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ASSESSING THE IMPACT OF SYNBIOTICS ON THE HEALTH AND PRODUCTIVE PERFORMANCE OF POULTRY

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ABSTRACT

As the world population increases to its projected seven billion people, the demand for both animal and plant-based food sources becomes more pressing. To increase production of meat, eggs, milk and fish, feed additives like antibiotics, probiotics, prebiotics, postbiotics and synbiotics are being considered. Scientists advocating for animal health typically support the combination of probiotics and prebiotics - otherwise known as synbiotics - for their beneficial properties. This review looks at how synbiotics can affect poultry production in terms of growth, carcass characteristics, intestinal histomorphology, immunity and microbiome. An electronic search was conducted with related keywords to assess relevant literature on this topic. Synbiotic products may help with growth performance as well as modify gut microbiome composition, prepare slaughter traits and stimulate immunity. The efficacy of synbiotics in poultry production depends on certain conditions including the bird's intestinal health, inclusion rate of these agents, quality of feed and water availability. This systematic review compiles all the research papers focused on synbiotics in poultry production and their potential impact on performance parameters.

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INTRODUCTION

Over the last half century, the poultry industry has made remarkable progress in production due to advances in genetics, management practices, and nutrition. This is demonstrated by observations of enhanced avian output as a result of more efficient feed utilization, increased yields, and improved animal health (Yaqoob *et al.*, 2022). Antibiotics have been implemented widely within this sector to improve performance, spur on growth, and safeguard birds against microbial infections (USDA, 2019; Letlhogonolo *et al.*, 2020). This is because antibiotics can enhance digestion and absorption of nutritional components from feeds (Hakimulue *et al.*, 2020) while sustaining bird welfare by minimizing bacterial diseases (Letlhogonolo *et al.*, 2020). They additionally provide an economical means to maximize growth rate and raise productivity (Paintsil *et al.*, 2021). The misuse of antibiotics has been noted for its potential to increase the risk of antimicrobial resistance bacteria, contaminate animal products, and pollute the environment (Christy *et al.*, 2018). These issues have come to global attention due to the impact they can have on food production, especially poultry. Consequently, many countries now impose restrictions or have outright banned their use in the pursuit of efficient poultry production that still insures safe meat and eggs. The emergence and spread of antibiotic resistance is a major worry with consequences for both humans and animals alike.

In recent years, there has been a great deal of research into alternative antibiotics for livestock due to the need for replacement for conventional antibiotics (Rafiq *et al.*, 2022). Prebiotics, probiotics, synbiotics, and postbiotics have been studied extensively in order to develop more precise and reliable biological control products for the industry. These replacements could aid in mitigating issues associated with antibiotic resistance while still supplying safe and nutritious food to both animals and humans. This review aims to assess current research on synbiotic applications in broilers from a critical point of view. It is inconceivable to accurately forecast the influence of synbiotics on broilers owing to multiple intrinsic and extrinsic factors. Moreover, results acquired from different studies tend to diverge significantly. Therefore, this evaluation attempts to analyze important findings on using synbiotics in broilers and explore their possible consequences.

The concept of symbiotic: The potential of synbiotics as feed additives for poultry has yet to be fully established; however, multiple in vivo trials have indicated a synergistic effect between prebiotics and probiotics, which can reduce food-borne pathogenic bacteria and increase lactic acid and short-chain fatty acids (SCFAs) production (Gibson *et al.*, 2017; Śliżewska *et al.*, 2020). Studies suggest combining prebiotics and probiotics is more advantageous than administering them individually (Abdel-Wareth *et al.*, 2019). Several investigations into the most effective probiotic and prebiotic combinations for synergy have been conducted ((El-Banna *et al.*, 2010), with findings indicating the capacity of synbiotics to benefit hosts by improving the survival rate and activity of beneficial bacteria in the gastrointestinal tract (Huyghebaert *et al.*, 2011). Synbiotic formulations may incorporate a variety of probiotic strains, such as *Lactobacilli, Bifidobacteria spp*., *S. boulardii*, and *B. coagulans*. Prebiotics commonly used in such formulations are oligosaccharides like fructooligosaccharide (FOS), GOS, and xylooligosaccharides (XOS), as well as natural sources like chicory root and yacon roots that naturally contain prebiotics. Reported health benefits associated with synbiotic consumption encompass heightened levels of *lactobacilli* and *bifidobacteria*, balanced gut microbiota, improved immunomodulation abilities, inhibition of bacterial translocation, and elevated growth performance (Elshaghabee & Rokana, 2022; Krumbeck *et al.*, 2018).

Modes of Action of Synbiotics: Studies of the ways in which synbiotics affect the host have been conducted widely. Prebiotics are known to boost probiotic bacterial growth within the intestines, and prebiotic and probiotic bacteria may operate independently. Through various studies, it was observed that synbiotics can amplify levels of beneficial bacteria, whilst also minimizing the development of potential pathogens in broiler chickens (Śliżewska *et al.*, 2020; Stefaniak *et al.*, 2019). Furthermore, supplementation with probiotics and synbiotics may possess favourable implications for intestinal microbiota composition. Nevertheless, a study determined that these strategies were unable to reduce *Salmonella Typhimurium* presence in caecal tissue or spread into other parts of an organism's body, like the liver or spleen in chickens (Tayeri *et al.*, 2018). Additional research pinpointed that a combination of *Bifidobacterium breve* probiotic and GOS prebiotic proved capable of strongly reinforcing protection against deadly infections caused by multidrug-resistant *Acinetobacter baumannii* on a mouse model (Krumbeck *et al.*, 2018). Synbiotics, a combination of prebiotics and probiotics, demonstrate potential for being used as an animal feed additive to encourage growth and balance gut microbiota. While synbiotics possess the same strengths and weaknesses as singular pre- or probiotic components, they have been observed to reduce diarrhea, increase digestibility and weight gain in animals. It has also been noted that strains of beneficial bacteria such as Lactobacillus and Bifidobacterium are found in higher concentrations when ingested. The presence of prebiotic elements improves the survival rate of the associated probiotics (Cobb *et al.*, 2019; Kosznik-Kwaśnicka *et al.*, 2019). Nevertheless, due to insufficient mixing ratios many synbiotics used in animal feed are ineffective; thus, it is recommended that appropriate controls be adopted during experiments involving the implementation of symbiotic-supplemented animal feed (De Paepe *et al.*, 2014).

Effect of Synbiotic on Growth Performance: Numerous studies have demonstrated that synbiotics, which are made up of probiotics and prebiotics that act synergistically, can be used as effective alternatives for in-feed antibiotics (Dong *et al.*, 2019; Mohammed *et al.*, 2018; Ren *et al.*, 2019). Prebiotics can provide suitable substrates for probiotics and promote their colonization, which in turn inhibit harmful bacteria (Elshaghabee and Rokana, 2022) and consequently improve animal growth (Basturk *et al.*, 2020). Better outcomes may include greater body weight at the end of trials, as well as reductions in feed intake for a similar final weight (increased feed conversion ratio) (Awad *et al.*, 2009; Chen *et al.*, 2018; Tayeri *et al.*, 2018). Dakhil and Al-Shammari, (2023) studied the influence of 0.5% synbiotics on the growth performance of broiler chickens. Results showed a substantial improvement ($P<0.05$) in mean body weight, cumulative weight gain, relative growth rate, cumulative feed intake, and feed efficiency when compared to the control group. Song *et al.*, (2022) evaluated the effect of MLP (microencapsulated *Lactobacillus plantarum*) and FOS (fructooligosaccharide) synbiotics on growth in broilers with higher average daily gain seen within the supplemented group than the control group ($P < 0.05$). Mohammed *et al.*, (2022), who also used 0.5 g/kg of synbiotic supplementation in their basal diet for broiler chickens, saw that these birds had significantly greater body weights than those given a control diet ($P< 0.05$). In a study, Khalil *et al.* (2021) explored the impact of giving commercial probiotics (Promax) and synbiotics (Bio-lux) at dosages of 1 g/L and 1.2 g/L through drinking water on growth parameters in broiler chickens, respectively. Results revealed that feeding synbiotics led to significantly higher live weight and lower feed conversion ratio (FCR; $P < 0.05$) than those in the probiotic and control groups. These findings are in line with Mohammed *et al.*'s (2018) research, which examined the effects of various levels of synbiotic (consisting of *Bifidobacterium animalis, Enterococcus faecium, Lactobacillus reuteri, Pediococcus acidilactici,* and fructooligosaccharides) at 0 (control), 0.5 and 1.0 g/kg in broiler chicken diets. Research outcomes demonstrated that supplementing with synbiotics had greater bodyweight (BW), BW gain, feed intake, and FCR compared to non-supplemented groups ($P < 0.05$). Abdel-Wareth *et al.* (2019) concluded that intake of synbiotic in the basal diet of broilers caused linear improvements in body weight, weight gain, feed intake, and feed conversion values ($P < 0.001$). Additionally, Tayeri *et al.* (2018) established a similar outcome from their research with commercial synbiotics at 0.15 g/kg feed for body weight, weight gain, and FCR; however, no changes were observed on feed intake. A separate study by Chen *et al.* (2018) determined that dietary addition of 1.5 g/kg synbiotic - comprising xylooligosaccharides, *Clostridium butyricum* and *Bacillus subtilis* - improved weight gain and feed utilizations with a reduction in overall feed consumption in broiler chickens. Aziz Mousavi *et al.* (2018) evaluated the effect of synbiotics (Biomin®IMBO) at concentrations of 0.05%, 0.0375%, 0.075% and 0.0625%. Results revealed that birds receiving diets enriched with any of these doses had significantly higher body weight gain, feed consumption, and feed conversion ratio ($P < 0.05$) compared to the control group. These results are in line with those found in prior studies when synbiotics were supplemented at different levels including by 1.5 g per kg diet (Cheng *et al.*, 2017), 1.13, 0.63 and 0.38 kg/ton (Abdel-Hafeez *et al.*, 2017), 0.5, 1, and 2 kg/ton (Ipek *et al.*, 2016), 1g/kg (Al-Sultan *et al.*, 2016), 2.15 g/kg (Min *et al.*, 2016), 250mg/kg (Sagor *et al.*, 2015), 1g/kg (Ghasemi *et al.*, 2014), 6 and 11g/kg (Mookiah *et al.*, 2014), 2.000 ppm (Muraroli *et al.*, 2014), 0.5, 1, and 1.5 g/kg (Fallah *et al.*, 2013) which indicated that the incorporation of synbiotics had a substantial effect on weight gain and feed conversion ratio. This improvement in weight gain could likely be linked to probiotics' capacity to secrete digestive enzymes such as lipase, protease, and amylase which help break down feed nutrients for better digestibility of starch, fat, and protein resulting in increased availability of nutrients for the broilers hence leading to higher live weight gain (Bedford, 2000). Additionally, improved FCR might be attributed to the combined effect of prebiotics and probiotics preserving normal microbial populations while simultaneously enhancing ileal digestibility(Aziz Mousavi *et al.*, 2018; Nisar *et al.*, 2021).

In spite of this, some authors have not observed any improvement when using the same mixtures evaluated by other researchers or when evaluating different combinations (Bogucka *et al.*, 2018; Roth *et al.*, 2019). Bhagwat *et al.* (2023)conducted a study to assess how dietary synbiotic formulation with phytoactives (SFP) would affect growth performance in broiler chickens if administered at 100 g and 150 g per ton of feed respectively. Results showed that body weight, weight gain, and feed efficiency remained unchanged across treatments ($p>0.05$). Similarly, Śliżewska *et al.* (2020) tested the effects of synbiotics containing *Lactobacillus, Saccharomyces cerevisiae*, and inulin (prebiotic), on the growth performance of broiler chickens and reported that including the synbiotics did not influence body weight and weight gain significantly. Nisar *et al.* (2021) conducted research to examine how varying levels of synbiotics at rates of 700, 1200, 1700 or 2200 g/ton feed may affect growth performance; however they found that body weight and feed consumption were similar for all treatments. The findings from Li *et al.* (2019), Al-Khalaifa *et al.* (2019), Sarangi *et al.* (2016), Sohail *et al.* (2012), and Erdoğan *et al.* (2010) confirms that the combination of prebiotics and probiotics can significantly reduce feed conversion ratio in Partridge shank chickens, without any impact on body weight gain or feed intake. This is a significant discovery which can be used as an effective dietary supplement to ensure optimal health for poultry, leading to higher quality produce with reduced costs for farmers and consumers alike.

Effect of Synbiotic on carcass traits: The evaluation of carcass traits is critical for profitable broiler production; hence it has been the subject of intense research for decades. The rise of synbiotics as a growth promoter in the early days has allowed for further study on their effectiveness in evaluating carcass traits in broilers, resulting in a better understanding of how to maximize profitability through improving these qualities. Research in this area continues to be conducted with increasing sophistication and precision, so that producers can strive to achieve maximum return from their investments. Tayeri *et al.* (2018) reported that carcass traits were linear improvements (P< 0.001) due to inclusion of commercial synbiotic (Biomin IMBO, Herzogenburg, Austria) at the rate of 0.15 g/kg feed. Another study conducted by Sagor *et al.* (2015) also observed that the synbiotic supplemented group had increased (p<0.05) carcass percentage compared with the control group and probiotic supplemented group. Saiyed *et al.* (2015) reported that carcass traits, dressing percentage, abdominal fat weight and abdominal fat percentage (as a percentage of dressed weight) were recorded significant (p<0.05) difference among different treatment groups due to supplementation of the symbiotic in the basal feed of broilers. According to the study of Abdel-Raheem *et al.* (2012), who reported that dressing percentage, breast meat yield, and thigh meat yield increased in synbiotic supplemented group as compared with other treatment groups. Similarly, Abdel-Raheem and Abd-Allah, (2011) reported a significant increase (p<0.05) in the carcass weight and dressing percentage in synbiotic supplemented broilers compared with either prebiotic or probiotic alone supplemented group in broilers. Another study conducted by Awad *et al.* (2009) concluded that the synbiotic supplemented group had a greater (p<0.05) carcass percentage as compared to the control group and probiotic supplemented group. Opposite results were found by Nisar *et al.* (2021), who observed no significant changes in carcass characteristics among the treatments due to dietary supplementation with synbiotics at rates of 700, 1200, 1700 or 2200 g/ton feed. Similar findings were reported by Sarangi *et al.* (2016), who showed that the supplementation of synbiotics did not have an impact on carcass traits with respect to dressing percentage, carcass percentage, heart weight, liver weight and gizzard weight, wing percentage, breast percentage, back percentage, thigh percentage, and drumstick percentage of broiler birds. Additionally, Ashayerizadeh *et al.* (2011) demonstrated that supplementing synbiotics (Primalac and BiolexMB) in the broiler diet had no significant effect on carcass, thigh meat yield and breast meat yield percentages. Another study conducted by Ghasemi *et al.* (2014), who reported that no significant variance in carcass traits were observed with the inclusion of 1 g/kg synbiotic compared with control group.

Effect of synbiotic on gut microbiota: It's conceivable that the incorporation of live microorganisms and specific fermentation substrates in the form of a synbiotic compound may remodel an individual's endogenous microbiota structure; hence, additional research into its capacity in animal homeostasis could be beneficial. Intestinal microbiota homeostasis is essential for enhancing poultry health, growth, and productivity (Yadav and Jha, 2019). Several studies have demonstrated that the inclusion of synbiotic mixtures can lead to changes in intestinal microbiota compared to a control group. Generally, these mixtures increase levels of beneficial bacteria such as *Lactobacilli* and *Bifidobacteria* while decreasing potentially pathogenic bacteria like *Enterobacteria* and *Coliforms* (Modesto *et al.*, 2011; Weiss *et al.*, 2013). Mohammed *et al.* (2019) evaluate the effect of different level of synbiotic (PoultryStar consists of *Bifidobacterium animalis, Enterococcus faecium*, *Lactobacillus reuteri*, *Pediococcus acidilactici,* and fructooligosaccharides) at 0 (control), 0.5 and 1.0 g/kg in broiler chicken. Result indicated that synbiotic fed broilers regardless of dose had lower cecal enumerations of *Escherichia coli* and *coliforms* whereas; they observed higher cecal enumerations of *Bifidobacterium* spp. and *Lactobacillus* spp. Another study conducted by Mohammed *et al.* (2022) evaluate the effect of synbiotic at the rate of 0.5g/kg feed in broiler chickens. At the end of the experiment, the counts of *Escherichia coli* of synbiotic supplemented birds lower than that of non-supplemented birds (P < 0.05); while there were no treatment effects on the populations of *Lactobacilli* (P > 0.05). Further, Nopparatmaitree *et al.* (2022) investigate the effects of synbiotic from trimmed asparagus by-products (TABP) combined with probiotic supplementation in broiler diets on the gut ecology. Result indicated that the supplementation of synbiotic increased the lactic acid bacteria, *Enterococcus* sp., and volatile fatty acids (*p* < 0.05) and decreased *Salmonella* spp. and *Escherichia coli* in the cecum of different treatment to control groups (*p* < 0.05). Dibaji *et al.* (2014) evaluated the effectiveness of various concentrations (from 0.0375% to 0.075%) of a synbiotic (Biomin Imbo, composed of *Enterococcus faecium* and fructo-oligosaccharides) over a 42-day feeding period. Their findings revealed that incorporating different levels of synbiotics enhanced *lactobacilli* numbers but diminished *Escherichia coli* and total coliform populations within the caecal contents of broiler chickens. According to Song *et al.* (2022) synbiotic, composed of microencapsulated Lactobacillus plantarum **(**MLP**)** and fructooligosaccharide (FOS) was investigated the effects on gut microbiota in broilers. No significant differences in populations of Escherichia coli were seen in chickens among the three groups, whereas, the populations of Lactobacillus were higher (P < 0.05) in chickens in the SYN group compared with those in CON and ANT groups. Similarly, previous studies have demonstrated that dietary supplementation of microencapsulated probiotics and prebiotics significantly increased caecal Lactobacilli counts in broilers (Ayalew *et al.*, 2022; Wein *et al.*, 2020). Another study conducted by Abdel-Wareth *et al.* (2019), who reported that *E. coli*, *Salmonella*, and *Shigella* were decreased (P < 0.001) by supplemental synbiotic levels compared to the control group during the entire study. Again, Mookiah *et al.* (2014) reported that synbiotics significantly (*P* < 0.05) increased the caecal populations of *lactobacilli* and *bifidobacteria*, and decreased the caecal *Escherichia coli* . Erdoğan *et al.* (2010) reported that supplementation of synbiotic at the rate of 1g/kg to the diet of broiler chickens had decreased the caecal coliform count (p<0.01).

Effect of Synbiotic on gut Morphology: The morphology of the intestinal mucosa is an important determinant of the digestive and absorptive intestinal functions, which in turn determine the growth performance of poultry. In general, synbiotic mixtures have been linked to an increase in villi height and the ratio between it and crypt depth, resulting in a larger absorptive area structure compared to a control group, indicating better gut health. Al-Baadani *et al.* (2016) found that the combination of *Bacillus subtilis* and MOS enlarges jejunal villi height and its surface area; not each component alone. Again, Mohamed *et al.* (2022) added a synbiotic at a rate of 0.5 g/kg to the basal diet in order to evaluate its effects on broiler chickens. Results showed that birds supplemented with the synbiotic had increased villus height compared to both CONT and BMD birds (P < 0.05). Min *et al.* (2016) showed that supplementation with 2.15 g of a synbiotic per kg of feed consisting of *Bacillus subtilis*, xylooligosaccharide and mannan oligosaccharide could significantly increased the villus height and villus: crypt ratio in the duodenum, jejunum and ileum (p< 0.05), comparing with control group. Al-Sultan *et al.* (2016) investigated the effects of dietary prebiotics, probiotic, synbiotic and organic acid salt at the rate of 1g /kg feed on gut morphology of broiler chicken. Synbiotic supplementation was superior in increasing villus height in duodenum and jejunum and ileum in comparison with pre, probiotic and organic acids. Nopparatmaitree *et al.* (2022) investigate the effects of synbiotic from trimmed asparagus by-products (TABP) combined with probiotic supplementation in broiler diets on the apparent small intestinal morphology. Results show synbiotic supplementation increased the villus height, villus surface area, and the depth of the crypt of the duodenum, jejunum, and ileum (*p* < 0.01). Cheng *et al.* (2017) evaluate the effect of 1.5-g synbiotic contained 150 mg xylooligosaccharide, 3 × 109 CFU of *Clostridium butyricum*, and 4.5 × 1010 CFU of *Bacillus subtilis* in broiler chicken. Result indicated that dietary synbiotic inclusion promoted the ratio of ileal villus height to crypt depth of broilers. However, Setyaningrum *et al.* (2019)

discovered that the beneficial action could be dose-dependent, as they observed a decrease in surface area when increasing the synbiotic dose from 0.1% to 0.2%.

Effect of synbiotic on immune response: Antibody titer against Newcastle disease vaccine (NDV) and infectious bursal disease vaccine (IBDV) are essential measures to maintain health and performance in poultry. Synbiotic treatment can act synergistically to boost effectiveness of vaccines and increase antibody titer against both NDV and IBDV. Furthermore, the addition of probiotics and prebiotics components may enhance gut immune system, contributing to better resistance against pathogenic agents. Therefore, monitoring antibodies arising from vaccination treatments combined with synbiotic supplementation represents a crucial tool in order to achieve success in poultry production. Study conducted by Al-Sultan *et al.* (2016) investigated the effects of dietary prebiotics, probiotic, synbiotic and organic acid salt at the rate of 1g /kg feed on immune response of broiler chicken. Results revealed that the synbiotic group had highest antibody response to Newcastle disease vaccine (NDV) vaccine in comparison with prebiotic and organic acids group. Similar results were obtained by Cheng *et al.* (2017) who demonstrated that antibody titers against ND in broiler chicks fed diets containing b-glucan (0.025%, 0.05%, or 0.1%) and *Bacillus amyloliquefaciens* (0.05%, 0.1%, or 0.2%) were significantly greater than those of the control group. Houshmand *et al.* (2012) reported that antibody titer to ND virus was increased in all groups supplemented with probiotics (*Bacillus subtilis* and *Clostridium butyricum*) and prebiotics (2 g/kg), compared to the control group, indicating a positive effect on immunity of the treated groups. According to the study conducted by Bhagwat *et al.* (2023), reported that supplementation of synbiotic in the basal diet of broilers had significantly increased titre against NDV (P<0.05) compared to the control group. However, Rehman *et al.* (2020) and Silva *et al.* (2009) [71,72] studied and found that titer against ND was not affected by synbiotics. Similarly Salehimanesh *et al.* (2016) concluded that titre against NDV was not affected by synbiotics (probiotic plus probiotic at the dose rate of 0.9 g/kg each). According to Nisar *et al.* (2021), the effect of various levels of dietary supplementation of synbiotics, at rates of 700, 1200, 1700, or 2200 g/ton feed was explored. Results revealed that NDV antibody titre was not affected by supplementation of varying levels of synbiotics on day 35. Similarly observation were obtained by Zulkifli *et al.* (2000), who concluded that antibody production against Newcastle disease vaccine was not affected by probiotic. Similarly, Bhagwat *et al.* (2023) conducted a study to evaluate the effect of dietary synbiotic formulation with phytoactives (SFP) at the rate of 100g and 150g per ton of feed on growth performance in broiler chickens. Results revealed that NDV antibody titre was not affected by supplementation of varying levels of synbiotics (p>0.05). Rehman *et al.*, (2020) observed that Antibody titer for infectious bursal disease (IBD) was improved (P= 0.026) by the interaction effect between probiotics and prebiotics, when compared with the control group, whereas, Panda *et al.* (2000) found that the addition of synbiotics to broiler diets resulted in higher antibody titers against IBD. According to the study conducted by Bhagwat *et al.* (2023), reported that supplementation of synbiotic in the basal diet of broilers had significantly increased titre against IBD (P<0.05) compared to the control group. However, findings of IBD titer were against the results of Awad *et al.* (2015) who found that antibody titer was decreased by the supplementation of synbiotics. Silva *et al.* (2009) stated that the supplementation of synbiotics did not affect the antibody titer against IBD.

Effect of synbiotic on serum biochemical profile: Serum biochemical parameters evaluated in poultry after treatment with synbiotics typically include triglyceride, cholesterol, albumin, globulin, total serum protein, glucose and uric acid. These parameters are important to evaluate the impact of synbiotics on the poultry's health and metabolic status. Triglycerides provide a measure of fat metabolism while cholesterol can give an indication of lipid levels; both are used as indicators of dietary health. Albumin and globulin act as carriers for proteins in the bloodstream while total serum protein is indicative of overall wholesomeness. Glucose levels allow for assessing carbohydrate regulation and uric acid tracks inflammation in tissues and organs. These parameters serve as useful biomarkers to assess how well treatments with synbiotics are working to maintain or improve poultry health. According to Abdel-Hafeez *et al.* (2017) synbiotic did not affect serum total protein, albumin, globulin, and glucose in comparison with control groups. Similarly, Alkhalf *et al.* (2010) reported that supplementing broiler diet with probiotic, prebiotic or synbiotic did not have any effect on total protein, glucose, albumin, and globulin. Another study conducted by Śliżewska *et al.* (2020) evaluate the effect of three synbiotic preparation comprised three, four or five strains of *Lactobacillus sp*., respectively, as well as *S. cerevisiae* and inulin on serum biochemistry of broiler chickens. Result indicated that all measured biochemical parameters- total protein, albumin, uric acid, triglyceride and glucose concentration were in the normal ranges for poultry. In addition, diets containing synbiotic had no significant effect on total serum protein (Ashayerizadeh *et al.*, 2011; Erdoğan *et al.*, 2010), plasma glucose (Ghasemi *et al.*, 2014; Kazemi-Bonchenari *et al.*, 2013); albumin (Kazemi-Bonchenari *et al.*, 2013). 1.5 g/kg synbiotic substantially increased blood glucose but decreased cholesterol (p<0.05). Serum total protein and uric acid also decreased in the all dietary levels of synbiotic compared to control group (P<0.05). However, Dev *et al.* (2020) reported that synbiotic supplemented group had significantly lower serum glucose and triglyceride levels (**P <** 0.01) compared with control group. In a study Ashayerizadeh *et al.* (2011) found enhanced serum cholesterol level in broiler chickens in response to synbiotics supplementation and Sharifi *et al.* (2011) also reported better cholesterol picture in broiler chickens when synbiotic was given in the diet. Additionally, when animals consumed a diet containing probiotics and prebiotic in combined form, there was a significant decrease in total cholesterol level (Ademola *et al.*, 2004). Liong *et al.* (2007) presented that the use of synbiotic consumption in broilers decrease cholesterol levels. According to Abdel-Hafeez *et al.* (2017) concluded that serum total cholesterol was significantly decreased in comparison with control groups with the inclusion of synbiotic in the basal diet. Similarly, Ghasemi *et al.* (2014) reported that synbiotic supplementation was significantly decreased (P< 0.05) the plasma triglyceride and cholesterol levels at 42 days. Another study conducted by Tang *et al.* (2017) to evaluate the effect of synbiotic at the rate of 0.2% in layer. Result indicated that inclusion of synbiotic had decreased (P < 0.05) the serum total cholesterol at 36 weeks of age. In a study Khalil *et al.* (2021) investigated the effects of selected commercial probiotics (Promax) and synbiotics (Bio-lux) at a dose rate of 1 g/L and 1.2 g/L respectively through drinking water on blood-biochemical parameters in broiler chickens. Result indicated that Serum total cholesterol (TC) and triglycerides (TG) level were significantly lower in the synbiotics (Bio-lux) supplemented group than in the control and probiotic groups. Another study conducted by (Dev *et al.*, 2020) evaluate the effect of synbiotic consists of Lactobacillus acidophilus (LBA) and mannan-oligosaccharides (MOS) supplementation on the serum biochemistry of broiler chickens. Results indicated that synbiotic supplemented group had significantly lower serum total cholesterol levels (**P <** 0.01) compared with control group.

CONCLUSION

Research indicates that administered synbiotics have advantageous outcomes for the health of animals, including enhanced growth, intestinal morphology, carcass characteristics, blood indicators, and protection from microbes. Synbiotics are steadily becoming favored in animal husbandry due to their potential advantages in bringing about superior results than singular components. However, further study is required to understand how to use synbiotics commercially in animal science. It requires examining their preventive and therapeutic effects, ascertaining appropriate dosages and treatment periods, and determining the ideal synbiotic concoctions.

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