Organic Acid Salt from Complete Feed Silage Corn Based by Product as an Alternative to Substitute Antibiotic Function as a Growth Promotor for Broiler

(Garam Asam Organik dari Pakan Lengkap Berbasis Limbah Jagung sebagai Alternatif Substitusi Antibiotik untuk Pemacu Pertumbuhan pada Ayam Pedaging)

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Abstract. This study was designed to evaluate the efficacy of organic acid salt Zn from complete feed silage based on corn by product as an alternative to subtitute antibiotic function as a growth promotor for broiler. Ninety day old commercial Cobb broiler chickens were randomly distributed into six groups having three replicates of five birds in each group. Negative control (R0) birds were offered standard basal diet and no challenged, positive control (R1) birds were offered standard basal diet and challenged with 10^7 *Salmonella typhimurium*. Treatment R2, R3, R4 and R5 were challenged by 10^7 CFU of *Salmonella typhimurium* which added in feed with 0.1% flouroquinolone, 0.1%, 0.2%, and 0.3% of organic acid salts. The result showed that dietary of organic acid salts affect consumption, weight gain, and final body weight ($P<0.05$). Meanwhile, feed conversion (FCR) was not affected by antibiotics nor organic acids. Our conclusion, Dietary organic acid salt from complete feed silage corn based by product until dose 0.2% can improve the performance of broiler chickens infected *Salmonella typhimurium*

Key Words: broiler, organic acid, *Salmonella typhimurium*

Introduction

Digestive tract is the most important organs of livestock related to feed digestion and absorption of nutrients (Santos, 2005). According to Pedroso *et al*. (2005) there is a complex bacterial community in the digestive tract of one day old chickens (DOC). Community bacteria (commensal and pathogens) in the digestive tract will interact intra community with other bacteria and host through tissue of chicken digestive organs (Apajalahti, 2005). Commensal bacteria is important for the host to identify and fight pathogenic bacteria in the digestive tract (Apajalahti, 2005). Pathogenic bacterial such as *Salmonella typhimurium* and *Escherichia coli* will compete in acquiring nutrients with commensal bacteria in the digestive tract of chicken. Other, pathogenic bacteria can produce metabolites that are harmful to the host. This can result in disrupted growth and increase the chances of contracting the disease.

The use of antibiotics as feed additif has long been used in poultry feed to stabilize microbes in the digestive tract, improve performance, and prevent infectious diseases in the digestive tract (Miles *et al*., 1984; Waldroup *et al*., 1985). In addition to treating the infection, antibiotics since 1990 began to be used in low doses as a growth promotor by inhibiting subclinical infection (Mackenzie 2003).

However, intensive use of antibiotics for long periods can cause resistant pathogenic bacteria (Phillip *et al*., 2004; Ray *et al*., 2006). Luangtongkum *et al.* (2006) reported that the percentage of resistant pathogenic bacteria that occur in conventional farms that using antibiotics is higher than in organic farms. Further that Griggs and Jacob (2005) showed that the use of antibiotics can leave residues in livestock products. Therefore, since Januari 2006 The European Union has banned the use of antibiotics as growth promotor in cattle (Mackenzie 2003).

An alternative that can be used to replace the function of antibiotics is an organic acid (Revington 2002). Organic acid can reduce the toxic components produced by the bacteria, reducing the colonies of pathogenic bacteria in the intestinal wall, preventing intestinal epithelial cells damaged (Lopez *et al*., 1995; Griggs and Jacob 2005; Gunal *et al*., 2006), and increasing chicken performance (Denli *et al*., 2003; Leeson *et al*., 2005).

So far there has been no published data on the study of the use of organic acids as by product from silage. This research was conducted to examine the possibility of producing organic acid salts of complete feed silage corn based by products and the effects as an alternative to antibiotics for growth promotor in broiler chickens.

Research Methods

Dietary Treatment

Six experimental diets, with 3 replicates, were fed to broiler chicken for 30 day: a negative control diet without infection and additive supplementation (R_O); a positive control diet with infection (R_1); 0.1% antibiotics (flouroquinolone) with infection (R_2); 0.1% organic acid salt with infection (R_3); 0.2% organic acid salt with infection (R_4); 0.3% organic acid salt with infection (R_5). The basal diet was broiler starter phase ration (Leeson dan Summer, 2005). Composition and nutritional rations used in this study can be seen in Table 1.

Experimental Design

A total of 90 Cobb chicks were randomly allocated to group of 5 birds to each of 18 floor pens, with 3 pens per treatment and the floor was covered with clean litter. Experimental design used was completely randomized design. The data obtained were analyzed statistically with analysis of varian (Steel and Torrie, 1993) using the program SAS 9.1 and followed by Duncan Test if significantly different. Variables were observed in this study consisted of performance of chickens (feed consumption, weight gain, feed conversion (FCR), and final body weight).

Result and Discussion

Salmonella typhimurium infection in this study was still in the subclinical stage. This can be seen from condition of the chicken during the study was not showing clinical symptoms of *Salmonella typhimurium* infection.

Table 1. Nutritional content of basal diet (%DM)

Nutritional content*	%
Dry matter	88.14
Crude protein	23
Metabolism energy (kkal/kg)	3055
Crude fiber	4.56
Extract ether	2.29
Ca	0.99
P avaliable	0.46
Methionine	0.45
Lysine	1.38
Zink**	0.01

*calculated; ** Laboratory analysis

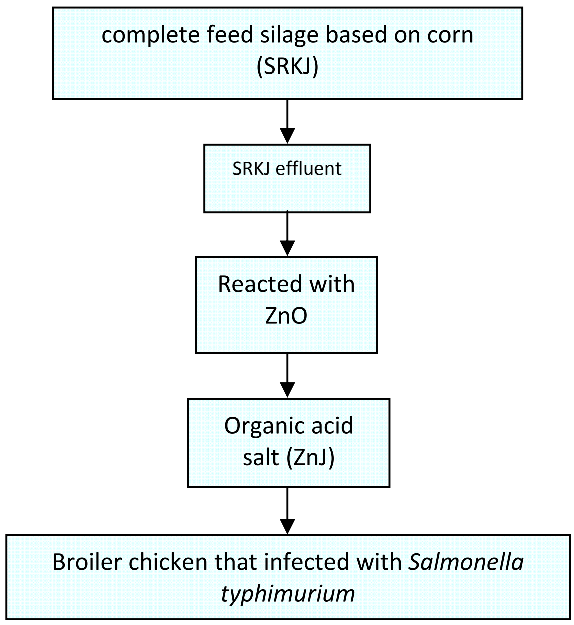

Figure 1. Framework flow diagram

According to Ashton (1990), chickens infected with *Salmonella* will have diarrhea and can cause death. In this study the mortality rate are 4% or 3 from 75 chickens infected *Salmonella typhimurium*, 1 bird in each R_1, R_4, and R_5 treatment.

The result showed that dietary of organic acid salts affect consumption, weight gain, and final body weight ($P<0.05$). Meanwhile, feed conversion (FCR) was not affected by antibiotics nor organic acids (Table 2). Further more the result showed that *Salmonella typhimurium* infection treatment (R_1) reduce consumption, weight gain, and final body weight compared to chickens that are not infected (R_0). While feed conversion was not affected by *Salmonella typhimurium* infection.

Dietary organic acid salts at a dose of 0.1% and 0.2% (R_3 and R_4) affects feed consumption, weight gain, and final body weight better than antibiotic treatment. However, increasing doses of organic acids up to 0.3% in the ration (R_5) can reduce feed consumption, weight gain, and the final body weight than the R_3 and R_4 treatment.

Antibiotics at dose 0.1% or organic acid treatment up to 0.3% can not improve the FCR value. Nevertheless R_3 treatment has a FCR equal to antibiotics treatment (1.91). While administered 0.2% and 0.3% organic acid salt (R_4 and R_5) can increase FCR value than giving antibiotics or R_3 treatment. However the result were better than the positive control.

The result obtained in this study related to the number of *Salmonella typhimurium* colonies contained in the chicken digestive tract until the end of the study that was not affected by treatment (data not published). According to Winarsih (2005), subclinical infections of *Salmonella typhimurium* increased feed consumption, but decreasing weight gain and increased FCR. Thus, high FCR in this study, is due to inefficiency of feed digestion and feed absorption.

The complete mechanism of the addition of organic acid and salts on performance of cattle is not yet known. According Schöner (2002) organic acid mechanism in the stomach can be divided into 2 way. first, lowering the pH of the stomach and the influence of organic acid anions. Dietary organic acids can lead to lower pH in the stomach. This can accelerate the achievement of optimal pH (pH 4-3) to activate pepsinogen and pepsin which may increase the protein digestibility (Eckel *et al*., 1992).

Further more dietary organic acid can reduce the formation of ammonia in the stomach (Eidelsburger *et al.,* 1992a), wich result in reduced deamination of amino acids. Thus increasing the protein retention value and the amount of amino acids that can be absorbed. The final result is improving livestock productivity.

Other mechanism is through improving feed quality. The study of Van Rensburg *et al.* (2005) showed that humic acid (oxihumate) can be used to bind aflatoksin in poultry feed. Aflatoxin is a toxin that can interfere the health and productivity of livestock. Additionally to toxin binding, organic acid can also increase the availability of phosphorus in the feed. Dietary of citric acid in the feed can increase the value of phosphor from the phytat bonds (Rafacz-Livingston *et al.,* 2005).

The concentration of organic acids given in this research is still very low. Some studies of the influence dietary organic acid on performance of broiler chicken showed that the concentration used ranges from 0.24-99% (Marcos *et al.,* 2004; Leeson *et al.,* 2005; Rahmani dan Speer 2005; Jarquin *et al*., 2007; Çelik *et al.,* 2007). Whereas the highest concentration of organic acid in this study (R_4) is only 51.7×10^{-5}% (Table 3).

Therefore, there be another factor in this study that also influence the achievement of broiler performance. In this study Zn contained in the organic acid salt be expected to influence the performance of experimental animals. This is because the Zn-J salt in the digestive tract will be dissociate into ion Zn and organic acid ions.

Zn content from each treatment in this study ranged between 100-142.9 ppm (Table 4). This amount exceeds the recommendation of the Summer and Leeson (2005) that only 60 ppm. Hegazy and Adachi (2000) showed that supplementation of 60 ppm Zn can improve weight gain and feed conversion of broiler chickens infected with *Salmonella*.

Table 2. Broiler performance average

Treatment	Consumption (g)	Weight gain (g)	FCR	Final body weight (g)
R_0	1388 ± 69^{bc}	744 ± 23^{ab}	1.84 ±0.13	971 ± 49^{ab}
R_1	1519 ± 49^{a}	641 ± 18^{c}	2.14 ±0.19	882 ± 17^{c}
R_2	1283 ± 42^{d}	672 ± 38^{bc}	1.91 ±0.15	904 ± 44^{bc}
R_3	1452 ± 27^{ab}	760 ± 17^{a}	1.91 ±0.11	997 ± 19^{a}
R_4	1529 ± 92^{a}	756 ± 69^{a}	2.10 ±0.18	994 ± 67^{a}
R_5	1310 ± 40^{cd}	624 ± 41^{c}	2.10 ±0.14	861 ± 41^{c}

Different superscript in the same column showed significant difference (p<0.05). R0= negative control, R1 = positive control, R2= 0.1% antibiotic, R3= 0.1% organic acid salt, R4 = 0.2% organic acid salt, R5= 0.3% organic acid salt.

Table 3. Maximum concentration of organic acid in each dose

Dose (%)	Organic acid concentration ($x10^{-5}$ %)*					
	malate	benzoate	laktate	sitrate	suksinate	fumarate
R_3	4.94	2.49	17.2	1.63	0.71	5.10
R_4	9.88	4.97	34.4	3.26	1.42	10.20
R_5	14.8	7.46	51.7	4.89	2.13	15.30

*with assumption that all organic acid in the corn silage effluent bound in the salt form
R3=0.1% organic acid salt, R4= 0.2% organic acid salt, R5= 0.3% organic acid salt

Table 4. Zn concentration in each treatment

Treatment	Zn concentration (ppm)
R_0	100
R_1	100
R_2	100
R_3	114.3
R_4	128.6
R_5	142.9

R_0, R_1, R_2= basal diet, R_3 = 0.1% organic acid salt
R_4 = 0.2%organic acid salt, R_5= 0.3% organic acid salt

According to Purwanti (2008), 120 ppm ZnO supplementation tended to afford performance and can improve the health status of broiler chickens better than without dietary Zn.

Nevertheless, Kim and Patterson (2004) showed that dietary of Zn minerals upt o 1 500 ppm did not have a negative impact on broiler performance. Zn excretion in feces will linearly increase with the increasing of Zn rations.

Further more, Zn supplementation on feed may reduce the risk of *Salmonella enteritidis* infection in laying hens during molting phase (Moore *et al.*, 2004).

Additionally, 181 ppm Zn supplementation can enhance immune response by increasing the IgG and IgM antibodies compared to chickens given 34 and 68 ppm Zn (Bartlett and Smith 2003).

Conclusion

Dietary organic acid salt Zn-J until dose 0.2% can improve the performance of broiler chickens infected *Salmonella typhimurium*.

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