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Abstract

Gastrointestinal Microflora Homeostasis, Immunity and Growth Performance of Rabbits Supplemented with Innovative Non-Encapsulated or Encapsulated Synbiotic †

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Abstract: Synbiotics are a mixture of probiotics (live microbes) and prebiotics (nutrients for intestinal microbiota—soluble fibers, polyphenols, and polyunsaturated fatty acids) that are now being considered important tools to help in maintaining animals in good health. Synbiotics may improve animal health through different effects. Synbiotics can modulate the gastrointestinal microbiota community in favor of beneficial intestinal and cecal microorganisms, improve immune system functions, and provide specific active molecules that can improve the digestion of feed and absorption of nutrients. Achieving adequate efficiency of the synbiotic products depends on maintaining probiotic survival and prebiotic stability against processing, storage, and gastrointestinal conditions. The development of nano-encapsulation technique facilitates the protection of live microorganism as well as the controlled and sustained release of bioactive molecules. In this study, the synbiotic, fabricated to be used as a dietary supplement for growing rabbits, consisted of *Saccharomyces cerevisiae* yeast (SCY) and *Moringa oleifera* leaf extract (MOLE) encapsulated, or not, with alginate nanoparticles. Sixty-four, 40-day-old, growing rabbits were equally allocated into four groups, receiving per each kg diet: non-capsulated 11×10^{12} SCY + 0.15 g MOLE (NCS), encapsulated 5.5×10^{12} SCY + 0.075 g MOLE (LCS) encapsulated 11×10^{12} SCY + 0.15 g MOLE (HCS), or no synbiotic (control). The treatments continued for six consecutive weeks, from 40 to 82 days of age. During the experimental period, growth performance variables including body weight (BW), feed consumption, BW gain, and feed conversion ratio were recorded weekly. At the end of the treatment, at 82 days of age, blood samples and intestinal and cecal samples were individually collected from six randomly selected rabbits. Also, in vitro gastrointestinal system simulation was used to test the survival of the yeast cells through the gastrointestinal tract. Results revealed that the encapsulation process significantly improved yeast survival against gastric and intestinal digestion. Compared to the control, NCS and LCS treatments, the HCS treatment increased the number of intestinal and cecal yeast cells ($p < 0.05$) and lactobacillus bacteria ($p = 0.062$) and decreased the number of salmonella ($p < 0.05$) and coliform ($p = 0.08$) bacteria. Rabbits treated with HCS had the highest ($p < 0.05$) phagocytic activity, lysosomal activity, and lowest serum concentrations of immunoglobulin E and malondialdehyde compared to the control, NCS and LCS treatments. The HCS treatment significantly improved body weight gain and feed conversion ratio compared to control treatment, while the NCS and LCS treatments showed intermediate values. In conclusion, the encapsulation process improved the efficiency of the innovative synbiotic. The high dose of encapsulated synbiotic adjusted gut microflora constitutes and boosted the immunity and growth performance of rabbits during the fattening period. These positive effects on immunity and growth performance are mostly

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related to the prevalence of beneficial intestinal and cecal microorganisms, indicating the opportunity of using synbiotics, specifically in an encapsulated form, as antibiotic alternatives. These findings pave the way towards more sustainable animal production, ensuring the maintenance of adequate animal health while excluding the hazards of antibiotics use and their related risks to the health of humans and animals.

Keywords: nano-encapsulated synbiotic; growing rabbits; gut microflora; immunity; antioxidant; growth

Supplementary Materials: The following are available online at www.mdpi.com/2504-3900/73/1/5/s1, poster presentation.