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SELECTED SERA MACRO AND MICRO – MINERAL COMPOSITIONS OF CROSSBRED WEANER PIGS FED RAW PRIDE OF BARBADOS (*Caesalpina pulcherrima*) SEEDMEAL

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ABSTRACT

An experiment was conducted with sixteen crossbred (Large White x Landrace) weaner pigs weighing on the average 4.00 kg to assess the sera macro and micro minerals of weaner pigs fed graded levels of raw pride of Barbados seed at 5, 10 and 15% inclusion level in eight weeks feeding trial. Blood samples were collected from the animals through the ear vein for mineral analyses. Results shows that dietary treatments had no significant effect (P>0.05) on calcium and phosphorus. Availability and utilization of calcium and potassium similarly gave values on the test ingredients that were comparable or even superior to values on the control diet (P>0.05). However, the experimental treatments had significant effect (P<0.05) on blood sodium, potassium and magnesium composition. Level of 17.20 mg/kg Phosphorus was obtained in pig fed 10% raw pride of Barbados seed meal while pig on control (diet 1) recorded the least values (16.50 mg/kg). The highest sodium values (124.99 mg/kg) was obtained in pig fed diet 3, 10% inclusion of raw pride of Barbados while the least value (95/88 mg/kg) was recorded for pigs fed 0% inclusion of raw pride of Barbados seed meal in diet 1.The highest value of magnesium (3.85 mg/kg) was obtained in pigs fed diet 4 while the least value (3.00 mg/kg) was recorded for pigs fed 0% inclusion of raw pride of Barbados in diet 1.Blood iron ranged from 100.5 in pigs on control diet to 114.67 in those fed diet 4. Zinc of 50.25 was obtained in pig on control diet and 90.22 in diet 4 while in copper, the highest value (113.33) was recorded for pig on diet 4 while the least were obtained in the control diet. There were no significant difference (P>0.05) in the values recorded for manganese. Based on the findings of this study, it could be concluded that raw pride of Barbados was deficient in some micro minerals and therefore suggested that the seed should be supplemented with other feed ingredients that are rich in the nutrient. Raw pride of Barbados seed meal should be included in the weaned pigs diet up to 15% without any adverse effects on bioavailability and utilization of macro and micro minerals.

Key words: Macro and micro minerals, Raw, pride of Barbados, Pigs, Bioavailability

INTRODUCTION

Minerals are inorganic substances present in all body tissues and fluids and their presence is necessary for the maintenance of certain physicochemical processes which are essential to life (Eruvbetine, 2003). Macro and micro minerals deficiencies constitute significant nutritional and public health problems. Every form of life requires these inorganic elements for normal life processes (Ozcan, 2003). The micro minerals are required in amounts less than 100 mg\dL while the macro minerals are required in amount greater than 100 mg/dL (Murray *et al.*, 2000). Dietary deficiencies due to absence of these vital nutrients in feedstuff are observed to have significant adverse effects on animals consuming the feedstuff. Both micro and macronutrients deficiencies are known to impair the body functions and to elevate the

severity of many diseases and infections in man and animals while compromising growth, development and reducing productivity in animals (NGMDCN, 2005).

Batra and Seth (2000) opined that the micronutrient deficiencies which are of greatest public health significance are iron deficiency anaemia caused by insufficient dietary intake, poor iron absorption and loss from intestinal bleeding due, in most cases, to parasitic worms such as round, whip and hookworms. Pig production represents one of the fastest ways of increasing animal protein since pigs grow at a faster rate and are highly more prolific than cattle, sheep and goats. Apart from their high rate of reproduction, pigs are characterized by the efficiency of nutrient transformation into high quality animal protein. The objective of this study is to provide information on the composition of macro and micro minerals in blood of weaner pigs fed raw pride of Barbados seed meal.

MATERIALS AND METHODS

Experimental location

The experiment was carried out at the piggery unit of the Teaching and Research Farm, Oyo State College of Agriculture and Technology, Igboora, Nigeria. The experimental area lies within 7 15° North and 3 30° East of equator with an average rainfall of 1278mm and average annual temperature of 27^{o}C (Sanusi, 2011).

Experimental diet

Ripened pods of pride of Barbados were collected within Igboora metropolis. The dried and mature pods were worked on to remove the seeds in lateral arrangement. Over 100 kg seeds were collected and grinded into pride of Barbados seed meal using hammer mill. The meal produced was used to formulate four isocaloric and isonitrogenous experimental diets containing graded levels (0, 5, 10 and 15%) of pride of Barbados seed meal (Table 1).

Table 1: Gross Composition of Experimental Diets fed to weaner pigs

Ingredients	**T1**	**T2**	**T3**	**T4**
Maize	30.00	28.00	25.00	20.00
Maize Offal	25.00	25.00	25.00	25.00
Raw Pride of Barbados seed meal	0.00	5.00	10.00	15.00
Soya-bean meal	20.00	17.00	15.00	15.00
Palm Kernel Cake	20.00	19.00	19.00	19.00
Local Fish meal	1.25	2.25	2.25	2.25
Bone meal	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50
Vit. Min. Premix	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Determined Analysis				
Dry Matter (%)	91.06	90.40	91.71	91.19
Moisture (%)	8.94	9.60	8.29	8.81
Crude protein (%)	18.90	19.05	19.10	19.25
Crude fibre (%)	5.00	6.00	7.00	8.00
Ash (%)	5.20	5.01	5.30	5.10
Ether extract (%)	5.00	4.50	4.60	6.00
Nitrogen Free Extract (%)	56.96	58.14	53.71	55.84
Digestible Energy (kcal/kg)	3.326	3.601	3.507	3.480

Experimental animals and management

The animals were quarantined for one week, during which they were treated against ectoparasites using diazintol solution (0.5 ml/5kg body weight), dewormed with albendazole (2.5% oral suspension) and injected intramuscularly with oxtetracycline a broad-spectrum antibiotic at 0.5 ml/5kg body weight. The animals were fed twice daily at 08.00 a.m and 03.00 p.m. The animals were fed 4% of their body weight and rations adjusted as the animals advanced in age .Water was supplied *ad libitum* .The animals were housed in concrete floored pens equipped with watering and feeding facilities. Routine management practices were followed.

Proximate analysis

The proximate composition of the experimental diets and digestible energy content were analysed according to the procedures of AOAC (2005).

Collection of blood samples and analysis

Blood samples were taken from the ear vein of two pigs per treatment at the end of the feeding trial. The blood samples were collected into plain bottles without Ethylene Diamine Tetra Acetate acid (EDTA) for the determination of micro and macro nutrients .Macro and micro minerals in sera samples were determined using flame atomic absorption spectrophotometer model 372, Perkin Elmer, 1982. Sodium and potassium were determined using the standard flame emission photometer employing NaCl and KCl to prepare the standards (AOAC, 1984). Phosphorus was determined calorimetrically using the spectronic 20 (Gallenkamp, Uk) as outlined by Pearson (1976) with KH_2PO_4 as standards.

Statistical analysis

Data collected were subjected to analysis of variance using Statistical Analysis Software (SAS, 2012). Means were separated using Duncan multiple range test of the same software at 5% probability.

RESULTS AND DISCUSSION

The results of the macronutrients status in the blood of weaner pigs maintained on raw pride of Barbados in diets are presented on Table 2.The highest value (9.00 mg/dL) of calcium was recorded in pig fed diet 4 while the least value (8.56 mg/dL) was obtained in pig fed diet 3.The values of sodium ranged from (124.99 mg/dL) in diet 3 to (95.88 mg/dl) in pig fed the control diet. Phosphorus was highest (17.20 mg/dL) in pig fed diet 3 while the least value (16.50 mg/dL) was recorded in pigs on control diet. Pigs fed diet 2 had the highest value (5.88 mg/dL) of potassium while the least value (4.00 mg/dL) was obtained in the pigs fed control diet. Magnesium values range from 3.00 mg/dL in the control diet to 3.85 mg/dL in pigs fed diet 4. Results of micro nutrients composition in the sera of weaned pigs fed raw pride of Barbados seed meal is shown in Table 3. Iron levels ranged from 100.5 in the control diet to 114.67 in pigs fed diet 4. Weaned pigs fed diet 4 recorded the highest value 90.22 while those on control diet were lowest 50.23.The highest value of copper (113.33) was obtained in pigs fed diet 4 while the least (95.75) was in those fed control diet. The experimental diet had no significant effect ($P>0.05$) on serum calcium and phosphorus. Calcium and phosphorus values in this study were comparable with the control diet. Fleck (1976) reported that calcium in combination with phosphorus as was obtained in the raw pride of Barbados based diets was involved in bone mineralization and formation. Raw pride of Barbados seed meal in the diet could therefore serve as a good source of calcium and phosphorus when combined with other nutrients for formation of bones in the animal. Murray et *al*. (2000) reported that calcium activates large number of enzyme such as adenosine triphosphate (ATP) and it is also required for membrane permeability, involved in muscle contraction, normal transmission of nerve

impulse and neuromuscular activity. Phosphorus is needed to promote growth, maintain and, repair bone and is responsible for energy production and storage as adenosine triphosphate (Malhorta, 1998). The sodium, potassium and magnesium content in the blood of weaned pigs fed pride of Barbados based diet had significant (P<0.05) effect on the experimental animal. value of iron ranged from (100.05) in the control diet to (114.67) in the pigs fed diet 4.Weaned pigs fed diet 4 recorded the highest value (90.22) while pigs on the control diet recorded the lowest value (50.23).The highest value (113.33) of copper was obtained in pig fed diet4 while the least value (95.75) was recorded for pigs fed the control diet. The experimental diet had no significant (P>0.05) difference in the value obtained for calcium and phosphorus.

Table 2: Macro Mineral in weaned pigs fed raw pride of Barbados seed meal in diets (mg/dL)

Minerals	T1	T2	T3	T4	SEM
Calcium (mg/dl)	8.65	8.83	8.56	9.00	0.33
Sodium (mg/dl)	95.88^{d}	106.43^{c}	124.99^{a}	120.35^{b}	3.89
Phosphorus (mg/dl)	16.50	16.70	17.20	16.55	0.54
Potassium (mg/dl)	4.00^{c}	5.88^{a}	4.31^{b}	4.43^{b}	0.33
Magnesium (mg/dl)	3.00^{d}	3.25^{c}	3.70^{b}	3.85^{a}	0.12

^{a,b,c,d} means on the same row with different superscript are significantly different (P<0.05) SEM= Standard error of mean.

Calcium and phosphorus values in the blood of weaned pigs given raw pride of Barbados based diets was comparable with that on the control diet. Fleck, (1976) reported that calcium in combination with phosphorus as obtained in raw pride of Barbados based diets is involved in bone mineralization and formation. Raw pride of Barbados seed meal in the diet could therefore serve as a good source of calcium and phosphorus when combined with other nutrients to act in concert in the formation of bone in the animal body is assured. Murray *et al.* (2000) reported that calcium activates large number of enzymes such as adenosine triphosphate and it is also required for membrane permeability, it is also involved in muscle contraction, normal transmission of nerve impulse and neuromuscular activity.

Phosphorus is needed to promote growth, maintain, and repair bones and it's responsible for energy production and storage as adenosine triphosphate (Malhotra, 1998). The sodium, potassium and magnesium contents in the blood of weaned pigs fed pride of Barbados based diets had significant (P<0.05) effect on the experimental animals. As the level of inclusion of experimental diet increased, the values obtained for the dietary treatments also increased. The content of sodium in blood of weaned pigs fed raw pride of Barbados based diets was different from that recorded in the blood of pigs receiving the control diet, suggesting that the raw pride of Barbados seed meal could not meet the sodium requirement of the weaned pigs fed the experimental diet (Monica, 1987). Also it may be as a result of level of inclusion of salt (0.50%) in the diet which may not allow sodium to be stored in the body. Patience and Zijistra, (2001) opined that the standard recommendation of (0.2-0.3%) inclusion of salt will meet the dietary sodium requirement for weaner pigs. Potassium is involved in ammonium ion excretion by the kidney (NRC, 1998), regulation of heart rate and preventing tetany in skeletal muscle (Herdriks and Moughan, 1993). The decrease in the value of potassium as the level of inclusion of raw pride of Barbados seed meal increased indicate hypocalcaemia which is low level of serum potassium and this manifested as diarrhoea, metabolic alkalosis and familial periodic paralysis (Hays and Swenson, 1985). Magnesium is a constituent of bones, teeth and enzyme cofactor (Murray *et al.*, 2000). Magnesium is absorbed in the intestine and

then transported through the blood to cells and tissue. The significant (P<0.05) effects of magnesium content in blood of weaned pigs may be attributed to gastrointestinal disorders that impaired absorption and can limit the body ability to absorb magnesium (Merck, 1986).

Table 3: Micro mineral content in weaner pigs fed raw pride of Barbados seed meal in diets (mg/kg)

Minerals	T1	T2	T3	T4	SEM
Iron (mg/kg)	100.05^{d}	101.26^{c}	112.38^{b}	114.67^{a}	2.87
Zinc (mg/kg)	50.25^{d}	60.28^{c}	75.33^{b}	90.22^{a}	5.69
Copper (mg/kg)	95.75^{d}	100.55^{c}	105.67^{b}	113.33^{a}	2.81
Manganese (mg/kg)	1.15	1.58	2.00	2.50	0.22

[a, b, c, d]Means on the same row with different superscript differ significantly (P>0.05)

Significant differences (P<0.05) was observed on the sera iron and zinc of pigs receiving the raw pride of Barbados based diets relative to the control diet .Pigs fed diet T_4 (15% inclusion level of raw pride of Barbados seed meal) had the highest value (114.67 mg/kg) while the lowest value (100.05 mg/kg) were recorded on the pigs fed the control diets. The iron obtained in this study was below the normal recommended level of micro minerals (118 mg/kg) for weaned pigs (infoespecialtyfeeds.com). The low level of iron content in the blood of weaned pigs fed raw pride of Barbados seed meal may be due to the effect of anti-nutritional factors embedded in the test ingredient. Phytic acid and oxalic acid decreases iron absorption by forming iron phytate and iron oxalate .Iron is required for haemoglobin and it is a pro oxidant which is also needed by microorganisms for proliferation (Galan *et al.,* 2005).

Iron deficiency is associated with alterations in many metabolic processes that may impair brain functioning (Beard, 1999).The values obtained for zinc increases as the level of inclusion of raw pride of Barbados seed meal increased with the pigs fed 15% inclusion of raw pride of Barbados based diet had the highest value (90.22 mg/kg) while pigs on the control diet had the lowest (50.25mg/kg).Although the value obtained were below the normal recommended level of (115mg/kg) zinc for weaner pig (infoespecialtyfeeds.com).This may be as a result of toxins (tannin, saponin, oxalate and phytate) that exerts deleterious effects on the micro nutrients of the animals. Adepoju (2009) opined that saponin reduce the uptake of certain nutrients at the gut through intra-luminal physicochemical interaction .The low level of zinc recorded in blood of weaner pigs fed experimental diets may result in zinc deficiency which causes a marked depression of appetite, growth rate and parakeratosis. The values obtained for copper were significantly (P<0.05) different across the treatment .Copper is an essential micronutrient necessary for the hematologic and neurologic system (Tan *et al.,* 2006). It is necessary for the growth and formation of bone, formation of myelin sheaths in the nervous system, help in the incorporation of iron in haemoglobin and in the transfer of iron from tissues to the plasma (Murray *et al.,* 2000).

There were no significant (P>0.05) difference in the values obtained for manganese in the blood of weaned pig fed virgin pride of Barbados based diet. Manganese is a cofactor of hydrolase, decarboxylase and transferase enzymes (Murray *et al*., 2000). Although the value obtained for manganese were below the normal recommended level of (120 mg/kg) for weaner pig (infoespecialtyfeeds.com),the manganese contents of the blood of weaned pigs were not affected. Since the experimental diet had no significant effect on the manganese content in blood of weaned pigs, manganese deficiency in pigs such as lameness, enlarged hock joints and shortened legs were not noticed.

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