Advances in Biological Sciences Research, volume 21
Proceedings of the 6th International Seminar of Animal Nutrition and Feed Science (ISANFS 2021)

Evaluation of Kandis Acid (*Garcinia xanthocymus*) as Acidifier on Broiler Performance

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ABSTRACT
This study was conducted to evaluate the effect of organic acids in kandis acids solution as acidifier on broiler performance. Totally 300 broiler of hybro strain was devided into four groups. This study used a Completely Randomized Design consisting of 4 treatments and 5 replications. Each replication consisted of 15 chickens. Experimental group P1, P2, and P3 received kandis acid which was contained organic acids in the form of solution as acidifier with pH 4, pH 3 dan pH 2 for 3 weeks. Control group (n=75) received drinking water without any additives. The variables that were measured in the experiment are feed consumption, water consumption, organic acid consumption, body weight, body weight gain, feed conversion ratio, mortality, and income over feed cost. All data collected within the present study were analyzed using Analysis of Variance and if there were significant differences further tests needed to performed with Duncan's multiple range test by SPSS version 25. There were no significant performance differences among broilers given with different kandis acid solution with different acidity degrees until 35 d of age (P>0.05). From these results, it can be concluded that water with addition of kandis acid as acidifier with different degrees of acidity not affect the broiler growth performance.

Keywords: *Acidifier, Broiler, Growth performance, Kandis acid, Organic acids.*

1. INTRODUCTION

Several attempts to replace antibiotics are enzymes, prebiotics, probiotics, herbs, essential oils, immunostimulants, antimicrobial peptides, and acidifiers [1]. Acidifier is an organic acid that has a direct impact on the mechanism of improving feed digestibility in livestock [2]. Acidifiers enhance growth performance by establishing low pH conditions in the digestive tract by supporting endogenous digestive enzymes and reducing unwanted microorganisms in the gut [3]. Acidification diets with weak organic acids have been reported to decrease the pathogenic colonization and the production of toxic metabolites, increase protein digestibility, Ca, P, Mg, Zn, and as a substrates in intermediate metabolism [4].

Organic acids are not antibiotics, but they can improve performance when used properly with nutrition, management, and bio-security regulation [4]. Organic acids detected in Garcinia fruit, especially G. Xanthochymus were hydroxy citric acid (HCA), malic acid, oxalic acid, tartaric acid, acetic acid, and the most dominating was citric acid [5]. Utilization of citric acid as an acidifier can increase the weight and length of the small intestine (duodenum, jejunum, ileum) [6], but giving gelugur sour leaf that contain HCA can be said to have not be able to increase duck performance [7].

The malic acid increase metabolism and reduce toxicity in the body that causes liver disease [8]. The addition of propionic and lactic acid with different levels in the feed can reduce Salmonella, *Escherichia coli*, and the number of fungi in the feed [9]. Other researcher [10] also noted the increase in villi length could be attributed to the intestinal epithelium acting as a natural barrier against pathogenic bacteria and toxic substances present in the intestinal lumen. Based on this, this experimentation was led to evaluate the use of Kandis acid as an acidifier in drinking water with different degrees of acidity on the performance of broiler chickens.

2. MATERIALS AND METHOD

2.1. Place and Date

This experimentation was diracted from October 2019 to November 2019. The area of the preservation of the broiler chicken at the Field Research Center of

Poultry Nutrition Building C, Faculty of Animal Science, IPB University.

2.2. Cage and Animal

The bird utilized in this experimantion were Hybro PG+ strains which were raised from Day Old Chick (DOC) to the age of 35 days. The quantity of broiler chickens utilized was 400 which were distributed into 4 treatments and 5 replications, each replication comprised of 15 chickens.

The enclosure utilized in this study was a settlement confine. The material utilized was bamboo. The foundation of the enclosure (litter) utilized was chaff. The enclosure was outfitted with 2 bulbs of 75 watts, a spot to feed and drink.

2.3. Diet

This study used two types of feed, that was BR-11 commercial feed which is a crumble shape for the starter period and BR-12 commercial feed which is pellets for the finisher period. The nutrition ration content used is shown in Table 1.

Table 1. Nutrient content of commercial rations BR-11 and BR-12

Composition		Nutrient content	
		BR 11	BR 12
Water content (%)	Max	13.00	13.00
Fat (%)	Min	5.00	5.00
Protein (%)		22.00	20.00
Fiber (%)	Max	5.00	5.00
Ash (%)	Max	7.00	7.00
Calcium (%)	Min	0.90	0.90
Phosphor (%)	Min	0.60	0.60
Aflatoxin (ppb)	Max	50.00	50.00
Metabolic energy (Kcal kg^{-1})		2870.00	2970.00

2.4. Kandis Acid Composition

This study used Kandis acid (*Garcinia xanthochymus*) which had been dried. Kandis acid was obtained from sellers at the traditional market of Caringin, Dramaga, Bogor, West Java. Organic acids contained in kandis acid include 0.10% hydroxycitric acid, 0.73% malic acid, 0.37% oxalic acid, 8.00% citric acid, 0.04% acetic acid, and 0.20% tartaric acid [5].

2.5. Procedure

2.5.1. Preparation Kandis Acid Solution

Kandis acid fruit that has been weighed as much as 40 g is put into 1 L of boiling water. Kandis acid which has been put into 1 L of boiling water then allowed to stand for 1 night and filtered from the kandis acid fruit to be used as the extract of kandis acid. The extract that has been formed is then taken as much as 3.5 L and added 6.5 L of pH 7 water to make a solution with pH 2. Making a pH 3 solution with 1 L of extract added 9 L of pH 7 water and making a solution with pH 4 which is 0.5 L of kandis acid added with 9.5 L of water pH 7.

2.5.2. Preservation

Broiler chickens were raised for 35 days. The feeding and drnking water was given as per the livestock needs. On the first three weeks, the chickens were fed with BR-11, while the finisher fed with BR-12 was given at the fourth and fifth weeks.

2.5.3. Kandis Acid Solution Measurement

Kandis acid treatment is given every 3 days in 1 week on Wednesday, Friday, and Sunday each given for 6 hours starting at 10.00-16.00. Chickens was given drinking water without the addition of kandis acid after 16.00. Kandis acid solution was given as much as 2 - 5 L in each stall containing 15 broiler chickens. Water consumption is calculated every day by measured the initial supply of drinking water and deducted the remain drinking water on the next day. The treatment was carried out for 3 weeks until the finisher period.

2.5.4. Experiment Design and Data Analysis

The experimental design utilized in this study was a completely randomized design (CRD) with 4 treatments and 5 replicants. Every replication comprised of 15 broilers. Data were analyzed by Analysis of Variance (ANOVA). If the data obtained are statistically different, it was continued with Duncan's test. Mathematic model based on Steel and Torrie [11].

$$Xij = \mu + \tau i + \varepsilon ij \quad (1)$$

Xij = The value of observations on the treatment and replication of kandis acid
μ = General mean
τi = Effect of kandis acid treatment
εij = Error of treatment
i = The amount of treatment
j = The amount replication

2.5.5. Treatment and parameters

The treatment on this study was P0 (control), P1 (Kandis acid solution pH 4), P2 (Kandis acid solution pH

3), P3 (Kandis acid solution pH 2). The parameters observed were feed consumption, body weight, body weight gain, water consumption, organic acid consumption, mortality, feed convertion ratio, and income over feed cost.

Table 2. Total average performance of broiler (1-35 days)

Variable	Treatment			
	P0	P1	P2	P3
Feed consumption (g head^{-1})	2602.05±100.16	2534.77±272.42	2497.07±178.38	2543.20±104.90
Water consumption (mL head^{-1})	5865.63±259.96	5899.14±518.89	5921.93±521.68	5715.74±242.86
Body weigh (g head^{-1})	1351.73±58.38	1405.22±178.41	1332.03±105.64	1330.76±63.84
Body weigh gain (g head^{-1})	1310.45±58.33	1364.42±178.56	1291.31±105.24	1289.33±63.33
Feed convertion	1.99±0.11	1.86±0.08	1.94±0.13	1.98±0.14
Mortality (%)	7.92±8.71	10.58±10.15	3.83±5.64	10.58±10.15
IOFC (Rp head^{-1})	3203.78±1188.98	2690.75±1029.3	1795.87±1216.92	2181.84±1550.69

Table 3. Prediction of broiler chicken organic acid consumption (15-35 days)

Consumption	Treatment		
	P1(pH 4)	P2(pH 3)	P3(pH 2)
Kandis acid water (mL head^{-1})	805.75±80.78a	794.73±79.49a	463.64±60.51b
HCA (mg head^{-1})	1.70±0.17	3.53±0.35	9.99±1.3
Malic acid (mg head^{-1})	12.38±1.24	25.78±2.58	72.90±9.51
Oxalic acid (mg head^{-1})	6.28±0.63	13.07±1.31	36.95±4.82
Citric acid (mg head^{-1})	135.70±13.61	282.57±28.26	798.88±104.26
Acetic acid (mg head^{-1})	0.68±0.07	1.41±0.14	0.39±0.05
Tartaric acid (mg head^{-1})	3.39±0.34	7.06±0.71	19.97±2.61

conversion ratio, mortality, and income over feed cost (Table 2).

Prediction results of organic acid consumption in kandis acid solution can be seen in Table 3. Organic acids contained in kandis acid fruit include HCA, malic acid, oxalic acid, citric acid, acetic acid, and tartaric acid.

3.1. Feed Consumption

The result showed that the treatment with acidifier in drinking water had no significant effect on feed consumption (P>0.05). The average consumption during the study was lower than the standard broiler consumption according to Leeson and Summers [12], that consumption of 35-day-old broilers was 3,056 g (cock) and 2,838 g (hen).

The high ambient temperature that reaches 32.5°C in the cage causes broilers to reduce feed consumption to reduce body heat [13]. In general, the current temperature in Indonesia during the day the average daily temperature ranges between 27.7°C and 36.6°C with humidity between 55.8% and 86.8% [14].

The level of consumption describes the palatability of a feed. Palatability is the attractiveness of a feed to cause appetite which is determined by taste, smell, and color [15]. The presence of contamination in feed causes broilers not to be stimulated to always eat so that feed consumption is low compared to existing standards.

3.2. Water Consumption

Acidification treatment is an effort to improve water quality by lowering the pH of the water used for drinking. It aims to improve chicken health and support performance [16]. Based on the result of variance analysis, the use of kandis acid solution in drinking water

3. RESULT AND DISCUSSION

The results showed that Kandis acid solution as an acidifier had no effect on performance, i.e feed consumption, body weight, body weight gain, water consumption, organic acid consumption, feed

did not affecting water consumption (P>0.05). Giving kandis acid solution is not a factor for chickens to consume more or less drinking water. Water consumption is considered normal because it is in accordance with the ratio between water consumption and feed consumption [17], while the consumption of kandis acid water only, known to have a significant effect (P<0.05), where the consumption of pH 4 and pH 3 is higher than the kandis acid solution pH 2. According to Anggraeni [16] that when using an acidifier in drinking water, usually the target acidity is pH 4. Birds receive water on the acidic side better than they receive water on the alkaline side [18].

3.3. Organic Acid Consumption

The result indicated that the use of an acidifier in th kandis acid solution form was not statisfically significant (P>0.05) on growth performance, but at pH 2 and pH 3 treatments it could reduce meat cholesterol [19]. Treatment of pH 2 and pH 3 had higher consumption of HCA, based from the function of HCA, it could inhibit fat synthesis [5]. Therefore, the growth of fat decreases and causes the resulting body weight to be low. The use of kandis acid significantly reduced the number of E.coli colonies in the intestine [20] although statistically it had no significant effect on performance. This was indicated by the consumption of acetic acid which is classified as a short chain fatty acid. Organic acid content material varies relying on the nature of the target organism, in specific on the complexity of the structure of the outer cell wall or membrane [21]. Gram advantageous bacteria (eg *Clostridium perfringens*, *Streptococcus* spp., *Enterococcus* spp.) are prone to medium chain fatty acids while gram disadvantageous bacteria (eg, *Campylobacter jejuni*, *Escherichia coli*, *Salmonella* spp.) are prone to short chain fatty acids.

The capability of organic acids in inhibiting microbes relies upon on their pKa value, which is the pH at which 50% of the acid is dissociated. Thus, it is clear that each acid has its own spectrum of microbial activity associated with a certain pH range [22]. Acid mixtures represent several pKa values and are used because of their wider spectrum of activity based on antibacterial, antiviral, antifungal, and antifungal properties [23]. Organic acids with the highest antimicrobial activity have pKa somewhere in the range of 3 and 5. Therefore, there are diverse organic acids that can act at various rates dependent on the pH of the environment: organic acids with higher pKa can be utilized to protect food/feed, otherwise, in terms of nutrition, a lower pKa implies the acid acts in the stomach [24].

It is known that gastric juice produced by proventiculus has a pH value of 2, there is an indication of a possible lower pH decrease due to the addition of organic acids. This is reinforced by the explanation [25] which states that after feed enters the digestive tract, the pH of the digestive tract will be the same as the pH of the feed. If this happens, the provision of drinking water that has a pH that is too low (pH 2, 3 and 4) causes the pH of the digestive tract in the form of proventiculus to be too low, then the secretion of enzymes in the digestive process such as pepsin, lipase, and amylase will be inhibited so that the absorption of food juices will occur. including minerals and vitamins in the small intestine does not occur optimally and causes the resulting performance is also good.

Based on the climate of pKa and pH value, organic acids in the undissociated structure can diffuse across the bacterial cell membrane and dissociate inside the cell, delivering H+ particles and bringing down the intracellular pH. To balance the drop in pH, microorganisms activate energy-devouring proton pumps and simultaneously, the RCOO anion is poisonous to DNA replication, disturbing metabolic functions and increasing cell osmotic pressure. The mix of these two activities restrains bacterial replication and growth, prompting to a bacteriostatic or bactericidal impact [21].

3.4. Body Weight and Body Weight Gain

The outcomes showed that there was no interaction between the addition of Kandis acid solution in drinking water on body weight and body weight gain of chickens (P> 0.05). Body weight and body weight gain were lower when compared to the study [26,27] with the average body weight of chickens reached 1473.30 g head^{-1} and the average body weight gain reached 1435.50 g head^{-1} for the hybro strain. This shows that the lack of energy intake due to low ration consumption can not maximize the growth of new tissue so that the body weight obtained is also low [28].

3.5. Feed Convertion Ratio (FCR)

The outcomes showed that there was no interaction between the addition of kandis acid solution in drinking water and ration conversion (P> 0.05). The feed conversion rate is higher than the conversion rate for broiler broiler strains according to Annisa and Arifirman [26,27] which is 1.65. The high feed conversion value indicates that the efficiency of feed utilization is not good, high feed consumption and low production are the main causes of the high FCR value of broilers [29].

Conversion of rations should be an average of 2 kg of feed per kg of meat or less than 2 kg is better. A high ration conversion value indicates the amount of ration needed to increase body weight is increasing and the ration efficiency is getting lower [30].

3.6. Mortality

Kandis acid solution with different acidity (pH) had no critical impact (P>0.05) on mortality. The interaction

between the two did not occur so that Duncan's test was not continued. Chicken death occurred in the 4th and 5th week of rearing. According to [31], deaths that occurred in the finisher period were caused by respiratory attacks. Clinical symptoms shown by chickens include loss of appetite, mouth that sometimes opens due to difficulty breathing, weakness, and muscle spasms in chickens. The anatomical pathology shown was white fungal growth on the surface of some organs, especially the lungs.

Based on the mortality rate and the symptoms shown, the disease experienced by chickens leads to aspergillosis or brooder pneumonia. Aspergillus normally lives as a saprophyte, its spores can be found in the air, dust, straw, seeds and decaying plants. Therefore, it is necessary to apply good management, hygiene and environmental sanitation to prevent aspergillosis. Predisposing factors for aspergillosis include animals in uncomfortable conditions, crowding, lack of feed, spore-contaminated feed and fatigue [32].

3.7. Income Over Feed Cost (IOFC)

Broilers treated with acidifier in their drinking water in the form of kandis acid solution did not give a significant difference to the IOFC value ($p>0.05$). At the time of rearing until the age of five weeks, the selling price of chickens in the market is Rp. 17,000 kg^{-1} live weight, the price of tamarind fruit in the market is Rp. 60,000 kg^{-1}, and the price of feed for each kg is Rp. 7,600 kg^{-1}. Based on the resulting IOFC value, the benefits for each treatment have not been maximized. This is because the value of body weight gain is low and feed consumption is relatively the same in each treatment and is not followed by low feed prices [33].

4. CONCLUSION

In conclusion, kandis acid as acidifier on water drinking with different degrees of acidity does not affect broiler growth performance.

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