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Effect of Either Powder or Encapsulated Form of Garlic and *Phyllanthus niruri* L. Mixture on Broiler Performances, Intestinal Characteristics and Intestinal Microflora

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Abstract: Effect of the mixture of garlic and *Phyllanthus niruri* L. in either powder or encapsulated form on broiler performances, intestinal characteristics and intestinal microflora were investigated. One hundred ninety two 1-day-old Lohmann broiler chicks were subjected to 8 different dietary groups, namely 2 forms of phytobiotic (non-encapsulated powder and encapsulated) and 4 levels of inclusion (0, 0.4, 0.8 and 1.2%). Data were then analyzed by two-way Nested of Completely Randomized Design ANOVA and if there was significant effect followed by Duncan's Multiple Range Test. The results showed that combination of garlic and *Phyllanthus niruri* L. in encapsulated form improved ($P<0.05$) BWG and IOFC of broilers, though with almost no changes in intestinal characteristics and intestinal microflora. Increasing levels of garlic and *Phyllanthus niruri* L. combination from 0 to 1.2% in encapsulated form did not significantly improve broiler performances and intestinal microflora, though they tended to increase ($P<0.01$) viscosity. It is concluded that the use of combination of garlic and *Phyllanthus niruri* L. in encapsulated form performs better than the combination of garlic and *Phyllanthus niruri* in powder. It is suggested to use 0.8% encapsulated of combination of garlic and *Phyllanthus niruri* in broiler diet.

Key words: Garlic, *Phyllanthus niruri* L., powder, encapsulated, broiler

INTRODUCTION

Feed cost contributes 60-80% of production cost in a common broiler farm. Effort to improve feed efficiency in order to reduce feed cost could be achieved by the use of feed additives such phytobiotic, enzymes, probiotic, acidifier etc. One of the feed additives currently under investigation is herbs (garlic and *Phyllanthus niruri* L.) which is intended to reduce feed cost by improving feed efficiency. Phytobiotic could be used to serve as feed additives due to their suitability and preference, lower cost of production, reduced risk of toxicity, minimum health hazards and environment friendliness (Devegowda, 1996). Recent research works on herbs/phytobiotic as feed additive have shown encouraging results with regards to weight gain, feed efficiency, intestinal microba, intestinal morphology, lowered mortality and increased liveability in poultry (Kumar *et al*., 2010; Isabel and Santos, 2009; Zhang *et al*., 2009; Garcia *et al*., 2007; Durrani *et al*., 2006).

Dietary garlic supplementation 5, 000 mg/kg did not significantly influence the final live weight, feed intake, weight gain feed conversion ratio, carcass and organ characteristics in broiler chickens (Onibi *et al*., 2009). Addition 1 and 3% garlic significantly increased body weight gain as compared with 0.5% garlic supplemented groups (Raeesi *et al*., 2010). Manjrekar *et al*. (2008) reported that *phyllanthus niruri* L. has anti-oxidant and hepato-protective activity with associated deleterious effects on kidney and testes. *Phyllanthus niruri Linn* extract as a natural medicine is used to increase cellular and humoral immunity (Patria *et al*., 2006).

Sarkar *et al*. (2005) reported that the curative role of *phyllanthus niruri* L. against nimesulide induced hepatic disorder is probably due to its antioxidant properties. It is likely that the active ingredients of the herb might be able to subside the side effects of this anti-inflammatory drug Garlic and *Phyllanthus niruri* L. processed into powder form for practical use as an additive in poultry feed but the alleged efficacy effects of garlic and *Phyllanthus niruri* L. are present in active compounds and essential oils did not appear. This is due to the active compounds and essential oils have been lost and damaged by milling and heating. Efficacy of garlic and *Phyllanthus niruri* L. are expected to remain and practical to use and can reach the small intestine, so that the necessary protection encapsulation technology.

Encapsulation technology is usually carried out by employing spray dyer or vacuum oven using temperature above 100°C. This may lead to lost activity of active compounds prior to or during encapsulation process. Alternatively, in this experiment the use of microwave

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oven having lower temperature of 60°C is proposed. The aim of this research was to compare the effect of powder and encapsulated phytobiotic (mixed garlic and *Phyllanthus niruri* L.) in broiler feed on performances, intestinal characteristics and intestinal microflora.

MATERIALS AND METHODS

One hundred and ninety two unsex day old Lohmann broiler chicks from local Hatchery were used with uniform initial body weight of 43.43±3.32 g. They were randomly allotted to 24 experimental units. Each experimental flock unit was of 100x90x70 cm in sizes and used for 8 chicks till 35 days of age, equipped with waterer and feeder and raised on litter floor.

The composition of basal diet used shown in Table 1 were formulated free antibiotics.

The phytobiotic mixture was prepared by mixing garlic and *Phylanthus niruri* L. at ratio 3:1, then BHT (Butylated Hydroxy Toluene) was added 0.075%. Gum arabic and whey in the ratio (4:1) as an encapsulant was added to the 30% mixture and, dried using a microwave oven modification at a temperature of 60°C and equipped with blower.

The experiment was designed based on Nested Completely Randomized Designed with 2 main factors, namely form and level of phytobiotic. The forms comprised of powder and encapsulated forms, while levels of phytobiotic consisted of 0, 0.4, 0.8 and 1.2% of phytobiotic added to the basal diet. Each treatment was repeated three times, with 8 chicks each. Feed and water were given *ad libitum* till 35 days of age.

The performances measured included Feed Consumption (FC), Body Weight (BW), Feed Conversion Rate (FCR), Carcass Percentage (CP) and Income Over Feed Cost (IOFC). The jejunal pH and viscosity were measured based on Piel *et al*. (2005). The number and length and crypt depth of villi were observed based on Garcia *et al*. (2007) and Tekeli *et al*. (2010). The ileum, defined as the region from Meckel's diverticulum to a point 40 mm proximal to the ileocecal junction, was dissected and the contents were collected by gently flushing with NaCl Physiologis solution. Samples of ileum (40 mm segments) were obtained at its midpoint and immersed Into bottle with 10% formalin solution for morphological analysis. Two portions per sample were cut perpendicular to the longitudinal axis of the intestine and embedded in paraffin wax. Transverse sections were cut (3 μm), stained by hematoxylineosin and analyzed under a light microscope DIC Olympus BX51TF to determine morphometric indices by using cyto vision software. The morphometric variables measured included villus height, crypt depth and villus number at the top and the base. While Lactic acid bacteria. *Escherichia coli* and *Salmonella* sp. were identified based on Gariga *et al*. (1998).

Data were then analyzed by two-way Nested of Completely Randomized Design ANOVA and if there was significant effect followed by Duncan's Multiple Range Test (Steel *et al*., 1980).

Table 1: Composition of basal diet used

Feedstuffs	Starter (%)	Finisher (%)
Ingredient (%)		
Yellow corn	53.8	52.09
Soybean meal	20.6	17.86
Polished rice	0	10
Meat and bone meal	5	5
Fish meal	10	10
Copra meal	5	0
Coconut oil	3.97	3.65
Salt	0.24	0.13
DL methionine	0.19	0.07
Filler	1.2	1.2
Analyzed composition, DM (%)		
Metabolizable energy (Kcal/kg)	03.054	03.106
Crude protein (%)	22.89	21.57
Crude fiber (%)	3.74	3.18
Crude fat (%)	6.51	7.77
Ash (%)	7.25	9.1
Lysine (%)	1.12	1.02
Methionine (%)	0.49	0.36

RESULTS AND DISCUSSION

Effect of garlic and *Phyllanthus niruri* L. mixture form on broiler performance: The effects of garlic and *Phyllanthus niruri* L. mixture in either powder or encapsulated form on broiler performances, intestinal characteristics and intestinal microflora were summarized in Table 2.

Encapsulated garlic and *Phyllanthus niruri* L. mixture significantly improved (P<0.05) BWG and IOFC. The forms of garlic and *Phyllanthus niruri* L. mixture did not significantly affect FC, FCR, CP, viscosity, villi number, villi length and digestive microbial population. The comparative results between powder and encapsulated garlic and *Phyllanthus niruri* L. mixture used in broiler

Table 2: Effects of powder or encapsulated garlic and *Phyllanthus niruri* L. mixture on broiler performances. intestinal characteristics and intestinal microflora

	Treatments	
Variables	Powder	Encapsulated
FC (g/bird)	2.586.73±149.16	2.631.13±133.30
BWG (g/bird)	1.444.20±81.01[a]	1.571.94±85.47[b]
FCR	1.79±0.08	1.68±0.12
CP (%)	65.37±2.36	66.29±1.30
IOFC (IDR*/bird)	10.416±859[a]	11.912±1.144[b]
Viscosity (cp)	4.59±0.10	4.18±0.44
Crypt depth (μm)	131.67±17.49	140.83±18.11
Villi number (per lumen)	111.92±10.99	117.58±8.98
Villi length (μm)	459.67±36.42	535.47±40.38
Lactic acid bacteria (log cfu/ml)	9.26±0.30	9.55±0.46
Escherichia coli (log cfu/ml)	4.57±0.35	4.13±0.60
Salmonella sp (log cfu/ml)	4.24±0.05	4.22±0.08

*IDR: Indonesian rupiah (1US$ = Rp. 9.350)

Phyllanthus niruri L. mixture was more effectively enhancing broiler performances due probably to increasing absorptive surface. Due to better performances of broiler with encapsulated garlic and *Phyllanthus niruri* L. mixture obtained. It might suggest that encapsulation process is able to protect allicin, essential oil and total flavonoid. Further experiment was needed to explain nutrient utilization of broiler fed diet containing encapsulated garlic and *Phyllanthus niruri* L. mixture additive. While essential oil, allicin, phylantin and total flavonoid content of powder form was found to be 0, 437%, 608.63 mg/100g, 22.15 mg/100g and 0, 269%, respectively. Furthermore, essential oil, allicin, phylantin and total flavonoid content of encapsulated form was found to be 0, 624%, 720.40 mg/100g, 97.80 mg/100g and 0, 272%, respectively. Onu (2010) reported that broilers fed garlic, ginger and garlic and ginger mixture supplemented diets recorded the better body weight gain, FCR than broilers fed the control diet. *Origanum virens* L. encapsulation was achieved by immersion of the aggregates in the essential oil (Ribeiro *et al*., 2004). Kadam *et al*. (2011) reported that the degradation of ginger oil is higher at the elevated temperature due to gum Arabic is successful in encapsulating ginger oil.

The effect of levels of garlic and *phyllanthus niruri* L. mixture in powder form on broiler performances, intestinal characteristics and intestinal microflora: The effects of garlic and *Phyllanthus niruri* L. mixture addition in powder form on broiler performances. intestinal characteristics and intestinal microflora were summarized in Table 3.

Although increasing levels of garlic and *phyllanthus niruri* L. mixture in powder form tended to increase BWG ($P<0.05$) and to decrease ($P<0.01$) viscosity, levels of garlic and *Phyllanthus niruri* L. mixture in the diet did not significantly change crypt depth, villi number, villi length and intestinal microflora. Onibi *et al*. (2009) reported that supplementary garlic in the diets of broilers did not influence significantly ($P>0.05$) BWG, carcass and organ weights. Sarica *et al*. (2005) reported that an antibiotic growth promoter (flavomycin) and two herbs natural feed additives (thyme and garlic) with and without a xylanase-based enzyme complex had no significant effect on growth performance and the concentrations of total aerobic bacteria and *E. coli* in the small intestine when incorporated into wheat-based broiler diets Onu (2010) reported that ginger and garlic supplementation at 0.25% in broiler finisher diets enhanced the growth rate and feed conversion ratio of the birds.

In this experiment, garlic and *Phyllanthus niruri* L. mixture of 1.2% improved BWG and reduced intestinal viscosity indicating its ability to reach the small intestines in significant amount.

The effect of levels of garlic and *Phyllanthus niruri* L. mixture in encapsulated form on broiler performances, intestinal characteristics and intestinal microflora: The effects of garlic and *Phyllanthus niruri* L. mixture addition in encapsulated form on broiler performances, intestinal characteristics and intestinal microflora were summarized in Table 4.

Although increasing levels of encapsulated garlic and *Phyllanthus niruri* L. mixture in the diet tended to significantly increase BWG ($P<0.05$) and villi length ($P<0.01$) and non pathogenic bacteria (Lactic acid bacteria) and to decrease ($P<0.01$) viscosity and pathogenic bacteria (*Escherichia coli*), levels of encapsulated garlic and *phyllanthus niruri* L. mixture in the diet did not significantly improve FC, FCR, CP and IOFC.

Kumar *et al*. (2010) reported that addition of Garlic-PRO naturo at 250 ppm to the diets improved body weight and feed conversion efficiency. The results obtained in this experiment also showed that the phytobiotic mixture supplement was able to reduce viscosity and *E. coli* counts in the intestine and increase the villi length in comparison to the control (level of 0%). This may lead to enhance growth performance with optimum improvement at 0.8% of encapsulated garlic and *Phyllanthus niruri* L. It is concluded that the use of

Table 3: Effects of levels of powder garlic and *Phyllanthus niruri* L. mixture on broiler performances. intestinal characteristics and intestinal microflora

	Levels of powder garlic and *Phyllanthus niruri* L. in the diet (%)			
Variable	0	0.4	0.8	1.2
FC (g/bird)	2, 552.96±59.82	2, 529.45±60.71	2, 552.54±238.46	2, 711.97±238.46
BWG (g/bird)	1, 412.19±92.74^{a}	1, 410.76±4.76^{a}	1, 424.24±45.86^{a}	1, 529.63±102.99^{b}
FCR	1.81±0.08	1.79±0.05	1.79±0.14	1.77±0.08
CP (%)	66.17±2.78	64.14±0.96	65.66±3.16	65.53±2.95
IOFC (IDR*/bird)	10, 176±1, 123	10, 189±284	10, 071±1, 078	11, 071±834
Viscosity (cp)	6.20±0.17^{C}	4.17±0.29^{AB}	3.67±0.15^{A}	4.33±0.29^{B}
Crypt depth (μm)	126.67±15.28	130.00±10.00	133.33±15.28	136.67±15.28
Villi number (per lumen)	108.67±12.89	108.33±16.26	112.67±16.07	118.00±12.16
Villi length (μm)	444.56±35.10	469.00±33.98	470.89±59.78	454.22±25.06
Lactic acid bacteria (log cfu/ml)	9.11±0.09	9.30±0.49	9.43±0.39	9.30±0.17
Escherichia coli (log cfu/ml)	4.94±0.11	4.65±0.39	4.36±0.36	4.32±0.06
Salmonella sp. (log cfu/ml)	4.26±0.05	4.25±0.03	4.23±0.01	4.21±0.08

Table 4: Effects of levels of encapsulated garlic and *Phyllanthus niruri* L. mixture on broiler performances. intestinal characteristics and intestinal microflora

	Levels of encapsulated garlic and *Phyllanthus niruri* L. in the diet (%)			
Variable	0	0.4	0.8	1.2
FC (g/bird)	2, 656.77±161.83	2, 630.56±134.15	2, 619.14±202.24	2, 618.07±105.75
BWG (g/bird)	1, 478.32±80.44^{a}	1, 542.57±64.66^{a}	1, 633.52±55.34^{b}	1, 633.33±26.01^{b}
FCR	1.80±0.08	1.71±0.14	1.60±0.08	1.60±0.08
CP (%)	65.89±0.76	66.05±1.15	66.80±2.37	66.41±1.03
IOFC (IDR*/bird)	10, 729±830	11, 574±1, 339	12, 769±444	12, 574±702
Viscosity (cp)	6.40±0.10^{C}	3.27±0.25^{A}	2.87±0.12^{A}	4.16±0.29^{B}
Crypt depth (μm)	130.00±17.32	126.67±11.55	130.00±10.00	176.67±11.55
Villi number (per lumen)	101.67±17.50	114.00±7.00	122.00±13.74	132.67±12.09
Villi length (μm)	458.44±16.06^{A}	499.67±22.84^{A}	535.89±29.93^{A}	647.89±63.91^{B}
Lactic acid bacteria (log cfu/ml)	9.07±0.10^{A}	9.33±0.30^{A}	9.67±0.29^{AB}	10.14±0.04^{B}
Lactobacillus sp. (log cfu/ml)	6.83±0.73	6.87±0.17	7.35±0.35	6.88±0.48
Escherichia coli (log cfu/ml)	4.98±0.09^{B}	4.06±0.46^{A}	3.81±0.45^{A}	3.66±0.14^{A}
Salmonella sp. (log cfu/ml)	4.28±0.17	4.27±0.05	4.19±0.03	4.14±0.05

encapsulated garlic and *Phyllanthus niruri* L. mixture improved performance of broiler and the use 0.8% encapsulated garlic and *Phyllanthus niruri* L. mixture is suggested.

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