RESEARCH ARTICLE

EFFECT OF ORGANIC ACID AS A FEED SUPPLEMENT ON GROWTH PERFORMANCE OF BROILER

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ABSTRACT

An experiment was carried out to evaluate the effect of organic acid as a feed supplement on growth performance of broiler. The experiments were laid out in Completely Randomized Block design (CRD) with four treatments. The treatments were Control, 0.5% Propionic acid, 1% Lactic acid, 1% Citric acid. Each treatment was replicated thrice. It was revealed that the effect of organic acid on feed conversion ratio were 1.48, 1.49, 1.54 and 1.68 in these different treatments control, Propionic acid, Lactic acid and Citric acid respectively. The cumulative feed intake was found to be 3073.94gm, 2911.46gm, 3338.24gm and 3214.94gm in these different treatments control, Propionic acid, Lactic acid and Citric acid respectively. Similarly, water intake were found to be 356.79ml, 350.28ml, 400.97ml and 355.51ml in these different treatments control, Propionic acid, Lactic acid and Citric acid respectively. From the overall experiment, we observed that control feed gave less feed conversion ratio (FCR) though mortality rate was higher. The FCR was found to be less in propionic acid as comparison to other organic acids and the mortality rate was found to be lowest as well. Cumulative feed intake were highest in lactic acid treatment and lowest in propionic acid treatment and water intake were highest in lactic acid treatment and lowest in propionic acid treatment. So, we can conclude that the effect of lactic acid on water intake and feed intake were found to be better whereas the effect of propionic acid was found to be better on feed conversion ratio.

KEYWORDS

Broiler, Organic acid, Growth

1. INTRODUCTION

Livestock systems occupy about 30 per cent of the planet's (Steinfeld et al., 2006). Their products contribute 17 % to kilocalorie consumption and 33 % to protein consumption globally, but there are large differences between rich and poor countries (Rosegrant et al., 2009). Livestock systems have both positive & negative effects on the natural resource base, public health, social equity and economic growth (World Bank 2009). Currently, livestock is one of the fastest growing agricultural subsectors in developing countries. Its share of agricultural GDP is already 33 % and is quickly increasing. This growth is driven by the rapidly increasing demand for livestock products, this demand being driven by population growth, urbanization and increasing incomes in developing countries (Delgado, 2005). More than 66 % of total population is involved in agricultural practices. Agriculture contributes 33.7% of total GDP among which 15% is contributed by livestock production. Among various animal husbandry enterprises, poultry production has assumed number one position and attained industrial status in many countries. It is one of the main practices among livestock production in Nepal that contributes about 3.5% of GDP. It ranks in 112th position in chicken meat production. Out of 2, 95,167 Mt ton total meat production poultry accounts for 42,810 Mt ton in year 2071/72 (MOAC, 2014).

Dietary acids for poultry diets are classified as inorganic and organic acids. However, organic acids have been more often used for poultry diets. Organic acids can be defined as carboxylic acids including fatty acids, which have the chemical structure of R-COOH with acidic properties. However, not all organic acids have been used as feed additives in poultry diets. Short chain fatty acids such as formic (C1), acetic (C2), propionic (C3), and butyric acid (C4), and other carboxylic acids such as lactic, malic, tartaric, fumaric, and citric acid have been most commonly used in the poultry industry because their chemical and physical properties are applicable to poultry diets (Dibner and Buttin, 2002). Previously, several reviews have discussed the effects of dietary organic acids on broiler chickens (Dibner and Buttin, 2002; Ricke, 2003; Anjum and Chaudhry, 2010; Islam, 2012). Generally, organic acids are weak acids and do not dissociate completely in water. They are widely distributed in nature as normal constituent of plants or animals tissues and form through microbial fermentation of carbohydrate mainly in the large intestine. However, not all organic acids have been used as feed additives in poultry diets. Organic acids are also found in their sodium, potassium or calcium form. Citric acid, in biochemistry is important as an intermediate in the citric acid cycle and therefore, occurs in the metabolism of virtually all living things. More than 50% of citric acid is being used as acidulant in beverages and some 20% in the other food application

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2. LITERATURE REVIEW

In Nepal, more than 65% of people depend upon agriculture. Contribution of agricultural sector in Gross Domestic product (GDP) of Nepal is 33%. Among them contribution of livestock sector in total GDP is 26.8% and poultry sub sector within livestock contributes 8% of Agriculture Gross Domestic product (AGDP) and indigenous poultry is widely prevalent which contributes 55% of total poultry population (Kattel, 2016). In poultry production, organic acids have not gained as much attention as in Pig production (Langhout, 2000)

2.1 Effect of organic acid in poultry performance

La Ragione and Woodward stated that several organic acids protect young chicken by competitive exclusion; improve growth performance, feed efficiency mineral adsorption and nutrient utilization (La Ragione and Woodward, 2003). Revista Brasileira de Zootecnia reported that the use of an organic acid's mixture (comprising 30.0% lactic acid, 25.5% benzoic acid, 7% formic acid, 8% citric acid and 6.5% acetic acid) in broiler diets improved its performance as compared to the control diet at 42 days of age and organic acids provided better carcass characteristics. An increase in body weight gain was observed in the organic acid group (2402 g) compared to the control group (2276 g) at the end of 42 day of experiment. Improvements in broiler performance in response to organic acids are often reported. However, an important limitation is that organic acids are rapidly metabolized in the foregut (the crop to the gizzard), which will reduce their impact on growth performance (Lückstädt and Mellor, 2011). Formic, acetic and propionic acids have very good solubility in water (Freitag, 2007).

2.2 Effect of organic acid on water intake

Langhout reported that high amount of organic acid supplementation reduces the water intake but it significantly improves the FCR (Langhout, 2000).

2.3 Effect of organic acid on weight gain

A group researcher examined eight experiments using various inclusion level of dietary citric acid. The data indicated that dietary citric acid generally led to increased body weight gain and feed efficiency but decreased feed intake of broiler chickens; however, there was high variation in the ratio of the number of positive responses to the number of negative responses (Kim et al., 2015). Al-Kassi and Mohssen reported that adding 2 g/kg of propionic acid to broiler diets resulted in significant improvements in body weight gain, feed intake, and feed efficiency by 11.2, 5.1, and 6.1%, respectively (Al-Kassi and Mohssen, 2009). Some researcher also observed that birds fed diets containing 2 g/kg blends of propionate salts and formats had numerically greater body weight gain and feed intake than those fed the control diets (Gunal et al., 2006). Some researcher also reported that body weight gain in acid blend-supplemented groups was increased by from 1.8 to 3.2%, whereas feed efficiency was improved by nearly 4.0% (Kim et al., 2009). Some researcher determined the cumulative effects of citric acid among enzymes and other minerals on feed intake, body weight gain, feed conversion, intestinal viscosity and toe ash of broilers fed on wheat-based diets (Zyla et al., 2000). The supplementation of the diet having 0.17% available P with the enzymes and citric acid, significantly improved body weight gain, feed intake, feed conversion and intestinal viscosity above the diet with 0.41% available P.

3. METHODOLOGY

3.1 Site selection

The experiment was carried out in the area of Campus of live sciences in Tulsipur, Dang which lies in Rapti Zone with latitude 28.1278 and longitude 82. 2956. Tulsipur is located in inner Terai, 450 km west of the capital city. This valley lies between the Mahabharat range in the north and Chure hill in the south.

3.2 Experimental design

The experiment was laid out in Completely randomized block design consisting of 4 treatments. Each treatment was replicated thrice and allotted randomly. Inside the house, 24 small rooms were made by partitioning with the help of wire gauge and plastics in which we were allotted 12 compartments. Figure below shows the structure of the poultry house:

Figure 1: Structure of the poultry house

Figure 2: Experimental design (CRD)

Treatment-1 (T1)	Compound feed without organic acids
Treatment-2 (T2)	Compound feed with 0.5% propionic acid
Treatment-3 (T3)	Compound feed with 1% lactic acid
Treatment-4 (T4)	Compound feed with 1% citric acid

Figure 3: Details of experiment

Note: 300 gram of citric acid were given for 30 kg of feed. 150-gram propionic acid were given for 30 kg of feed. Similarly, 300 ml lactic acid for 30 kg of feed were given to the birds. Other different activities and methodology performed are explained as below:

- Plastic coverings: To maintain the temperature inside, the gauzed wall was covered by tarpaulins in all sides. These tarpaulins could be removed when required.
- Fumigation: Fumigation was done in order to control the living pests inside the poultry house. Fumigants like formaldehyde and potassium permanganate was used.
- Liming: To reduce the infection and transfer of pests from outside environment, lime was placed just inside the door of the poultry house. Similarly, lime dust was sprayed all over the walking alley.
- Bedding management: For reducing the cold from the cemented floor, risk husks were used as the bedding material (2-3 inch). Above the rice husk, newspapers were placed in such a way that the chicks would not feed on the bedding material.
- Jute sack hanging: For the purpose of regulating the fresh air inside the poultry house, we hang the jute sack around the periphery of the farm, and that sack was sprayed with cold water time to time and kept moistened. The sack was kept at the distance about 2 m from the farm. This was found beneficial to maintain cool temperature inside the farm.
- Use of incandescent lamp: A light bulb was used having the metallic filament to create warmth to the brooding chicken as they are susceptible to cold condition. This lamp was operated through electric current.
- Use of electrolyte: Similarly, for the purpose of reducing the heart stress in poultry; they were given electrolyte. Electrolyte was given during the sunny days. It was given at rate of 1 gm/ 1 litre of water. And in less sunny days; it was given @ 1gram/ 2 litre of water. Electrolyte was not given during rainy and cloudy days.
- Vitamins and minerals: the birds were given 5-8 gram of vitamin powders for 28 days; the birds were also given minerals supplements @ 25 gram/ 125 birds with the aim to fulfill their mineral requirement.
- Liver tonic: Liver tonic was given to support the liver in detoxification and to improve the structural and functional integrity of liver cell. It was given @5-10 ml for 100 birds.
- Vaccination: Ranikhet vaccine was given to them to them to protect from ranikhet disease which causes diarrhea. This was given on the 7th day while vaccine against Gumboro disease was given on 14th day.

4. RESULTS AND DISCUSSION

4.1 Effect of organic acid on growth performance

From our experiment, we found out that several organic acids have effective protection on young chicks. The feed intake and growth

performance were also better compared to control feed, which was with correspondence to La Regione and Woodward. But the feed efficiency was more in the chicks fed with control feed followed by other organic acids.

4.1.1 Effect of organic acid on Body Weight

Table 1: Effect of organic acid on body weight								
Treatments	Days					Total weight gain	Average daily gain	FCR
	7-13days	14-20days	21-27days	28-34days	35-38days			
Control	197.63±5.91	505.12±34.62	794.03±45.9	1272.8±139.6	2118.38±239.1	2072.05	54.52	1.48
Propionic acid	209.84±5.229	498.93±32.7	832.66±19.73	1310.66±83.91	1996.79±74.35	1953.52	51.41	1.49
Lactic acid	207.42±1.5	517.72±25.97	860.90±59.20	1420.55±147.83	2213.66±165.05	2169.26	57.08	1.54
Citric acid	223.03±23.36	515.36±28.23	903.15±52.77	1321.81±33.67	1962.45±26.28	1917.23	50.45	1.68
Mean	209.48±14.15	509.28±27.28	847.68±57.72	1331.46±110.67	2072.82±165.40	2028.42	53.37	1.54
P-value	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05

According to our experiment, we found out the broiler fed with citric acid have decreased feed intake in 4th and 5th week in correspondence to Kim et.al. But body weight gain was less in 2nd, 3rd and 4th week along with the decreased feed efficiency compared to other organic acid treatment. The body weight gain was maximum in case of lactic acid treatment.

Though the body weight of broilers treated with propionic gained less mean body weight, the feed efficiency and reduced mortality rate was better compared to other organic acid treatment which is as similar as experiment of Al Karsi and Mohssen.

2.3.1 Effect of organic acid on feed intake per bird

Table 2: Effect of organic acid on feed intake					
Treatment	Days				Cumulative feed intake (gm)
	2 nd week (7-13 days)	3 rd week (14-20 days)	4 th week (21-27days)	5 th week(28-37days)	
Control	57.86±1.8	91.52±4.1	111.57±6.4	124.67±11.0	3073.94
Propionic Acid	56.90±6.0	84.38±5.5	107.62±4.2	116.87±13.8	2911.46
Lactic Acid	64.29±3.9	92.14±9.6	122.29±10.3	141.43±25.4	3338.21
Citric Acid	61.71±3.2	96.14±5.1	119±11.2	127.97±16.4	3214.94
Mean	59.44±4.8	91.05±7.7	115.1±10.1	127.73±19.2	3134.64
P-value	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05

The feed intake was found more in case of lactic acid treatment. The feed intake in citric acid treatment was more in 2nd week which got decreased

in 3rd and 4th week. The result of our experiment on feed intake varied than that of Zyla et al in case of citric acid treatment.

2.3.2 Effect of organic acid on water intake

Table 3: Effect of organic acid on water intake				
Treatment	Days			
	2 nd week(7-13 days)	3 rd week(14-20 days)	4 th week (21-27days)	5 th week(28-37days)
Control	126.74	202.1	237.71	356.79
Propionic acid	113.25	196.11	242.28	350.28
Lactic acid	121.54	211.89	261.26	400.97
Citric acid	149.01	228.26	245.42	355.51

From the experiment, we observed that the broilers fed with organic acid treatment showed reduced water intake result in 4th week only. Also, the feed conversion ratio is higher than that of control feed treatment (Langhout, 2000).

5. CONCLUSION

Initially, brooding was done for (0-6) days using incandescent lamp. Then on the 7th day, 12 compartments were divided each accommodating 10 chicks. Then different treatments were randomized and replicated. The principal treatments were: control feed, feed treated with propionic acid (0.5%), lactic acid (1%) and citric acid (1%). Each replication was given feed according to their treatments twice a day. Water was provided thrice a day according to their requirements. Different vitamins and minerals

were provided according to their vitamins and mineral deficiency. To reduce the heat stress, electrolyte was given according to the weather condition. Weighing was conducted on weekly basis and chicks were vaccinated against Ranikhet and Gumboro disease at 7th and 14th day respectively. Chicks were reared up to 38 days by following regular management basis. From the overall experiment, we observed that control feed gave less feed conversion ratio (FCR) though mortality rate was higher. The FCR was found to be less in propionic acid as comparison to other organic acids and the mortality rate was found to be lowest as well. So, the overall performance was found to be better in propionic acid among other organic acids in term of feed conversion ratio but the performance like water intake and feed intake were found better in lactic acid treatment than in other acid treatments.

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