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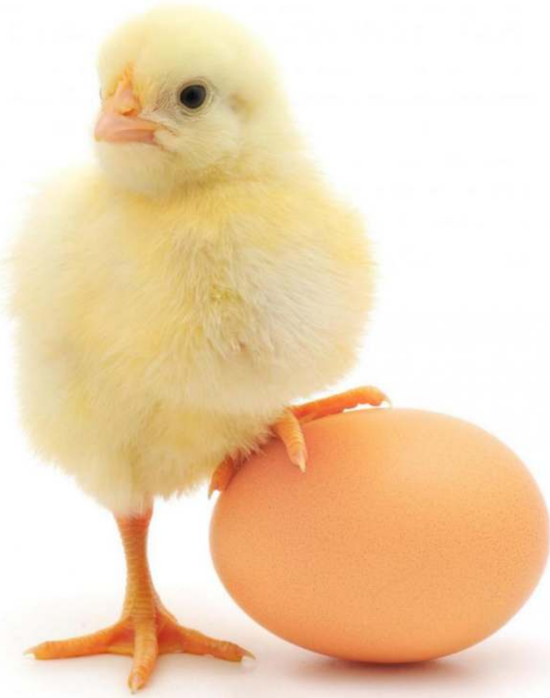

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Effect of Phase Feeding Supplemental Fungus Myceliated Grain on Oocyst Excretion and Performance of Broiler Chickens

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Abstract: An experiment was conducted to investigate Fungus Myceliated Grain (FMG) feed inclusion strategies for broilers and the effects of this feed on natural *Eimeria* oocyst excretion and bird performance. Two hundred ninety-four straight-run day-of-hatch broiler chicks were obtained from a local commercial hatchery and randomly distributed in seven treatment groups with three replications of 14 chicks as follows: 1) Control-No FMG; 2) 5% FMG-starter feed; 3) 5% FMG-grower feed; 4) 5% FMG-starter, grower, finisher feed; 5) 10% FMG-starter feed; 6) 10% FMG-grower feed and 7) 10% FMG starter, grower, finisher feed. Fecal oocyst count, mortality, live body and bursa weight were determined at the end of the 7 wk trial. Results showed that broilers in treatments 1 and 2 produced the highest counts of *Eimeria*, which was significantly higher than that of treatment 6 ($p<0.05$) with the lowest count of *Eimeria*. Mortality was not significantly influenced by treatments. There were significant differences in the live and bursa weights, but not in the relative bursa percent. The results suggest the best response in terms of anticoccidial protection occurs with the 10% inclusion in the growers feed and for body weight at the 5% inclusion level in the starter feed.

Key words: Broilers, fungus myceliated grain, *Eimeria*

INTRODUCTION

Feed supplements with natural medicinal products have been widely used as growth and health promoters in farm animals in China for years (Li, 1998). The mushroom is a macrofungus with a distinctive fruiting body large enough to be seen with the naked eye and with over 2,000 species that possess medicinal properties (Chang and Miles, 2004). Many substances with immunomodulating effects have been found in mushrooms. Most medicinal mushrooms contain biologically active polysaccharides, glycoproteins and other valued substances. There is little doubt that mushroom-based products can serve as good dietary supplements. It is still up in the air exactly how these products work, but with the heightened interest around the world, the answers are forthcoming soon. Many achievements in medicinal mushroom research have occurred recently, with positive findings in the health care arena for both humans and animals. For example, Selegean *et al*. (2009) utilized the polysaccharide containing extracellular fractions from the edible mushroom *Pleurotus ostrentus* at different levels to help poultry vaccines stimulate the immune system against the infectious bursal disease virus during the critical first two weeks post hatching.

Chickens are generally given drugs in their feed to prevent the intestinal disease known as coccidiosis, which occurs worldwide and is caused by protozoan parasites of the Genus *Eimeria*. It is considered to be one of the most economically important poultry diseases. These protozoa develop resistance to standard drugs while invading the cells of the chickens' intestines, thereby making it hard for the chicks to absorb feed, with negative consequences for weight gain. Each year, poultry producers in the United States raise more than 7 billion broiler chickens. Many of these broilers develop avian coccidiosis, which costs these poultry producers between $450 million annually (Allen and Fetterer, 2002) and $1.5 billion (Yun *et al*., 2002). As a consequence of drug resistance, new advancements such as live oocyst vaccinations and inovo-coccivac have been developed and are being utilized in the poultry industry. During the past several years, researchers who have been investigating various natural products have found many that have potential for use as dietary supplements for coccidiosis control. Therefore, it is important to continue seeking natural alternatives and ways to utilize them for health enhancement in chickens and other animals. The aim of the present study was to investigate the effect of phase feeding Fungus Myceliated Grain (FMG) at two different levels on fecal oocyst excretion and performance in broiler chickens.

MATERIALS AND METHODS

Birds and experimental design: A total of 294 day-of-hatch Ross x Ross straight-run broiler chicks were obtained from a local commercial hatchery and fed Fungus Myceliated Grain (FMG). The chicks were

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randomly assigned to 7 treatments as follows: 1) Control-No FMG; 2) 5% FMG-starter feed; 3) 5% FMG-grower feed; 4) 5% FMG-starter, grower, finisher feed; 5) 10% FMG-starter feed; 6) 10% FMG-grower feed and 7) 10% FMG-starter, grower, finisher feed. Each treatment occurred in 3 replicated 1.524m x 3.657m floor pens with 14 chicks each. The chicks were fed a basal mash starter, grower and finisher diet free of drugs or medication (Table 1). The diets were formulated to meet or exceed the nutrient requirements for broilers as recommended by the National Research Council (1994). The phase diets were supplemented with 0, 5, or 10 percent fungus myceliated meal and fed to chicks housed on used litter during their respective stage of development. The chicks were started at 35°C and the temperature was reduced weekly until reaching 25°C. During the course of the 49 d experiment, continuous lighting was provided with a reduction in intensive level starting at 3 wk. Feed and water were provided *ad libitum* and the trial was performed according to the guidelines established by the Institutional Animal Care and Use Committee. All chicks were vaccinated at the commercial hatchery for infectious bronchitis, Newcastle and Marek's diseases. No form of coccidiosis protection was provided at the hatchery or at the research farm to the chicks.

Table 1: Composition of the basal diets

	Amount		
Ingredients	Starter	Grower	Finisher
Corn	1167.00	1324.00	1410.00
Soybean meal	716.00	563.00	478.00
Corn micro-flush	19.94	20.73	20.30
Limestone fine	19.42	20.40	21.37
Dicalcium phosphate (18.5%)	41.77	36.92	31.47
Lysine (78.5%)	0.01	1.26	4.27
Methionine (99%)	3.80	2.67	2.01
Threonine	1.06	0.02	1.58
Salt	10.00	10.00	10.00
PX NCSU Br mineral (TM90)	4.00	4.00	4.00
Choline chloride (60)	4.00	4.00	4.00
PX NCSU Br Vitamin (NCSU90)	1.00	1.00	1.00
Selenium premix NCSU (0.02%)	2.00	2.00	2.00
Poultry fat (Miter)	10.00	10.00	10.00
Total batch weight	2000.00	2000.00	2000.00

Fungus myceliated grain preparation: Sorghum grain was soaked in water overnight, drained and 5 kg each were loaded in micropore fitted bags (PPB75/ SEH61X38-57, Microsac, Belgium) and sterilized at 121°C for three hours, then inoculated with shiitake (*Lentinula edodes*) and incubated at 25°C for 2 wk before use. The resulting fungus myceliated grain substrate was processed by sun drying for approximately 6-12 h and ground for inclusion supplementation into the basal feed.

Fecal oocyst recovery and count: A total of 2 chickens per treatment replication (n = 6) were removed from floor litter pens at 49 d of age and placed in individual wire cages. Fecal samples were collected the following day into 25 ml plastic tubes and transported to the laboratory, ground, homogenized and diluted. The oocysts were counted using a McMaster counting chamber (Hodgson, 1970).

Statistical analysis: Statistical analysis was carried out using SPSS version 17 (SPSS Inc). The Duncan Multiple Range Test (DMRT) was used to establish the source of the variation at a = 0.05.

RESULTS AND DISCUSSION

The results of *Eimeria* counts after 7 wk are presented in Table 2. The chickens exposed to treatment 6 had the lowest counts of *Eimeria*, although these were not significantly different from those of treatments 3, 4, 5 and 7 ($p>0.05$). Treatments 1 and 2 had the highest counts of *Eimeria*, which were significantly higher than that of treatment 6 ($p<0.05$).

The differences in the counts of *Eimeria* did not appear to negatively affect the weights of the male chickens because; we observed that treatment 2 produced the highest weights. In addition, there were no significant bursa/live weight ratio differences in all the treatments ($p>0.05$). The 10% inclusion in the grower phase treatment resulted in the lowest *Eimeria* oocyst count of all treatments. Conversely, the 5% inclusion at the starter phase resulted in the highest oocyst count, thus demonstrating the importance of protection during the phase in the production cycle when coccidiosis peaks.

Table 2: *Eimeria* counts, live and bursa weights of broilers on d 49

Treatments	Eimeria oocyst counts	Live weight (kg)	Bursa weight (g)	Bursa/live ratio (%)
Control-No FMG	9100.00±2907.89bc	2.77±0.09ab	4.71±0.18ab	0.17±0.00a
5% FMG-Starter feed	14200.00±5692.98c	2.92±0.07b	4.70±0.81ab	0.16±0.03a
5% FMG-Grower feed	2383.33±1245.44ab	2.83±0.15ab	5.43±0.98ab	0.19±0.03a
5% FMG-Starter, grower, finisher feed	3100.00±894.89ab	2.81±0.11ab	6.06±0.66b	0.22±0.02a
10% FMG-Starter feed	6166.67±855.92abc	2.50±0.05a	3.84±0.65ab	0.16±0.03a
10% FMG-Grower feed	116.67±16.67a	2.63±0.17ab	3.53±0.63a	0.13±0.02a
10% FMG-Starter, grower, finisher feed	1266.67±93.80ab	2.75±0.11ab	3.92±0.93ab	0.14±0.04a

Values represented in the table are the mean ± standard error. Means with the same letters are not significantly different according to the Duncan Multiple Range Test ($p>0.05$)

Interestingly, the 10% FMG inclusion suppressed bursa and live body weights numerically and statistically when compared to some treatments. The reason is not clear but in previous studies, the administration of mushroom extracts in the water for extended periods of time decreased body and bursa weights (Willis *et al.*, 2007). During the past several years, some researchers have been investigating the anticoccidial activities of various natural products that have potential use as dietary supplements. For instance, Dalloul *et al.* (2006) demonstrated that lectin extracted from the mushroom *Fomitella fraxineo* can be an effective growth promoting and immunostimulating agent in poultry during coccidiosis. In another study, some mushroom extracts were shown to have immunoenhancing potential in chickens experiencing coccidiosis (Guo *et al.*, 2004). Recent work with other mushrooms has shown *in vivo* protective effects against *E. tenella* infection (Ogbe *et al.*, 2009). The results from one study showed that treatment with *Ganoderma lucidum* resulted in a marked reduction in the number of *Eimeria tenella* oocysts shed in the faeces, leading to improved weight gain.

The basis for this research design is to provide fungus myceliated grain at different levels and times for immunomodulatory help during critical times in the production cycle and for economical reasons to reduce the cost of providing this product to the chickens. The purposes of this study are to examine the immunomodulatory effects of FMG administered at different levels and times in the production cycle and to find the most economical method for doing so. Sorghum grain is the dietary base for broiler rations in many parts of the world and is readily available and the bioactive properties of fungus myceliated sorghum grain help reduce susceptibility to infections and diseases. Based upon the results of this study, it can be concluded that supplementing feed with fungus myceliated grain can reduce fecal shedding of oocysts without compromising other performance traits and that the costs of utilizing such an alternative anticoccidial control can be reduced through phase feeding.

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