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GROWTH PERFORMANCE AND HAEMATOLOGICAL PARAMETERS OF WEANLING PIGS FED DIETS SUPPLEMENTED WITH CHLOROACETIC ACID

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ORIGINAL ARTICLE

ABSTRACT: *This study investigated the effect of chloroacetic acid on growth performance and heamatological parameters of weanling pigs. Thirty-six cross-bred weanling pigs (Landrace × Duroc) were allotted randomly to four treatment groups, with three replicates of three weanling pigs in each group. Control (T_1) weanling pigs were given a standard basal diet; Treatment 2, 3 and 4 were diets of 0.3, 0.6 and 0.9 percents levels of inclusion of chloroacetic acid respectively. After six weeks, blood and intestinal samples were collected from one animal per replicate. Data on feed intake and weight gain were collected daily. Results showed that chloroacetic acid did improve the animal growth performance. There was a decrease in pH. There was significant differences (P<0.05) on white blood cell and mean corpuscular haemoglobin across the treatment. There was no significant difference (P<0.05) across the treatments on pack cell volume and red blood cell count. This study showed that chloroacetic acid influenced some haematological parameters, decreased the pH of the gastro-intestinal tract of the animals. Further studies will be needed to better understand the mechanisms underlying the effects observed when chloroacetic acid is fed to weanling pigs.*

Key words: *Nitrogen Chloroacetic Acid, Growth Performance, Haematological Parameters Weanling Pigs.*

INTRODUCTION

Weanling in piglets is a crucial stage because the pigs are exposed to nutritional, environmental and social stresses resulting to low weight gain, nutrient melabsorption and increased occurrence of diarrhoea (Barnett et al., 1989; Boundry et al., 2004; Hedermann and Jensen, 2004). Antibiotics have been widely used to limit the impact of the post-weaning period on animal health. Nevertheless, antibiotic fed to farm animals may be responsible for the spreading of bacteria that are resistant to such antimicrobials (Bager et al., 1997; Philips et al., 2004). This led to the prohibition of the use of antibiotics as a growth promoter. The adjustments following the withdrawal of these products in animal production have been difficult at times and many replacement solutions have been proposed, more or less successfully by the feed additive industry. Organic acids are important approach that have potential to improve performance in animals (Patterson and Burkholder, 2003; Ricke, 2003) and also provide people with healthy and nutritious animal products (Ricke, 2003).

Chloroacetic acid is an organic acid that has been reported to be beneficial to weanling pigs helping them to overcome problems occurring during the post weaning period (Tsiloyiannis et al., 2001), and improved animal growth performances (Partenen and Mroz, 1999). Blood is important in the maintenance of physiological equilibrium in the body (Wilson and Mead, 1987). However, this equilibrium may be disturbed due to certain nutritional, environmental, physiological and pathological conditions. The knowledge of haematological values is useful in diagnosing various pathological and metabolic disorders, which can adversely affect the productivity and reproductive performance of weanling pigs hence, resulting in great economic losses to pig farmers (Okoli et al., 2008). The current research investigated the response of weanling pigs fed chloroacetic acid at various levels of inclusion in the diet on their growth performance and haematological parameters.

MATERIALS AND METHODS

Animals and experimental design

A total of 36 crossbred pigs (landrace × Duroc) were weaned at 35 days and transported to Piggery Unit of Michael Okpara University of Agriculture, Umudike, Nigeria. They were housed in individual pen (50×90cm) with

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free access to feed and drinking water for 42 days. The experimental design was complete randomized design (CRD). Data obtained were subjected to analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test as described by Steel and Torrie (1980). The criteria for significance were a probability of 0.05. After a 7 days adaptation period during which all piglets received the same based diet, the pigs (8±2kg of body weight) were divided into 4 groups (9 animals per group) that were homogenous for weight and sex. The pigs received 1 of 4 diet treatments, consisting of the base diet with (a) no addition (control diet), or with the addition of chloroacetic acid at (b) 0.3%, (c) 0.6% and (d) 0.9%. All diets were formulated to provide the same amount of energy, protein, essential amino acids, calcium and phosphorous. Feed and water were provided on an *ad libitum* basis. Composition of the experimental diets is reported in Table 1.

Table 1 - Percentage composition of experimental diets

Ingredients	Experimental diets			
	CHLA 0.0%	CHLA 0.3%	CHLA 0.6%	CHLA 0.9%
Maize	25.00	25.00	25.00	25.00
Maize offal	10.00	10.00	10.00	10.00
Brewers dry grain	15.00	15.00	15.00	15.00
Groundnut cake	8.00	8.00	8.00	8.00
Palm kernel cake	6.00	6.00	6.00	6.00
Wheat offal	27.3	27.3	27.3	27.3
Soya meal	5.00	5.00	5.00	5.00
Methionine	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1
Bone meal	3.0	3.0	3.0	3.0
Salts	0.25	0.25	0.25	0.25
Vit (mineral premix)	0.25	0.25	0.25	0.25
Total composition	100	100	100	100
Calculated nutrient content				
Crude protein %	19.521	19.521	19.521	19.521
ME (Kcal/kg)	2432.71	2432.71	2432.71	2432.71
Chloroacetic acid	0%	0.3%	0.6%	0.9%

Data Collection

pH determination: To determine the pH, 10g of gut content from stomach, duodenum, jejunum, caecum and rectum were collected aseptically on 90ml sterilized physiological saline (1:10 dilution) Al-Natour and Alshawabkeh, 2005) and pH were determined.

Blood sample: At the end of the experiment, three pigs were randomly selected per treatment group and bled from a punctured jugular vein. The samples for haematological analysis were collected in bottles containing ethylene diamine tetracetic acid (EDTA) at 1.5 mg/ml of blood as anti coagulant for the determination of haematological indices of interest such as red blood cell (RBC), white blood cell (WBC) haemoglobin and packed cell volume (PCV). Values obtained were used to calculate the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) as described by (Dacie and Lewis, 1991).

Growth performance: The initial weights of the weanling pigs were taken at the beginning of the experiment. Weight gain was obtained by subtracting the initial live weight from final live weight. Data on feed intake were determined by difference between the quantity offered and quantity left over each day. Feed conversion ratio was obtained by dividing feed intake by weight gain.

RESULTS AND DISCUSSION

Effects of haematological values

The haematological values of weanling pigs fed different levels of chloroacetic acid are shown in Table 2. CHLA 0.0% had the highest value of WBC count followed by CHLA 0.9% and CHLA 0.3% while CHLA 0.6% gave the lowest value which were significant (P<0.05). Okoli et al. (2008) reported a normal range of 3.00 to 4.20 x 10^3 for pigs. The higher value in CHLA 0.0% (5.20) may be as a result of the infection, while the normal value in CHLA 0.3% and CHLA 0.9% and lower value in CHLA 0.6% of WBC indicates lower level or absence of infection which may be due to the effect of chloroacetic acid acting as an antibiotic in the body. This result confirmed those obtained by Woldenden et al. (2007) and Abd El-Hakim et al. (2009) who concluded that organic acids could be used in animals, not only as a growth promoter but also as a meaningful tool of controlling intrinsic pathogenic bacteria. The red blood cell count values indicated that there were significant difference across the treatments (P<0.05), which is in consonant with Akanno et al. (2008). For packed cell volume, CHLA 0.0% gave the highest value (34%), followed by CHLA 0.9% (33%) and CHLA 0.3% (32%) while CHLA 0.6% gave the lowest value (15%). CHLA 0.0%, 0.3% and CHLA 0.9% fell within the normal range (30-50%) as reported by Okoli et al., (2008). For haemoglobin concentration, CHLA 0.0%, 0.3% and CHLA 0.9% fell within the normal range (10-16g/dL) ad reported by Okoli et al. (2008). There were no significant differences across the haemoglobin concentrations. Thus Okoli et al. (2008)

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reported a normal range of mean corpuscular haemoglobin concentration to be (30-36%) in which all the treatments fell within the normal range. For the control the MCHC falls below the treatments values, this indicates that chloroacetic acid improved the MCHC. There was a significant difference on mean corpuscular haemoglobin (MCH) across the treatments (P<0.05). According to Okoli et al. (2008), CHLA 0.3% and CHLA 0.9% fell within the normal range; CHLA 0.0% fell above the normal range, while CHLA 0.6% fell below the normal range. Significant difference also existed on mean cell volume (MCV) among the treatments (P<0.05).

Table 2 - Haematological values of weanling pigs fed chloroacetic acid at different levels

Parameters	Treatments				SEM
	CHLA 0.0%	CHLA 0.3%	CHLA 0.6%	CHLA 0.9%	
WBC (X10^{3}ml)	5.20^a	3.10^c	1.70^d	3.90^b	0.08
RBC (X10^{6}ml)	4.30^a	4.70^a	4.20^a	4.80^a	0.21
PCV (%)	34.00^a	32.00^a	15.00^b	33.00^a	2.35
Hb (g/dL)	11.20^a	10.80^b	7.01^e	11.07^a	0.06
MCHC (%)	32.94^c	33.75^a	33.33^b	33.33^b	0.01
MCH (pg)	26.05^a	22.98^b	16.66^d	22.92^c	0.01
MCV (μm^2)	79.67^a	68.09^b	50.00^c	68.75^b	1.45

Foot note: a,b,c,d- means in the row with different superscripts are significantly different from one another (P<0.05). SEM = standard error of the mean.

Growth performance

The growth performance of weanling pigs fed chloroacetic acid at different levels is shown in Table 3. There were significant differences between the control and the treatments on final weight and average daily feed intake. This is in agreement with the report of Piva et al. (2002 b) who reported that adding chloroacetic acid to the diet of weanling pigs improve their appetite and have positive effect on weight gain. The production results with respect to daily weight gain and feed conversion ratio was superior in group fed chloroacetic acid as compared to those obtained in the control group (Russel and Diez-Gonzale, 1998).

Table 3 - Growth performance of weanling pigs fed different levels of chloroacetic acid

Parameters	Treatments				SEM
	CHLA 0.0%	CHLA 0.3%	CHLA 0.6%	CHLA 0.9%	
Initial weight (g/animal)	6.70	5.93	6.57	6.47	0.94
Final weight (g/animal)	11.43	11.53	12.47	12.53	0.74
ADFI (g/animal/day)	0.81	0.83	0.81	0.81	0.01
ADWG (g/animal/day)	0.05^a	0.14^b	0.13^b	0.12^b	0.01
Feed conversion ratio	5.81	6.08	6.13	6.19	0.37

^{a,b,} means in the row with different superscript are significantly different from one another (P<0.05). SEM= standard error of the mean; ADFI= average daily feed intake; ADWG= average daily weight gain

There was no significant difference (P>0.05) on feed conversion ratio (FCR) across the treatments. There was a significant difference (P<0.05) between the CHLA 0.0% and other treatments. This implied that chloroacetic acid has slight effect on the daily weight gain of the pigs. This is in line with the report of Piva et al. (2002a). There was an increase in FCR from CHLA 0.3% to CHLA 0.9%. This showed that an increase in dietary inclusion of chloroacetic acid increases the FRC. At the same time, feeding high doses of organic acids may result in reduced feed intake and poor growth performance because of reduced feed acceptance.

Table 4 - pH values of weanling pigs fed chloroacetic acid at different levels

Parameters	Treatments			
	CHLA 0.0%	CHLA 0.3%	CHLA 0.6%	CHLA 0.9%
Stomach	5.37^c	4.50^c	4.33^c	4.53^c
Duodenum	5.28^c	4.48^c	4.50^c	4.50^c
Jejunum	6.37^b	5.47^b	5.47^b	5.63^b
Caecum	7.22^a	6.20^a	6.40^a	6.37^a
Rectum	7.17^a	6.01^a	6.17^a	6.33^a
SEM	0.25	0.20	0.23	0.22

^{a,b,c,} means in the same column with different superscript are significantly different (P<0.05)

Table 4 showed the pH of chyme from the gastro-intestinal tracts of weanling pigs fed different levels of chloroacetic acid. The pH of stomach, duodenum, jejunum, caecum and rectum varied significantly among all the treatments (P<0.05). In caecum and rectum, the highest pH values were recorded (6.32 and 6.17 averages, respectively) because appreciable amount of bacteria fermentation takes place there, thereby increased the alkalinity. Lowest pH value was recorded in the stomach, duodenum and jejunum (4.45, 4.49, and 5.52 average, respectively) because undissociated organic acid crossed mucous membrane and were absorbed in the small intestine. This finding is in accordance to Piva et al. (2002 a,b). This will cause reduction of the pH in the small

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intestine. But due to the presence of HCL and chloroacetic acid in the stomach, there was reduction in the pH of the stomach (Dibner and Butin, 2002).

CONCLUSION

This study showed that weanling pigs that received chloroacetic acid at 0.3 and 0.9 percent levels of inclusion gave better result on haematological parameters, increased the pH of the stomach, duodenum and jejunum. When fed to pigs after weaning, chloroacetic acid improved final weight and feed conversion ratio numerically. These results suggest that chloroacetic acid is worthy of further investigation as a potential alternative to antibiotics to improve growth performance and haematological values of pigs in the post weaned phase.

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