Research Article

The Effect of Continuous Administration of Drinking Water with Citric Acid on the Performance, Giblets and Internal Organs of KUB Chickens (2–8 Weeks of Age)

Dian Septinova*, Ridwan, Tiara Arnenda, Mita Dewita Sari, Riyanti Riyanti, Madi Hartono

Department of Animal Husbandry, Faculty of Agriculture, Lampung University, Prof. Soemantri Brojonegoro Street No.1 Gedongmeneng, Bandar Lampung, Lampung Province Indonesia.

Abstract | This study investigated the effect of continuous administration of citric acid (CA) as an acidifier in drinking water on the performance and internal organs of KUB chickens aged 2–8 weeks. A total of 200 KUB chickens were randomly divided into four groups: 0% (T0), 0.5% (T1), 1.0% (T2), and 1.5% (T3) CA. Results indicated that in the 2nd week, CA administration significantly decreased ($P < 0.05$) drinking water consumption, feed intake, body weight gain (BWG), and overall body weight of the chickens. In the 3rd week, water intake and body weight continued to decrease, while feed consumption decreased significantly only in the T3 group ($P < 0.05$). Body weight reduction persisted ($P < 0.05$) only through the 4th week. Notably, T1 chickens exhibited the highest feed conversion ratio ($P < 0.05$) by the 7th week. CA had no significant effect ($P > 0.05$) on the weights of the gizzard, liver, heart, spleen, and gallbladder. In conclusion, the continuous administration of an acidifier up to 1.5% in drinking water significantly decreased the performance of KUB chickens during the 2nd and 3rd weeks. However, from the 4th to the 8th week, the performance of the chickens tended to improve. Additionally, the use of an acidifier did not negatively impact the weight of giblets or internal organs. Based on these findings, it is recommended that the administration of acidifiers in KUB chickens begin in the 4th week, rather than earlier.

Keywords | Citric acid, Performance, Giblets, Visceral organs, KUB chicken

Received | October 23, 2024; **Accepted** | February 08, 2025; **Published** | February 28, 2025
***Correspondence** | Dian Septinova, Department of Animal Husbandry, Faculty of Agriculture, Lampung University, Prof. Soemantri Brojonegoro Street No.1 Gedongmeneng, Bandar Lampung, Lampung Province Indonesia; **Email:** dian.septinova@fp.unila.ac.id
Citation | Septinova D, Ridwan, Arnenda T, Sari MD, Riyanti R, Hartono M (2025). The effect of continuous administration of drinking water with citric acid on the performance, giblets and internal organs of KUB chickens (2–8 weeks of age). J. Anim. Health Prod. 13(1): 185-191.
DOI | https://dx.doi.org/10.17582/journal.jahp/2025/13.1.185.191
ISSN (Online) | 2308-2801

INTRODUCTION

Kampung Unggul Balibangtan (KUB) Chicken is a crossbred native chicken (Urfa *et al.*, 2017) known for its meat, which is prized for its distinctive and savory taste (Fausiah *et al.*, 2019). The nutritional value of KUB chicken protein and fat is higher than that of free-range chicken, while the aroma, tenderness, and taste are similar (Hidayat *et al.*, 2018). At 4 weeks of age, the average body weight of KUB chickens is 247.68 g/head; at 8 weeks, the weight is 745.27 g/head for females and 772.02 g/head for males; and at 12 weeks, the weight is 1346 g/head for females and 1875.2 g/head for males (Kostaman and Sutedi, 2019). According to Harnanik and Woraswati (2021), the average weight of KUB chickens is 821 g/head at 10 weeks and around 1 kg at 13 weeks.

The use of antibiotic growth promoters (AGPs) to increase chicken production has been banned due to concerns about residue accumulation and microbial resistance (Fadhiila *et al*., 2022). Several researchers have explored the use of acidifiers as a substitute for AGPs (Hidayat *et al*., 2018; Paras *et al*., 2022). Acidifiers can enhance feed hygiene, lower gastric pH, inhibit pathogenic bacteria, stimulate pancreatic secretion, improve protein digestibility, increase mineral absorption, and promote growth performance and immunity (Pearlin *et al*., 2019). Additionally, acidifiers can reduce feed conversion ratio (FCR) (Khalil *et al*., 2020), decrease the number of *Clostridium perfringens* bacteria, and increase the population of *Lactobacillus* bacteria in the caecum (Ding *et al*., 2017). Supplementation with citric acid (CA) at 30 g/kg of feed has been shown to optimize growth performance and nutrient retention in broiler chickens (Fazayeli-Rad *et al*., 2014). Furthermore, adding 1.5% CA to drinking water is effective in reducing abdominal fat (Fik *et al*., 2021).

Drinking water has a direct impact on growth and economy in poultry production (Martinez *et al*., 2021). Chickens consume more drinking water than feed, so the risk of microbes entering the digestive tract through drinking water is also higher. Providing good quality drinking water will increase the survival rate of chickens. Based on this, research on the effect of giving CA through drinking water on the performance of KUB chickens has been conducted.

MATERIALS AND METHODS

Research Design

This study employed a completely randomized design with CA administration treatments at doses of 0% (T0), 0.5% (T1), 1.0% (T2) and 1.5% (T3). CA-supplemented drinking water was provided continuously to the chickens for 24 hours. Each treatment was repeated five times, using a total of 200 unsexed KUB chickens. CA was added to the drinking water from 6 days of age until the chickens reached 8 weeks. The chickens were housed in an open house, with ad libitum access to feed and water. The feeds used were commercial feed BR-1 (for chickens aged 1-4 weeks) and BR-11 (for chickens aged 5-8 weeks). CA was supplied by PT Budi Starch, and the sweetener was provided by TBK Indonesia. In this study, chicken management followed a livestock welfare system, and halal slaughtering methods were employed for chicken processing.

Variables

Drinking water consumption was measured daily by calculating the difference between the amount of water provided and the remaining water. Feed consumption was measured weekly by subtracting the remaining feed at the end of the week from the amount provided at the beginning of the week (in grams). Body weight gain was calculated by subtracting the initial body weight from the final body weight each week. Body weight was recorded at the beginning of each week. Feed conversion ratio (FCR) was determined by comparing feed consumption with body weight gain per week. The weight of internal organs, including the gizzard, liver, heart, spleen, and gallbladder, was measured after the chickens reached 8 weeks of age.

Data Analysis

All data obtained were analyzed using analysis of variance (ANOVA) at the 5% significance level. Data are expressed as mean ± SD. If the results of the ANOVA were significant, further testing was performed using the least significant difference (LSD) test.

RESULTS AND DISCUSSION

Drinking Water Consumption

In the 2nd week, as the dose of CA increased, drinking water consumption by KUB chickens (ml/day) decreased significantly ($P < 0.05$), with T1 (34.49 ± 0.74), T2 (32.74 ± 1.39), and T3 (32.19 ± 1.58) showing lower consumption compared to T0 (36.49 ± 1.14). In the 3rd week, water consumption in T1 (45.88 ± 2.91) was not significantly different from T0 (49.86 ± 2.55), but consumption in T2 (45.80 ± 1.32) and T3 (44.11 ± 2.65) was significantly lower ($P < 0.05$). From the 4th to 7th weeks, drinking water consumption in T1 (59.14 ± 2.64 to 116.19 ± 2.92 ml/day), T2 (60.57 ± 3.54 to 114.20 ± 3.01 ml/day), and T3 (57.91 ± 4.65 to 113.68 ± 2.67 ml/day) was not significantly different ($P > 0.05$) from the control group (T0: 61.88 ± 4.59 to 120.15 ± 3.96 ml/day). In the 8th week, drinking water consumption in T1 (141.60 ± 3.55) and T2 (134.74 ± 6.93) was not significantly different ($P > 0.05$) from T0 (143.29 ± 5.09), but T3 (130.17 ± 6.06) had significantly lower consumption ($P < 0.05$) (Table 1).

Drinking water is an important element for chicken life, such as in the digestive and respiratory systems. The consumption of drinking water indicates the effectiveness of maintenance management and the health status of the chicken. The pH value and taste of drinking water are factors that also determine drinking water consumption. The consumption of drinking water of chickens (Table 1) shows that in the early phase, KUB chickens already have a good sense of taste. The higher the dose of CA, the more sour the taste of the drinking water and the less it is liked by the chickens, so that their drinking water consumption decreases. This fact is in accordance with the statement of Clark *et al*. (2014) that the sense of taste is a well-developed taste.

As the chickens get older, they become more adaptive to the taste of sour drinking water, so that starting from the age of 4 weeks, the consumption of KUB chicken drinking water with CA is not different (P>0.05) from the control. Chicken drinking water consumption with acid decreased again in the 8th week, except at T1. According to Roura *et al*. (2013), chickens are tolerant to acidic or alkaline solutions, but their water consumption will decrease if the pH of the solution is ≤ 2.9. In this study, the pH values of drinking water at T1, T2, and T3 were 3.74 (T1), 3.69 (T2), and 3.67 (T3).

Table 1: Average drinking water consumption of KUB chickens.

Week	CA dose (%)				
	0.0 (T0)	0.5 (T1)	1.0 (T2)	1.5 (T3)	P Value
	(ml/day)				
2	36.49 ±1.14[a]	34.49 ±0.74[b]	32.74 ±1.39[c]	32.19 ±1.58[c]	0.0002
3	49.86 ±2.55[a]	45.88 ±2.91[b]	45.80 ±1.32[b]	44.11 ±2.65[b]	0.0324
4	61.88 ±4.59	59.14 ±2.64	60.57 ±3.54	57.91 ±4.65	0.5022
5	84.64 ±3.60	85.94 ±7.19	79.05 ±5.80	80.37 ±6.11	0.2268
6	103.39 ±8.88	104.97 ±6.12	103.93 ±9.26	101.98 ±4.61	0.4290
7	120.15 ±3.96	116.19 ±2.92	114.20 ±3.01	113.68 ±2.67	0.7704
8	143.29 ±5.09[a]	141.60 ±3.55[ab]	134.74 ±6.93[bc]	130.17 ±6.06[bc]	0.0259

Note: Different superscripts in the same row indicate significant differences (P < 0.05).

The pattern of drinking water consumption by chickens in this study was similar to the results of research by Martinez *et al*. (2021) and Guo *et al*. (2022) that at the age of 1-10 days, the consumption of drinking water by chickens with an acidifier was no different from the control. According to Guo *et al*. (2022), after 7 days of age, the consumption of drinking water by chickens given 1.5–2.0% acidifier increased higher than the control. According to Ali *et al*. (2020), drinking water consumption of broilers whose drinking water was given 1% citric acid (pH 3.7) continuously for 12 hours up to 35 days of age was not significantly different from the control.

Feed Consumption

Administering higher doses of CA significantly (P < 0.05) reduced feed consumption (g/week) in chickens during the 2nd week, with the following values: T0 (149.8 ± 6.46), T1 (138.5 ± 3.13), T2 (135.1 ± 5.67), and T3 (128.4 ± 8.09). In the 3rd week, only feed consumption in T3 (190.1 ± 7.12) was significantly (P < 0.05) lower than the control group (T0: 205.6 ± 7.87). From the 4th to the 8th week, feed consumption in T0 (255.5 ± 12.38 to 449.9 ± 10.26), T1 (243.7 ± 13.17 to 488.4 ± 15.29), T2 (250.5 ± 15.43 to 450.4 ± 20.44), and T3 (239.1 ± 19.15 to 457.7 ± 14.64) was not significantly different (P > 0.05) (Table 2).

Table 2: Average feed consumption of KUB chickens.

Week	CA dose (%)				
	0.0 (T0)	0.5 (T1)	1.0 (T2)	1.5 (T3)	P-value
	(g/week)				
2	149.8 ±6.46[a]	138.5 ±3.13[b]	135.1 ±5.67[bc]	128.4 ±8.09[c]	0.0004
3	205.6 ±7.87[a]	200.3 ±8.40[a]	202.4 ±9.53[a]	190.1 ±7.12[b]	0.0048
4	255.5 ±12.38	243.7 ±13.17	250.5 ±15.43	239.1 ±19.15	0.3702
5	379.6 ±10.39	371.3 ±21.59	359.0 ±16.95	369.0 ±25.43	0.6257
6	390.3 ±8.80	394.5 ±11.58	379.4 ±15.08	378.9 ±16.17	0.3456
7	434.5 ±10.05	444.4 ±16.83	424.0 ±12.30	422.6 ±13.98	0.3794
8	449.9 ±10.26	488.4 ±15.29	450.4 ±20.44	457.7 ±14.64	0.1147

Note: Different superscripts in the same row indicate significant differences (P < 0.05).

The total consumption of broiler chicken feeds on days 1 to 10 significantly decreased with the addition of 0.25% CA to drinking water (Mohammed, 2018). Up to 35 days of age, the consumption of broiler feeds that received 1% CA in their drinking water did not differ significantly from the control (Ali *et al*., 2020). The addition of 1.25% CA to drinking water had no significant effect (P > 0.05) on feed consumption but tended to increase (Tajudin *et al*., 2021). In broilers aged 1–10 days, the administration of an acidifier in drinking water resulted in better feed consumption compared to control (Efekhari *et al*., 2015).

The decreasing consumption of chicken rations in weeks 2 and 3 is closely related to drinking water consumption. In weeks 2 and 3, KUB chickens are intolerant to the sour taste of drinking water so that drinking water consumption decreases and has an impact on decreasing feed consumption. The balance of drinking water consumption at T1, T2, and T3 in the 2 nd and 3 rd weeks was about 1.6 times more than feed consumption. Under normal conditions, drinking water consumption is 1.5 --2 times feed consumption.

Giving 0.25% CA in drinking water significantly reduces the pH of the digestive tract of broiler chickens (Ndelekwute *et al*., 2018). A low pH value will increase the secretion of pepsin enzymes and enzymes in the duodenum, but excessive acid reduction in the stomach will inhibit the secretion of acid (HCl) and pepsinogen by the stomach and suppress the secretion of digestive enzymes by the duodenum (Chun *et al.*, 2021). This slows down the digestion and absorption of food so that ration consumption is lower. Low drinking water consumption causes higher digestion viscosity so that the digestion process slows down and feed consumption decreases. The average consumption of KUB chicken rations in this study (39.88-41.87 g/head/day) was lower than the results of the study by Saelan *et al.* (2023), which was 65.04-66.09 g/head/day.

Body Weight Gain

Body weight gain (BWG, g/week) of KUB chickens in the 2nd week was significantly (P < 0.05) lower in T1 (77.9 ± 2.45), T2 (75.8 ± 4.94), and T3 (74.0 ± 3.57) compared to the control (T0: 82.4 ± 4.13). In weeks 3 to 8, BWG in T1 (95.3 ± 3.38 to 136.0 ± 21.23), T2 (102.2 ± 5.25 to 152.0 ± 20.73), and T3 (92.1 ± 6.80 to 146.1 ± 19.09) was not significantly different (P > 0.05) from the control group (T0: 98.0 ± 7.88 to 153.6 ± 15.82) (Table 3). According to Ishfaq *et al.* (2015), the acidifier (Acipure) had no significant effect on broiler body weight gain (0–41 days). However, other acidifiers, such as formic acid, have been shown to increase growth performance (Eftekhari *et al.*, 2015; Ding *et al.*, 2017, Mohammed, 2018; Khalil *et al.*, 2020; Martinez *et al.*, 2021).

Table 3: Average body weight gain of KUB chickens.

Week	CA dose (%)				P -Value
	0.0 (T0)	1.0 (T1)	1.0 (T2)	1.5 (T3)	
	(g/week)				
2	82.4 ±4.13^{a}	77.9±2.45^{b}	75.8 ±4.94^{b}	74.0 ±3.57^{b}	0.0216
3	98.0 ±7.88	95.3 ±3.38	102.2 ±5.25	92.1 ±6.80	0.0999
4	115.7 ±8.05	106.2 ±7.25	112.3 ±13.31	108.8 ±15.31	0.5897
5	116.1 ±6.06	105.3 ±11.29	95.5 ±13.63	108.8 ±13.65	0.0788
6	120.1 ±14.09	127.5 ±15.74	110.6 ±17.55	108.7 ±18.81	0.2251
7	153.6 ±15.82	136.0 ±21.23	152.0 ±20.73	146.1 ±19.09	0.1914
8	106.8 ±19.84	134.0 ±18.40	117.5 ±10.03	118.3 ±9.21	0.0789

Note: Different superscripts in the same row indicate significant differences (P < 0.05).

BWG in the 2nd week is very different from the results of Ding *et al.* (2017) that the addition of an acidifier is more effective when given in the starter phase. Acidification can increase digestibility and increase mineral absorption (Pearlin *et al.*, 2019), protein digestibility, fiber, and ether extract (Ndelekwute *et al.*, 2018). In addition to the type of chicken, according to Ding *et al.* (2017), Pearlin *et al.* (2019), and Hezaveh *et al.* (2020), the difference in response is also determined by the dose, method, type of acidifier, type, and nutrition of the feed given. In the 2nd week, KUB chickens experienced excessive acidification of drinking water so that digestive enzyme activity decreased, and nutrient absorption was disrupted. The total number of microbes in drinking water, as well as the types and total number of microbes in the digestive tract are also inhibiting factors for BWG of KUB chickens. The average weight gain of KUB chickens from this study (14.75-15.46 g/head/day) is almost similar to the results of the study by Saelan *et al.* (2023), namely 15.07-16.14 g/head/day.

Body Weight

The body weight of KUB chickens that received CA in the 2nd week was significantly lower (P < 0.05) than the control group (T0: 186.4 ± 8.72), with the following values: T1 (178.06 ± 6.55), T2 (173.54 ± 4.10), and T3 (170.00 ± 5.32). In the 3rd week, the body weight of KUB chickens in T0 (284.44 ± 13.74) was not significantly different (P > 0.05) from T2 (275.72 ± 9.32), but was significantly different (P < 0.05) from T1 (273.38 ± 9.44) and T3 (262.12 ± 5.50). Similar results were observed in the 4th week. From the 5th to 8th weeks, the body weight in T0 (516.24 ± 18.34 to 896.68 ± 30.70) was not significantly different (P > 0.05) from T1 (493.95 ± 24.38 to 891.42 ± 41.39), T2 (486.54 ± 22.83 to 866.68 ± 38.02), and T3 (486.22 ± 26.95 to 862.95 ± 40.40) (Table 4).

Table 4: Average body weight of KUB chickens.

Week	CA dose (%)				P -Value
	0.0 (T0)	0.5 (T1)	1.0 (T2)	1.5 (T3)	
	(g)				
2	186.4 ±8.72^{a}	178.06 ±6.55^{b}	173.54 ±4.10^{bc}	170.00 ±5.32^{c}	0.0057
3	284.44 ±13.74^{a}	273.38 ±9.44^{b}	275.72 ±9.32^{ab}	262.12 ±5.50^{c}	0.0214
4	400.18 ±15.38^{a}	379.54 ±11.51^{b}	388.04 ±16.14^{ab}	371.72 ±16.71^{b}	0.0487
5	516.24 ±18.34	493.95 ±24.38	486.54 ±22.83	486.22 ±26.95	0.1824
6	636.34 ±27.31	621.48 ±28.62	597.14 ±25.74	598.52 ±35.73	0.2790
7	789.92 ±21.47	757.46 ±35.32	749.17 ±30.89	744.61 ±31.56	0.1177
8	896.68 ±30.70	891.42 ±41.39	866.68 ±38.02	862.95 ±40.40	0.4107

Note: Different superscripts in the same row indicate significant differences (P < 0.05).

These results differ from those of Fik *et al.* (2021), who reported that administering 0.5–1.5% CA in the ration had no effect on the body weight of broiler chickens aged 1–14 days, but significantly increased body weight at 21–42 days of age. At 6 weeks of age, the average final weight of KUB chickens in this study (597.14 ± 25.74 to 636.34 ± 27.31 g) was higher than the findings of Erwan *et al.* (2023), which reported a range of 401.6–455.5 g. At 8 weeks of age, the average weight of KUB chickens in this study (862.95 to 896.30 g) was higher than the weight of KUB chickens in the study by Harnanik and Woraswati (2021), which was 636 ± 72 g. CA administration did not negatively affect chicken mortality rates. The mortality rate of KUB chickens up to the 8th week for all treatments was 0%.

Feed Conversion

At 7 weeks of age, the feed conversion of KUB chickens in T1, T2, and T3 was not significantly different (P > 0.05) from T0 (Table 5). Similarly, in weeks 5, 6, and 8, the feed conversion for KUB chickens in T0, T1, T2, and T3 remained high (3.12 ± 0.33 to 4.3 ± 0.82). This was due to the growth of the chickens beginning to decline while feed consumption continued to increase. These conversion values are still lower than those reported by Rajulani *et al.* (2022), who found that the average FCR of KUB chickens during 8 weeks of maintenance ranged from 4.11 to 4.73. According to Saelan *et al.* (2023), the average FCR of KUB chickens during 10 weeks of maintenance was 4.03–4.47.

Table 5: Average feed conversion of KUB chickens.

Week	CA dose (%)				P- Value
	0.0 (T0)	0.5 (T1)	1.0 (T2)	1.5 (T3)	
2	1.82±0.02	1.78±0.05	1.79±0.05	1.73±0.07	0.1141
3	2.10±0.12	2.10±0.06	1.98±0.05	2.07±0.12	0.1674
4	2.22±0.19	2.30±0.18	2.24±0.14	2.21±0.14	0.8189
5	3.28±0.19	3.55±0.31	3.80±0.40	3.41±0.31	0.0870
6	3.25±0.49	3.12±0.33	3.50±0.57	3.57±0.65	0.3786
7	2.83 ±0.25[b]	3.31 ±0.34[a]	2.84 ±0.37[b]	2.93 ±0.37[b]	0.0361
8	4.34±0.82	3.71±0.61	3.84±0.21	3.88±0.40	0.3483

Note: Different superscripts in the same row indicate significant differences (P < 0.05).

The feed conversion of chickens that was not significantly different from the control was also stated by Bzoska et. al. (2013) and Martinez *et al.* (2021). According to Ding *et al.* (2017); Mohammed (2018); Khalil *et al.* (2020), the feed conversion of chickens was significantly lower than the control when given acidifier.

Weight of Internal Organs

CA had no significant effect (P > 0.05) on the weight of the gizzard, liver, or heart of the chickens. The weight of the gizzard (14.4 ± 2.14 g for T1; 14.45 ± 0.89 g for T2; 15.65 ± 1.33 g for T3) was not significantly different (P > 0.05) from the control group (14.32 ± 2.78 g). Similarly, the weights of the liver and heart of KUB chickens were also not significantly different (P > 0.05) from the control (Table 6).

These results are similar to the reports of Fikri *et al.* (2021) and Haq *et al.* (2014). These results differ from the report of Xue *et al.* (2023) that the relative weight of goose liver given CA was not significantly different from the control, but the relative weight of gizzard with 0.50% CA was significantly higher while at 2.0% CA it was significantly lower. This difference is caused by differences in the types of poultry.

Table 6: Average weight of internal organs of KUB chickens.

Parameters	CA dose (%)				P-value
	0.0 (T0)	0.5 (T1)	1.0 (T2)	1.5 T3)	
Gizzard (g)	14.32 ±2.78	14.4±2.14	14.45 ±0.89	15.65 ±1.33	0.6658
Liver (g)	17.23 ±0.93	19.25 ±1.38	19.22 ±2.95	17.47 ±2.27	0.2679
Heart (g)	5.17±0.57	4.75±1.04	5.61±0.42	4.48±0.53	0.1561
Spleen (g)	3.27±0.66	2.76±0.69	2.98±0.61	2.48±0.57	0.2861
Gallbladder	1.66±0.51	1.28±0.34	1.23±0.29	1.31±0.23	0.233

Table 6 also shows the weight of the KUB chicken spleen and gallbladder when CA was added to drinking water at 56 days of age. CA administration did not affect the spleen weight (3.27 ± 0.66 g for T0; 2.76 ± 0.69 g for T1; 2.98 ± 0.61 g for T2; 2.48 ± 0.57 g for T3). The spleen is an organ involved in immune system activity. According to Al-Mutairi *et al.* (2020), the provision of organic acids in feed did not significantly affect the spleen of 42-day-old broiler chickens. Similarly, the administration of propionic acid had no significant effect on the relative weight of the spleen (Martinez *et al.*, 2021).

The gallbladder contains bile secreted by the liver to neutralize acidic conditions. Gallbladder fluid also contains salts that function to improve enzyme performance in feed nutrient metabolism. The results of the study (Table 6) showed that the administration of CA in drinking water for 56 days did not affect the weight of the gallbladder (1.66 ± 0.51 g for T0; 1.28 ± 0.34 g for T1; 1.23 ± 0.29 g for T2; 1.31 ± 0.23 g for T3) in KUB chickens. The administration of CA did not burden the liver's performance in neutralizing acid in the digestive tract.

CONCLUSIONS AND RECOMMENDATIONS

Continuous administration of citric acid at doses up to 1.5% in drinking water reduces the performance of KUB chickens during the 2nd and 3rd weeks. However, from the 4th to the 8th week, their performance tends to improve. The use of citric acid does not have a negative impact on the weight of giblets or internal organs. Therefore, it is recommended to begin CA administration in the 4th week, rather than earlier. Future studies should investigate the optimal timing, dosage, and duration of acidifier use to maximize growth performance while monitoring any long-term effects on overall health and organ development. Additionally, exploring the potential benefits of different types of acidifiers and their combinations could provide further insights into enhancing poultry performance.

ACKNOWLEDGMENTS

The authors are thankful to the Institute for Research and Community Service, University of Lampung, for funding this research.

NOVELTY STATEMENT

This study is a basic research on the use of citric acid acidifier into drinking water to improve the efficiency of KUB chickens. The results of the study indicate that further research is needed on the method, dosage, and time of giving citric acid so that it can be optimal to increase the productivity of KUB chickens.

AUTHOR'S CONTRIBUTIONS

All authors contributed to the research and manuscript. Conceptualization Dian Septinova; methodology Dian Septinova; sample collection and data tabulation Riyanti Riyanti, Tiara Arnenda, Mita Dewita Sari; revised the final manuscript Madi Hartono.

Conflict of Interest

The athors have declared that there is no conflict of interest.

REFERENCES

Ali AM, El Agrab HM, Hamoud MM, Gamal AM, Mousa MR, Nasr SAE., El Shater MAH, Laban SE, Zahran OK, Ali MM (2020). Effect of acidified drinking water by organic acid on broiler performance and gut health. Adv. Anim. Vet. Sci., 8(12): 1301–1309.

Al-Mutairi HMS, Hussein EOS, El Nabi ARJ, Swelum AA, El-Hack MEA, Taha AE, Al-Mufarrez SI (2020). Does the consumption of acidified drinking water affect growth performance and lymphoid organs of broiler. Sustainability, 12(8): 3093. https://doi.org/10.3390/su12083093

Bzoska F, Sliwinski B, Rutkowska OM (2013). Effect of dietary acidifier on growth, mortality, post-slaughter parameters, and meat composition of broiler chickens. Ann. Anim. Sci., 13: 85-96. https://doi.org/10.2478/v10220-012-0061-z

Clark L, Hagelin J, Werner S (2014). The Chemical Senses in Birds. Digital commons Univerisity of Nebraska-Liclon.

Ding X, Yang W, Yang ZB, Yang WR, Jiang SZ, Yi Wen KF (2017). Effects of feed acidifiers on growth performance, caecum microflora and nutrient and energy utilisation in broilers. Eur. Poult. Sci., 81:1-13.

Chun QG, Hui QS, Wen YX, Li HZ, Jian YZ, Cheng J, Qiu GM (2021). Dietary supplementation with acidifiers improves the growth performance, meat quality, and intestinal health of broiler chickens. Anim. Nutr., 7(3): 762–769. https://doi.org/ 10.1016/j.aninu.2021.01.005

Eftekhari A, Rezaeipour V, Abdullahpour R (2015). Effect of acidified drinking water on performance, carcass, immune response, jejunum morphology, and microbiota activity of broiler chickens fed diets containing grading levels of threonine. Livestock Sci., 180: 158–163. https://doi.org/10.1016/j.livsci.2015.07.010

Erwan E, Juliantoni J, Rizky A, Fati N (2023). Performance of KUB chicken feed sapuring as substitution of commercial feed. J. Livestock Anim. Health, 6(1): 51–56. https://doi.org/10.32530/jlah.v6i1.24

Fadhiila MR, Tugiyanti E, Susanti E (2022). The effect of giving feed additives as a substitute for antibiotics on the relative weight of the liver and kidneys of broiler chickens. Agrinimal: Jurnal Ilmu Ternak dan Tanaman, 10(2): 51–58. https://doi.org/10.30598/ajitt.2022.10.2.51-58

Fausiah A, Mahmud ATBA, Rab SA (2019). Organoleptic test of broiler chicken crossbred meat with density. Jurnal Ternak, 10(2): 60–63.

Fazayeli-Rad AR, Nazarizadeh H, Vakili M, Afzali N, Nourmohammadi R (2014). Effect of citric acid on performance, nutrient retention, and tissue biogenic amine content in breast and thigh meat from broiler chickens. Eur. Poult. Sci., 78. https://doi.org/10.1399/eps.2014.56

Fik M, Hrncar C, Hejnis D, Hanusova E, Arpasova H, Bujko J (2021). The effect of citric acid on performance and carcass characteristics of broiler chickens. Anim. Sci. Biotechnol., 54(1): 187–192. https://www.cabidigitallibrary.org/doi/pdf/10.555/ /20210260288

Fikry AM, Attia AI, Ismail IE, Alagawany M, Reda FM (2021). Dietary citric acid enhances growth performance, nutrient digestibility, intestinal microbiota, antioxidant status, and immunity of Japanese quails. Poult. Sci., 100(9): 101326. https://doi.org/ 10.1016/j.psj.2021.101326

Guo YJ, Wang ZY, Wang YS, Chen B, Huang YQ, Li P, Tan Q, Zhang HY,Chen W (2022). Impact of drinking water supplemented with 2-hydroxy-4-methylthiobutyric acid in combination with acidifier on performance, intestinal development, and microflora in broilers. Poult. Sci., 101(3): 1–13. https://doi.org/10.1016/j.psj.2021.101661

Haq A, Tabassum MC, Ahmad F, Shafi J, Ashraf M, Javed M, Rehman S (2014). Effect of dietary acidification with citric acid on carcass characteristics, haemogram, and serum metabolite values of broiler chicken. Pak. J. Life Soc. Sci., 12: 36–41.

Harnanik S, Wiraswati R (2021). Performance of Kampung Unggul Balitbangtan (KUB) Chicken on household-scale semi-intensive maintenance in swamp agroecosystem in Ogan Komering Ilir District. Jurnal Kali Agri, 3(2): 29–37. https://doi.org/10.56869/kaliagri.v2i2.252

Hezaveh MSS, Ghazemi HA, Hajkhodadi I, Moradi MH (2020). Single and combined effects of phytase and citric acid on growth performance, nutrient digestibility, bone characteristics, intestinal morphology, and blood components in meat-type quails fed low phosphorus diets. Anim. Feed Sci. Technol., 269. https://doi.org/10.1016/j.anifeedsci.2020.114677

Hidayat K, Wibowo S, Sari LA, Darmawan A (2018). Natural acidifier of lime juice (*Citrus aurantium*) as a substitute for antibiotic growth promoter in broiler chickens. *Jurnal* Ilmu Nutrisi dan Teknologi Pakan, 16(2): 27–33. https://doi.org/10.29244/jintp.16.2.2

Ishfaq, Rather SA, Mir AH, Gupta M (2015). Effect of Acipure (feed acidifier) on the growth performance, mortality, and gut pH of broiler chickens. Int. J. Livestock Res., 5(10): 40–46. https://doi.org/10.5455/IJLR.20150822031205

Khalil KKI, Islam MA, Sujan KM, Mustari A, Ahmad N (2020). Dietary acidifier and lysozyme improve growth performances and hemato-biochemical profile in broiler chickens. J. Adv. Biotechnol. Exp. Ther., 3(3): 241–247. https://doi.org/10.5455/jabet.2020.d130

Kostaman T, Sutedi E (2019). The performance of KUB chicken 0-12 weeks at Jatiwangi Village, Pakenjeng District, Garut Regency in BEKERJA Program. Proc. Natl. Semin. Anim. Husbandry Vet. Sci., 718–724.

Martinez Y, Almenderes CI, Hernandez CJ, Avellneda MC, Urquia AM, Vadivie M (2021). Effect of acetic acid and sodium bicarbonate supplemented to drinking water on water quality, growth performance, organ weights, cecal traits and hematological parameters of young broilers. Animals, 11(7): 1–15. https://doi.org/10.3390/ani11071865

Martinez Y, Gonzalez A, Botello A, Prez K (2021). Effect of a combination of propionic-acetic on body weight, relative weight of some organs, lactic acid bacteria and intestinal pH of neonatal broilers. Braz. J. Poult. Sci., 232(2): 1–8. https://doi.org/10.1590/1806-9061-2020-1252

Mohammed HA (2018). Effect of organic acid supplanted in drinking water during pre-starter and starter feeding phase on broiler performance. Polytechnic J., 8(2): 60–69. https://doi.org/10.25156/ptj.2018.8.2.60

Ndelekwute EK, Assam ED, Assam EM (2018). Apparent nutrient digestibility, gut pH and digesta viscosity of broiler chickens fed acidified water. MOJ Anat. Physiol., 5(4): 250–253. https://doi.org/10.15406/mojap.2018.05.00203

Paras MS, Purnamasari L, Cruz JFD (2022). Effect of dietary citric acid and microbial phytase on the growth performance of broiler chickens. Jurnal Ilmu Ternak, 22(2): 79–87. https://jurnal.unpad.ac.id/jurnalilmuternak/index

Pearlin BV, Muthuvel S, Govidasamy P, Villavan M, Alagawany M, Farag MR, Dhama K, Gopi M (2019). Role of acidifiers in livestock nutrition and health: A review. Anim. Physiol. Anim. Nutr., 104(2): 558–569.

Rajulani C, Bahri S, Zainudin S (2022). Performance of superior kampung chicken given fermented tofu dregs using microbacter alfaafa-11. Gorontalo J. Equatorial Anim., 1(2): 81–86. https://ejurnal.ung.ac.id/index.php/gijea

Roura E, Baldwin MW, Klasing KC (2013). The avian taste system: Potential implications in poultry nutrition. Anim. Feed Sci. Technol., 180: 1–9. https://doi.org/10.1016/j.anifeedsci.2012.11.001

Saelan E, Utami SS, Salim MU (2023). The performance of Kampung Unggul Balitnak (KUB) chickens with dietary addition of fermentation brain. Agrivet Journal, 11(1): 7–12. https://doi.org/10.31949/Agrivet/V11i1.5224

Tajudin, Sumarno, Fitasari E (2021). The effect of giving acidifier with different levels on feed consumption, body weight gain, and feed conversion in male native chickens. Jurnal Ilmiah Fillia Cendikia, 6 (2): 96–105. https://doi.org/10.32503/fillia.v6i2.1861

Urfa, Indrijani SH, Tanwiriah W (2017). Growth curve model of Kampung Unggul Balitnak (KUB) chicken. Jurnal Ilmu Ternak, 17(1): 59–66. https://doi.org/10.24198/jit.v17i1.14863

Xue JJ, Huang XF, Liu ZL, Chen Y, Zhang YK, Luo Y, Wang BW, Wang QG, Wang C (2022). Effects of citric acid supplementation on growth performance, intestinal morphology and microbiota, and blood parameters of geese from 1 to 28 days of age. Poult. Sci., 102(2): 102343. https://doi.org/10.1016/j.psj.2022.102343