EFFECTS OF SYNBIOTIC SUPPLEMENTATION OF HIGH FIBRE DIET ON GROWTH PERFORMANCE, INTESTINAL MICROBIAL ECOLOGY, JEJUNAL HISTOMORPHOLOGY AND CARCASS CHARACTERISTICS OF BROILER CHICKENS

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This is to certify that this research project titled "Effects of Synbiotic Supplementation of High Fibre Diet on Growth Performance, Intestinal Microbial Ecology, Jejunal Histomorphology and Carcass Characteristics of Broiler Chickens was carried out by Miss. Agboola, Nihinyo Bosede under my supervision in partial fulfillment of the requirements for the award of the degree of Master of Science (M. Sc.) in Animal Science, Obafemi Awolowo University, Ile-Ife, Nigeria.

_____ _____

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DEDICATION

This thesis is dedicated to the ALMIGHTY God through our LORD Jesus Christ, the author and the finisher of our faith.

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ABSTRACT

This study determined effect of synbiotic supplementation on growth performance and carcass quality of broiler chickens fed high fibre diets and to evaluate the effects of synbiotic on intestinal microbial ecology and jejunal histomorphology of broiler chickens fed this diet with a view to establishing the beneficial effect of synbiotic supplementation in high fibre diet on broiler chickens.

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. A total of three hundred and twenty (320) three-week old Arbor acre chicks were used for the research consisting of eight treatments (T_1- T_8) replicated four times and ten birds per replicate. The experimental design was a 2x2x2 factorial arrangement, consisting of two agro-industrial by-products at two inclusion levels with and without synbiotic (containing mannan oligosaccharide and *Saccharomyces cerevisae*) supplementation. The synbiotic was supplemented at 1g/kg of feed at the expense of maize and birds on T_1-T_4 received wheat offal based diet at 20% (without synbiotic), 20% (with synbiotic), 40% (without synbiotic) and 40% (with synbiotic) respectively while while T_5-T_8 received palm kernel cake based diet at 20% (without synbiotic), 20% (with synbiotic), 40% (without synbiotic) and 40% (with synbiotic) respectively. At the end of the five-week study, three birds with weight representative of each treatment were selected and slaughtered for carcass characteristics and evaluation of jejunal histomorphology and microbial ecology in small intestine and caecum.

Birds fed diets supplemented with synbiotic did not differ *($P>0.05$)* in feed intake from the non-supplemented group and supplementation decreased *($P<0.05$)* final body weight (FBW), daily

weight gain (DWG) and increased feed conversion ratio. In terms of fibre sources, birds fed wheat offal based diets (WO) had higher *(P<0.05)* feed intake than those fed palm kernel cake (PKC) based diets but did not translate to significant change in body weight gain. Relative weights of breast, wings, thigh and drumstick were not affected (*P>0.05*) by synbiotic supplementation. Synbiotic supplementation had negative effect (*P<0.05*) on nutrient digestibility except crude ash. Birds fed WO had higher *(P<0.05)* dry matter digestibility compared to those fed PKC. Birds fed 20% fibre ingredient had higher *(P<0.05)* nutrient digestibility values than those fed at 40% inclusion level. Birds fed synbiotic supplemented diets had higher *(P<0.05)* colony count of enterobacteria in ceaca and *E. coli* in both ceaca and small intestine than the non-supplemented group. Birds fed WO had higher *(P<0.05)* enterobacteria, *E. coli* and *Lactobacillus spp.* counts in ceaca and small intestine compare to those fed PKC based diet. Birds fed diets without synbiotic had higher (*P<0.05*) villi height, crypt depth, and full mucosal in the jejunum than the birds fed diets supplemented with synbiotics. Birds fed WO had increase (*P<0.05*) in crypt depth and sub-mucosal than those fed PKC. Birds fed high levels of fibre diet had increased (*P<0.05*) villi height, crypt depth and villi:crypt ratio.

The study concluded that synbiotic supplementation of high fibre diet had a negative effect on the overall performance of broiler chickens.

CHAPTER ONE

INTRODUCTION

The interest of previous researches into utilization of high fibre diets as an alternative to low fibre diets in poultry industry was as a result from the high prices of these conventional feedstuffs. However, these agro-industrial by-products consist of plant tissues such as lignin, hemicellulose and cellulose which are resistant to enzymatic digestion in the small intestine of poultry birds thus resulting in poor performance of the birds. In some studies conducted on the inclusion of agro-industrial by-products in broilers diet supplemented with antibiotics as antimicrobial growth promoters, it was reported that antibiotics enhanced the utilization of fibrous feedstuffs which are poorly digested by birds (Onifade and Odunsi, 1998).

Antibiotics are chemical substances derived initially from certain fungi, bacteria, and other organisms that can inhibit the growth of, and even destroy, harmful microorganisms (Davey, 2000). Antibiotics have therefore been used over decades both in prophylactic doses and as antimicrobial agents in poultry industry to prevent and control endemic and zoonotic pathogens in livestock. Numerous studies have reported that growth enhancement properties of antibiotics are closely related to interactions with the microbes in the gut. Antibiotics as antimicrobial growth promoters can help control diseases by selectively modifying and improving the gut microflora, reducing bacterial fermentation and preventing infectious diseases, thus increasing nutrient availability for the animal and improve growth performance (Dibner and Buttin, 2002; Hernández *et al*., 2006).

However, the use of antibiotics as growth promoter has come under scrutiny because of its contribution to bacterial resistance, drug residues (Dipeolu *et al*., 2002; Dipeolu *et al*., 2004)

and high lipid (fat) content in animal products (Lipstein *et al*., 1975), which are health hazards in both animals and humans. There is therefore increased interest in prebiotics, probiotics, phytobiotics, synbiotics, essential oils and organic acids. These bio-therapeutic agents have been shown to significantly increase feed efficiency and improve health status of livestock without any negative effects in animals or humans (Ezema, 2007).

A prebiotic is a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, thus improves health (Gibson and Roberfroid, 1995). Prebiotics are assumed to be non-digestible by human or animal digestive enzymes, thus they serve as substrates for beneficial bacteria mainly located in the hind gut. Steiner (2006) reported that prebiotics may enhance the digestibility and performance parameters by creating the favourable conditions for beneficial bacteria.

Simon (2005), defined probiotics 'as viable micro-organisms, which after sufficient oral intake, lead to beneficial effects for the host by modifying the intestinal microbiota'.Direct-fed microbial (DFM) or probiotics as a means of maintaining gut health, controls endemic and zoonotic agents in poultry (La Ragione and Woodward, 2003). The antagonistic activity of DFMs towards the pathogens can be attributed to the production of bactericidal substances, including bacteriocins and organic acids.

Bacteriocins are active proteinaceous substances produced by a variety of Gram-negative and Gram-positive bacteria that have a bactericidal action (Tagg *et al*., 1976). The bactericidal properties of DFMs are species specific and have been considered as antibiotics with a narrow bacterial-host range of activity. They exert their lethal activity through adsorption to specific receptors located on the external surface of sensitive exogenous bacteria, followed by metabolic,

biological and morphological alterations resulting in the killing of bacteria (Daw and Falkiner, 1996; Jin *et al*., 1997).

A synbiotic is, in its simplest definition, a combination of probiotics and prebiotics in a single preparation (Collins and Gibson, 1999). This combination could improve the survival of the probiotic organisms, because its specific substrate is available for fermentation. This could therefore results as an advantage to the host through the availability of the live microorganisms and the prebiotic. Sherief *et al.* (2012), concluded that synbiotic containing mannan oligosaccharide and *Saccharomyces cerevisae* in broilers' diets yielded greater probiotic effect and improved growth performance, intestinal microbial ecology, histomorphology and the overall health of broiler chickens.

1.1 Justification of Study

Though previous researches have established that in-feed antibiotics growth promoters enhanced the utilization of high fibre diets but the continuous use of antibiotics as growth promoter has come under close scrunity in the poultry industry. The probable beneficial effect of synbiotic has not been systematically investigated in high fibre diets based on palm kernel meal and wheat offals in broilers. There is therefore the need to investigate the efficacy of this feed additive on fibre digestibility.

1.2 Research Hypothesis

Research hypothesis of this study states that synbiotic supplementation (containing *Saccharomyces cerevisae* and mannan oligosaccharide) of high fibre diet would improve overall performance of Broiler chickens.

1.3 Objectives of Study

The objectives are

(a) to determine the effects of synbiotic on growth performance and carcass quality of broiler chickens fed high fibre diets; and

(b) to evaluate the effects of synbiotic on intestinal microbial ecology and jejunal histomorphology of broiler chickens fed high fibre diets.