeds and species are very scanty and needs to be established. More studies are also needed to explore alternatives to extend their shelf life and keeping qualities for long time. This aspect posses a great challenge as well as new opportunities for augmenting their usage without compromising safety and economics of usage. Different ways to increase their palpability and intake also needs to be investigated properly for their recommendation to be used as a regular supplement for companion animals to ensure their long and healthy life.

These further open new avenues for these products to be used by clinicians to prevent indiscriminate use of antibiotics. They possess a great potential to be established as a compound for diseases prophylaxis and maintenance of good health in the coming future.

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