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The Effect of Feeding Red Ginger (*Zingiber officinale* Rosc) as Phytobiotic on Broiler Slaughter Weight and Meat Quality

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Abstract: The research aimed to evaluate the potency of Red Ginger (*Zingiber officinale* Rosc) as a source of phytobiotic in the ration to increase physical quality of broiler meat. Two hundred of five days old broiler chickens were plotted into five different groups and each group was further divided into five sub-groups. Each group was given different rations, i.e.: R-0 (control ration without red ginger added); R-0.5, R-1.0, R-1.5, and R-2.0% (control ration added with red ginger at level 0.5, 1.0, 1.5, and 2.0% of the ration, respectively). All rations were designed as iso-protein ration with CP content of 21.0-23.0%, iso-caloric with energy content of 3150 kcal ME/kg, Ca 1.0%, and P 0.5%. The broilers were raised for 5 weeks. After five weeks all broilers were slaughtered and weighed to get data for carcass quality (slaughter weight, carcass weight, carcass percentage, fat weight and fat percentage) and the data of meat physical quality including pH, tenderness, water holding capacity (WHC), cooking loss (CL). The collected data were subjected to analysis of One Way Classification of Completely Randomized Design (CRD) and Duncan's New Multiple Range Test (DMRT). The result showed that broilers given ration with red ginger showed significantly higher slaughter weight ($P<0.05$) and carcass percentage ($P<0.01$) but lower fat weight ($P<0.05$) than broilers given ration without red ginger. Feeding red ginger in the ration as treatment slightly increased pH and tenderness of broiler meat but decreased water holding capacity and cooking loss as compared to those in the control treatment without red ginger in the ration. Feeding of red ginger phytobiotic feed additive increased productive performance, carcass and meat quality of broiler. Feeding the phytobiotic feed additive at level 1.0 to 1.5% looked to be the most optimum level for those purposes. Further researches have to be conducted to evaluate the potential of red ginger as a source of phytobiotic feed additive to replace the chemical antibiotics.

Key words: Zingiber, carcass, tenderness, cooking lost, broiler meat

INTRODUCTION

Broiler chicken is one of the most important animal protein sources for the Indonesian people as the price is relatively achievable even for the poorer people. The growth of broiler chicken is relatively faster with a shorter life cycle compared with other meat-producing livestock. At the age of 5 to 6 weeks, broiler can reach slaughter weight of 1.5 to 2.0 kg. In terms of its quantity, broiler is generally raised in a large number from thousands to hundreds thousand per farm per period of two months per period or six periods per year. Thus, broiler meat production is competitively to supply the demand for meat which increases continuously following the increase of human population and their requirement for high quality food.

However, the use of some chemically based feed additives, such as antibiotics and growth promoters, have been widely applied by broiler industries. These feed additives are used by the poultry industries to improve health and productivity of chicken flocks. These feed additives are effectively used to support such high and very fast growth of broiler. In contrast to their positive impacts, these some feed additives may still remain in the broiler products as residues or there are at least some perceptions among the consumers that broiler meat may contain the residues which may give negative effects on consumer's health problems (Donoghue, 2003). Mumtaz *et al*. (2000) summarized some residues possibly existed in broiler meat, their effects and mechanisms on consumer's health.

For those, an attempt has been done to evaluate the use of naturally available phytobiotics as feed additives in poultry diets to replace the chemically feed additive ones. Although there was still limited number of experiments reporting the potential of phytogenic feed additives, Windisch *et al*. (2008) have reviewed this issue and reported that these last feed additives have similar effects in improving poultry and swine production performance to those shown by antibiotics or other chemical feed additives. It was considered that phytogenic feed additives were as non-antibiotic growth promoters for use in livestock.

Red ginger (*Zingiber officinale* Rosc) is one of natural additive which has been widely used in human's food.

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Table 1: Feed composition and nutrient content of treatment feeds

	Treatment				
Parameters	R-0.0	R-0.5	R-1.0	R-1.5	R-2.0
Feed composition (%)					
Commercial broiler feed (BR-1)	98.00	98.00	98.00	98.00	98.00
Red ginger	0.00	0.50	1.00	1.50	2.00
Filler	2.00	1.50	1.00	0.50	0.00
Total	100.00	100.00	100.00	100.00	100.00
Nutrient content (%)*					
Water	10.81	10.86	10.92	10.97	11.03
Ash	8.15	8.20	8.26	8.31	8.37
Protein	17.83	17.87	17.91	17.95	17.98
Fat	5.54	5.59	5.63	5.68	5.72
Fiber	5.77	5.79	5.82	5.84	5.86
Calcium	1.61	1.61	1.62	1.62	1.62
Phosphor	0.17	0.17	0.17	0.17	0.17

*Analyzed at Food Technology Laboratory and Agriculture, Agriculture Technology Faculty, Gadjah Mada University, Yogyakarta, Indonesia

Red ginger contains many bioactive compounds in the form of volatile oleoresin and gingerol which serves to assist in optimizing the function of organs. It also contains vitamins and minerals which increase the added value of these plants as a nutritious crop species (Rismunandar, 1988). Essential oils in ginger have function as non-inflammation and anti-bacteria agents (Anonymous, 2003; Fuhrman *et al*., 2000).

MATERIALS AND METHODS

The materials used in this research were red ginger flour prepared from red ginger (*Zingiber officinale* Rosc) bought from traditional market Beringharjo-Yogyakarta. Red ginger flour was prepared by washing the ginger under water, then sliced and sun-dried for 1-2 days. Dry ginger was then ground to pass 1 mm screen to get ginger flour. To avoid chemically and microbiology damages, the red ginger flour was stored in impermeable glass tubes.

This research used 200 heads of 5 days old Hubbard Strain broiler chicken produced by PT. Cipendawa Agro Industry Tbk. The chickens were divided into 5 groups, then, each group was further sub-divided into 5 sub-groups as replication. The chickens in each group were given five different feeds as treatment. The feeds treatment were R-0 (as control feed which was commercial broiler feeds (BR-I) produced by PT. Central Proteina Prima, Semarang without red ginger added), then R-0.5, R-1.0, R-1.5, and R-2.0 which were control feed with 0.5%, 1.0%, 1.5%, and 2.0% red ginger added, respectively. All feeds were made as iso-caloric (at 3.150 kcal ME/kg) and iso-proteins (at 17.83-17.98 % CP content) using fine sand as filler or balancer. The composition and nutrient content of feeds used in this research were presented in Table 1. The feeds and drinking water were given *ad libitum*.

After 5 weeks old, all broilers were weighed, then a head of chicken sample was randomly selected from each sub-group. The selected samples were then slaughtered for carcass quality evaluation, including: carcass weight, meat : bone ratio and fat weight. Attempts were also done to evaluate physical quality of meat including: pH, tenderness, water holding capacity and cooking lost were measured.

RESULTS AND DISCUSSION

Data on total feed intake, body weight gain, feed conversion, slaughter weight, and carcass quality of broiler after reared for 5 weeks using rations containing different levels of red ginger as treatments are presented in Table 2.

Table 2 reveals that broilers fed on ration with red ginger showed significantly lower ($P<0.05$) feed conversion than those on control treatment. Addition of red ginger at level 1.5% in the ration (R-1.5) gave the highest broiler body weight and considerably lowest feed conversion. However, increase of red ginger in the ration up to 2.0% (R-2.0) showed lower feed intake, total weight gain and feed conversion. Broilers fed on ration with red ginger showed also significantly better quality of carcass than broilers fed on ration with no red ginger (control group). Table 2 also shows that quality of carcass of broilers fed on ration with different level of red ginger (treatment group) were not significantly different from each other ($P>0.05$). It means that broiler fed on ration with lowest red ginger addition (R-0.5) showed same carcass quality as on broiler fed on ration with higher level of red ginger addition.

Active compounds contained in red ginger rhizome might improve the conditions. Rismunandar (1988), Fuhrman *et al*. (2000) reported that red ginger contains active compounds such as atsiri oil (consisted of a-pinen, 3-felandren, borneol, kamfen, limonen, linalool, sitral, nonilaldehida, desilaldchida, metilhepte-non, sineol, hisaholen, 1-a kurkuinin, farnesen, humulen, zingiberen, zingiberol), and oleoresin which cause hot

Table 2: Feed intake, total weight gain and carcass quality of broiler fed on ration with different level of red ginger

	Treatment: Level of red ginger in the ration (%)				
Parameter	R-0	R-0.5	R-1.0	R-1.5	R-2.0
Feed intake (g/head)	4,180.0^{q}	4,4054.5^{r}	4,108.0^{q}	4,196.5^{q}	3,966.7^{p}
Total weight gain (g/head)	1,899.7^{a}	1,888.4^{a}	1,858.2^{a}	1,955.5^{b}	1,859.5^{a}
Feed conversion*	2.27^{b}	2.15^{a}	2.20^{a}	2.15^{a}	2.14^{a}
Slaughter weight (g)	1,632.2^{a}	1,860.4^{b}	1,820.8^{b}	1,785.6^{b}	1,793.0^{b}
Carcass weight (g)	942.9^{p}	1,112.4^{q}	1,144.9^{q}	1,121.7^{q}	1,160.2^{q}
Carcass percentage (%)	57.8^{a}	59.6^{ab}	62.9^{bc}	62.9^{bc}	64.9^{c}
Fat weight (g)	41.78^{b}	34.6^{a}	33.66^{a}	32.46^{a}	33.08^{a}
Fat percentage (%)**	2.56^{q}	1.87^{p}	1.85^{p}	1.81^{p}	1.75^{p}

Values in the same row with different superscripts (^{a,b,c}) showed significantly different ($p<0.05$) and superscripts (^{p,q}) showed highly significant difference ($p<0.01$)

Table 3: pH, water holding capacity, tenderness and cooking loss of broiler meat as affected by treatments

	Treatments (Level of red ginger in the ration (%))				
Parameter	R-0	R-0.5	R-1.0	R-1.5	R-2.0
pH	5.80^{a}	5.84^{a}	5.91^{a}	6.11^{b}	5.93^{a}
Water holding capacity	15.28	15.00	14.18	14.09	13.64
Tenderness	1.04^{a}	1.07^{ab}	1.08^{bc}	1.10^{bc}	1.11^{c}
Cooking loss	26.90	26.42	26.27	26.18	26.12

Values in the same row with different superscript (^{a,b,c}) showed significantly different ($p<0.05$) and superscript (^{p,q}) ($p<0.01$)

taste of ginger (consisted of gingerol, zingeron, shogaol, tanin, gingerdiol, resin). Ginger contains also active compounds thiol proteinase and zingibain. Both compounds are known to have potential as proteolytic enzymes improving protein digestion of the diet in the intestinal tract for better absorption (Friedli, 2005). Conley (1997) reported that red ginger has characteristic as stimulant for feed digestion and conversion which increase body weight gain.

Fat weight and fat percentage of the carcass decreased significantly with ration containing red ginger as also reported by Fuhrman *et al.* (2000) who evaluated the ex vivo effect of standardized ginger extract on the development of atherosclerosis in apolipoprotein E-deficient (E^{0}) mice, in relation to plasma cholesterol levels and the resistance of their LDL to oxidation and aggregation. It was reported that significantly decreases ($P<0.01$) of the levels of plasma triglycerides, VLDL, and LDL by 27, 36 and 58%, respectively were shown by mice consumed 250 µg/day of ginger extract for 10 weeks as compared to those in control mice consumed feed with no ginger extract. Similarly, significant reductions ($P<0.01$) of 29, 53 and 33% were obtained in plasma total cholesterol, LDL-cholesterol and VLDL cholesterol concentrations, respectively. Furthermore, peritoneal macrophages harvested from E^{0} mice after consumed 25 or 250 µg of ginger extract/day had a lower ($P<0.01$) capacity to oxidize LDL (by 45 and by 60%, respectively), and to take up and degrade oxidized LDL (by 43 and 47%, respectively).

Physical quality of meat is important properties which strongly influence consumer's preference to the meat. These properties include pH, color, smell, tenderness, water holding capacity, and cooking lost, in which these properties relates to each other. As reported by Qiao *et al.* (2001) that pH influenced water holding capacity and color of meat. Meat with lighter color than normal was associated with low pH, high moisture, and low water holding capacity. The degree of acidity or pH of meat was a factor which determined the resistance of the meat against invading microorganisms (Lawrie, 1979). Data of physical meat quality as affected by treatments of this experiment were presented in Table 3. Feeding red ginger in the ration slightly increased pH and tenderness of broiler meat but decreased water holding capacity and cooking loss as compared to those in the control treatment without red ginger in the ration. Active compounds of spicy flavor (gingerol) from red ginger stimulate the increase metabolic rate and activity of broiler chickens to be more active. These conditions will reduce energy store in the body in the form of glycogen, further these also deplete glycogen store in the body. Low level of muscle glycogen limits glycolysis in the muscles after slaughter and results in a high ultimate pH (Ali *et al.*, 2008). As also reported by Anonymous (2001) that the increased of broiler meat pH was resulted from low glycogen level in the muscle at slaughter due to glycogen depletion that generally occurs from a combination of chronic stress and activity levels before slaughter. The pre-slaughter stresses normally occur in poultry meat processing industry are heat stress, pre-slaughter shackling, struggle, crating and transportation and feed withdrawal.

Conclusion: Feeding of red ginger phytobiotic feed additive increased productive performance, carcass and meat quality of broiler. Feeding the phytobiotic feed additive at level 1.0 to 1.5% looked to be the most

optimum level for those purposes. Further researches have to conducted be to evaluate the potential of red ginger as a source of phytobiotic feed additive to replace the chemical antibiotic.

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