ASSESSMENT OF PROCESSED ROCK PHOSPHATE AS SOURCE OF INORGANIC PHOSPHORUS AND SUBSTITUTE FOR BONE MEAL IN BROILER DIETS

E.I IKANÍ, A.O. ADUKU* AND P.N. OKOH**

*National Agricultural Extension & Research Liaison Services,
Ahmadu Bello University, P.M.B. 1967, Zaria, Nigeria.*

*Formerly of Department of Animal Science Ahmadu Bello University, Zaria, Nigeria

**Department of Biochemistry, Edo State University, Ekpoma, Nigeria.

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ABSTRACT

A feeding trial was conducted for six weeks to assess the optimum replacement value of processed rock phosphate (PRP) for bone meal and as a source of inorganic phosphorus in maize-cotton seed meal based diets. A total of 144 day old Anack 80 strain broiler chicks were used. Triplicate groups of 12 birds were randomly placed on 4 diets containing 0, 1.8, 2.8 and 5.64% PRP which contributed 0, 0.16, 0.25 and 0.5% inorganic phosphorus in the diets respectively.

Results showed PRP levels in diets had no significant ($P>0.05$) effect on weight gain, growth rate and feed intake at 0 - 4 weeks. When 2.8% PRP replaced 2% of bone meal, feed efficiency was not significantly different from those birds fed 3% bone meal in control diet. Inclusion of 5.64% PRP significantly ($P<0.01$) depressed feed efficiency more than other treatment groups during the period. Addition of 5.64% PRP supported higher growth rate than other treatment group during 5 - 6 weeks, but this was not significantly different from birds fed on control and 2.8% PRP diets. Feed efficiency was significantly ($P>0.01$) lowest in the group fed on 1.8% PRP diet. Weight gain, growth rate and feed intake were not significantly ($P<0.01$) affected by treatments during 0 - 6 weeks.

It was concluded that 5.64% PRP which supplied 0.5% inorganic phosphorus supported optimum performance in broiler birds replacing 100% bone meal in control diet and caused growth that was equivalent to the group fed on 3% bone meal in control diet.

Key Words: Processed Rock Phosphate, Substitute, Inorganic Phosphorus, Bone Meal.

INTRODUCTION

Phosphorus is an indispensable inorganic mineral element in livestock production. It is one of the major constituents of bone (about 17.2%) and forms an essential component of organic compounds involved in almost every aspect of metabolism, optimum growth rate and optimum utilization of both calcium and phosphorus require an adequate level of each optimum ratio between them and sufficient vitamin D (Olorun, 1995).

It has been reported that phosphorus represents the third most expensive nutrient following energy and protein (Potchanakorn and Potter, 1987). Leg weakness with resultant increase in mortality, reduced growth rate, poor performance and down grading of birds deficient in phosphorus, pose a serious economic loss to the poultry industry (Nahorniak et al., 1983).

The conventional source of inorganic phosphorus in poultry diets in Nigeria is bone meal. There has been a tremendous jump in the price of bone meal in recent times. The trend in price change of bone meal between 1992 and 1997 shows an average of 900% rise from N800.00 per metric tonne in 1992 to N8,000.00 per metric tonne in 1997. Abubakar (1997). Also diversion of bones to other uses such as the manufacture of porcelain and gelatin, along with bones along with meat to provide bone which earns more profit to butchers all contributed in reducing the availability of bones for animal feed. Hence, the urgent need to explore other alternative sources of phosphorus supplement in poultry diets.

Literature on processed rock phosphate as an inorganic phosphorus supplement in broiler chickens is scanty. Waibel et al (1984) reported that differences existed among

TABLE 1: EXPERIMENTAL DIETS FOR BROILER STARTER 0 - 4 WEEKS

Ingredients (%)	DIETS			
	1	2	3	4
Maize	55.60	55.20	54.70	53.40
Cotton seed meal	40.50	40.63	40.76	41.04
Bone meal	3.0	2.0	1.50	-
Raw rock phosphate PRP	-	1.80	2.80	5.64
Salt	0.25	0.25	0.25	0.25
Oil	0.40	0.40	0.40	0.40
Vitamin/TM Premix ¹	0.25	0.25	0.25	0.25
Total	100.00	100.5	100.7	100.9
Calculated analysis of diets				
Crude protein %	23.12	23.14	23.15	23.17
ME Kcal/kg	2907.95	2897.41	2883.43	2845.84
Crude fibre %	7.06	7.07	7.08	7.09
Calcium %	1.12	1.14	1.20	1.20
Phosphorus %	0.69	0.68	0.69	0.69
Fluorine (mg/kg)	-	1.39	2.16	4.35
Lysine %	1.17	1.10	1.10	1.10
Methionine + Cystine	0.83	0.83	0.83	0.83

¹ The commercial premix (David Knight product) consist of the following per kilogram ration:- Vit. A 1500 I.U., Vit E 5mg Vit. D³ 3000I.U. Vit K 3mg, Vit. B¹ 2mg, Vit. B₂ 5.5mg, Vit. B¹² 10mg, Choline 120mg, Manganese 3.2mg, Cobalt 0.6mg, Zinc 25mg, Copper 2.6mg, Folic acid 2mg, Iodine 2mg, Molybdenum 240mg, D.N.O.T. 66MG, Antioxidant 56mg, Iron 5mg, Pantothenic acid 10mg, Biotin 30.5mg, Ampromium (tetracycline) 100mg, plus limestone flour.

biological values of phosphorus from different types of commercial phosphates. With biological value of dicalcium phosphate and commercial de-fluorinated phosphate were only 86% biologically effective. Bailey et al (1986) studied the effects of graded levels of dicalcium phosphate on bone mineralization and body weights which were estimated at weeks one and three, and found that body weight was not significantly affected by dietary phosphorus on young poult.

Nigeria imports her rock phosphate from Togo, substantial amount of which is used in the manufacture of single super phosphate fertilizer. Deposits of rock phosphate have been indicated in different parts of Nigeria like Abeokuta in South Western Nigeria in Dahomeyan basin. Kogbe (1981) reported occurrences of rock phosphate in Sokoto basin of the Illumedan basin. The discovery of rock phosphate deposits in Nigeria, scarcity and high prices of bone meal motivated this study which is aimed at:

a) Quantifying the optimum level at which processed rock phosphate serves as source of inorganic phosphorus and as substitute to bone meal in broiler diet.

b) Determining the effect of processed rock phosphate on performance parameters such as body weight gain, feed consumption and feed efficiency.

MATERIALS AND METHODS

Processed rock phosphate (PRP) was obtained from Kaduna Superphosphate Fertilizer manufacturing company. Chemical analysis of PRP and ashed bone meal were carried out (Table 3) before incorporation into the various diets. A total of 144 day-old Anack 80 strain broiler chicks were used in this study. Triplicate groups of 12 birds were randomly placed on four diets, such that group average weight at day-old were similar. The composition of maize-cotton seed meal basal diets used in this experiment are presented in Table 1. There were 4 dietary treatments containing 0, 1.8, 2.8 and 5.64% PRP in diets. Bone meal was completely replaced by calculated weight of PRP supplying equivalent levels of calcium and phosphorus in the bone meal replaced. Levels of calcium and phosphorus in diets were within range of broiler chicks requirements as recommended by NRC (1984). Broiler finisher diets are presented in Table 2. The day-old broiler chicks were quartered in an

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TABLE 2: EXPERIMENTAL DIETS FOR BROILER FINISHER (5 - 6 WEEKS)

Ingredients (%)	DIETS			
	1	2	3	4
Maize	65.50	65.00	65.00	65.00
Cotton seed meal	30.50	30.30	30.0	29.44
Bone meal	3.0	2.0	1.5	-
Raw rock phosphate PRP	-	1.80	2.8	5.64
Salt	0.25	0.25	0.25	0.25
Oil	0.40	0.40	0.40	0.40
Vitamin/TM Premix ¹	0.25	0.25	0.25	0.25
Total	99.00	100.00	100.2	100.98
Calculated analysis of diets				
Crude protein %	19.50	19.30	19.22	18.97
ME Kcal/kg	3007.65	2982.31	2975.05	2933.49
Crude fibre %	5.92	5.87	5.83	5.75
Calcim %	1.10	1.1	1.2	1.2
Phosphorus %	0.69	0.63	0.65	0.74
Fluorine (ppm)	-	1.39	2.16	4.35
Lysine %	1.10	1.10	1.10	1.10
Methionine + Cystine	0.83	0.83	0.83	0.83

¹ The commercial premix (David Knight product) consist of the following per kilogram ration:- Vit. A 1500I.U. 5mg Vit. D³ 3000I.U. Vit. K 3mg. Vit B¹ 2mg. Vit B₂ 5.5mg. Vit. B⁶ 2 10mg. Choline 120mg. Manganese 3.2mg. Cobalt 0.6mg. Zinc 25mg. Copper 2.6mg. Folic acid 2mg. Iodine 2mg. Molybdenum 240mg. D.N.O.T. 60mg. Antioxidant 56mg. Iron 5mg. Pantothenic acid 10mg. Biotin 30.5mg. Amprolium (tetracycline) 100mg. plus limestone flour.

TABLE 3: ANALYSIS OF PROCESSED ROCK PHOSPHATE (PRP) AND ASHED BONE MEAL

Minerals	*PRP (%)	Ashed bone meal (%)
Calcium	17.0	35.94
Phosphorus	9.14	16.82
Fluorine	0.81	0.36
Iron (Fe)	1.70	-
Manganese (Mn)	0.50	0.05
Magnesium (Mg)	0.18	0.50
Zinc (Zn)	0.06	0.50
Copper (Cu)	0.02	-

*Equivalent to soft rock phosphate (Hubbel, 1976).

open sided house on dry deep litter materials made of wood cleaned and disinfected. During brooding period (0 - 4 weeks) chicks were kept warm by heat provided from 40 watts electric bulbs and lanterns. The open sided house was sealed up to conserve heat in the pens. Feed and water were supplied ad libitum.

Measurement of Performance Indicators

Records of performance were carefully kept with each bird tagged and weighed individually on weekly basis. Feed was weighed out and weighed back on weekly basis to find the amount consumed. The parameters measured included weight gain, growth rate, feed intake and feed

efficiency. Data on performance indicators were subjected to analysis of variance for a completely randomized design. Least significant difference (LSD) was also used to compare and separate the means of the test diets (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The chemical composition of processed rock phosphate and ashed bone meal are as shown in Table 3. PRP contained 17% Ca and 9.14% P, while ashed bone meal contained 35.4% and 16.82% P. The PRP is equivalent to soft phosphate (Hubbel, 1972).

Performance of Chicks during 0 - 4 Weeks

TABLE 4: PERFORMANCE OF 0-4 WEEK OLD BROILER CHICKS FED VARIOUS PRP SUPPLEMENTED DIETS.

PRP in diet %	Mean Weight(g)	Body wt. Gain (G)	Wt. Gain/ bird/Day (g)	Feed intake(g)	Feed bird /day (g)	Feed efficiency G feed/ G gain
0.00	634.10	588.18	12.01	1111.68	39.70	1.89 ^b
1.80	629.68	590.01	21.07	1053.77	37.63	1.79 ^a
2.80	590.81	552.75	19.74	1061.17	37.89	1.916 ^b
5.64	606.25	563.13	20.12	1166.25	41.65	2.07 ^c
SEM ¹	50.18	46.98	1.68	91.43	3.26	0.01

^{a,b,c} Means in the same superscripts in the same column are not significantly different ($P > 0.01$)

¹ SEM: Standard Error of the Means

TABLE 5: PERFORMANCE OF 5-6 WEEKS OLD BROILER CHICKS FED VARIOUS PRP SUPPLEMENTED DIETS

PDCP in diet %	Weight Gain (g)	Wt. Gain/ Bird/day (g)	Feed Intake (g)	Feed intake Bird/day (g)	Feed efficiency G feed/gain
0	270.12 ^b	19.29 ^b	566.88	40.49	2.10 ^a
1.8	201.08 ^a	14.36 ^a	589.05	42.08	2.93 ^c
2.8	245.32 ^{ab}	17.52 ^{ab}	577.27	41.23	2.39 ^b
5.64	289.19 ^b	20.66 ^b	627.34	44.81	2.17 ^{ab}
SEM ¹	21.44	1.53	37.89	2.71	0.12

^{a,b,c} means in the same superscripts in the same column are not significantly different ($P > 0.05$)

¹ SEM: Standard Error of Means

TABLE 6: PERFORMANCE OF 0-6 WEEKS OLD BROILER CHICKS FED VARIOUS PRP SUPPLEMENTED DIETS.

PRP in diet %	Body weight (g)	Wt. gain (g)	Wt gain/ Bird/day (g)	Feed Consumption (g)	Feed intake Bird/day (g)	Feed efficiency (g feed/g gain)
0	904.23	860.88	20.50	1619.16	38.55	1.88 ^a
1.8	870.43	760.32	18.10	1586.42	37.77	2.09 ^b
2.8	869.75	831.60	19.80	1790.39	42.63	2.15 ^c
5.64	897.45	862.83	20.54	1597.43	38.04	1.85 ^a
SME ¹	55.07	51.34	1.22	100.44	2.39	0.01

^{a,b,c} Means in the superscripts in the same column are not significantly different ($P > 0.01$)

¹ SEM: Standard Error of Means

Performance of chicks during 0 - 4 weeks is presented in Table 4. Various levels of PRP fed in diets did not have adverse ($P > 0.05$) effect on weight gain, growth rate and feed intake. When 2.8% PRP replaced 2% bone meal, feed efficiency was not significantly ($P > 0.01$) different from the group on control diets. Inclusion of 5.64% PRP significantly ($P < 0.01$) depressed feed efficiency than other treatment groups. This observed depression could be due to the age of broiler chicks.

The group of birds on 1.8% PRP diet had highest

weight gain and growth rate at 0 - 4 weeks period, these values were not significantly ($P > 0.01$) better than other treatment groups at this young age. This seems to indicate PRP as a potential source of inorganic phosphorus for growing broiler chicks.

Chicks Performance during 5 - 6 weeks

Data on weight gain, growth rate, feed intake and feed efficiency at 5 - 6 weeks are presented in Table 5. Inclusion of 5.64% PRP in the diet supported higher weight gain and growth rate than other treatment groups during 5 - 6 weeks period, but this was not significantly ($P > 0.05$) different

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from birds fed on control and 2.8% PRP diets. The birds on 1.8% PRP diet had significantly ($P < 0.05$) reduced weight gain, but were not significantly different from those on 2.8% diet. This observed result agrees with that of Pensack (1974) who found that dicalcium phosphate containing 21% phosphorus were equally available to birds regardless of manufacturer.

PRP levels in diets had no significant ($P > 0.01$) effect on feed intake. However, feed efficiency was significantly ($P < 0.01$) reduced in the group fed on 2.8% PRP. This was followed by the birds fed on 2.8% PRP and 5.64% PRP diets. The birds on 5.64% PRP diet had statistically similar feed efficiency value as those on control diet. This tends to suggest availability of inorganic phosphorus in PRP for normal broiler performance.

Performance of Chicks during 0 - 6 Weeks

Summary of results on the overall performance of chicks from day-old to six weeks is as presented in Table 6.

Body weight gain, growth rate and feed intake were not significantly ($P < 0.05$) affected by the various PRP levels in diets during 0 - 6 weeks period. This result showed no significant difference due to dietary treatments on weight gain and it is in agreement with Bailey et al (1986) who noticed that body weight of young poult were not significantly affected by dietary phosphorus from graded levels of dicalcium phosphate. Data on feed efficiency (Table 6) indicated that 5.64% PRP enhanced efficiency of feed utilization that was equivalent to the group on 3% bone meal in control diet. Struwe, et al (1976) reported a depressing effect on feed efficiency on young poult given concentrated superphosphate and dicalcium aluminium phosphate fed to supply recommended or higher levels of supplemental phosphorus. The observed improved parity in our results could be due to differences in poultry type and types of commercial phosphates used as inorganic phosphorus source.

It was concluded that 1.8, 2.8 and 5.64% PRP could replace 1, 1.5 and 3% bone meal respectively as potential source of inorganic phosphorus in diets of broiler chicks from 0 - 6 weeks. Based on this finding, PRP could replace bone meal in totality without adverse effect in

broiler diets.

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