EFFECT OF PHOSPHORUS SUPPLEMENTATION ON PREGNANCY IN WHITE FULANI (BUNAJI) CATTLE

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SUMMARY

THE effect of bonemeal supplementation on pregnancy and plasma phosphorus level in White Fulani (Bunaji) cattle was investigated over a 13-month period. The monthly mean plasma levels of inorganic phosphorus for supplemented cows varied from 4.63mg/100ml in dry season to 8.09mg/100ml in the rainy season in contrast to 3.07 to 7.09/100ml in the dry and rainy seasons respectively, for the controls.

Bonemeal supplementation resulted in earlier conception and calving. Fifty percent of the supplemented cows calved by the end of the period of supplementation in contrast to 25 percent of the controls. By two months after the study period, 100% of cows that received the supplementation had conceived compared with 87.50% of the controls. It is concluded from the study that bonemeal is a practical method for improving the fertility of White Fulani cattle in the grazing areas of Nigeria where soil and forage are deficient in phosphorus.

INTRODUCTION

CATTLE in West Africa have a low reproductive efficiency compared with temperate zone breeds (Lansbury, 1962; Wheat and Broadhurst, 1968, 1972; Lamorde and Weinman, 1972; Zemjanis, 1974; Nuru and Dennis 1976). The importance of the animal's nutritional environment in restricting productivity has been emphasized by Lansbury (1962). Protein and phosphorus deficiencies in West African grasses have been confirmed by analytical and supplementation studies (Lansbury,

1962; Goldsworthy and Heathcote, 1966; Hagger, 1969, 1971; Umoh and Koch, 1971). Lansbury (1962) recommended investigating urea and phosphates as economical means of supplying these nutrients.

Recently, phosphorus deficiency of forages of the savanna grazing areas of Nigeria was confirmed (Kapu, 1975). Since phosphorus supplementation in one form or another has improved reproductive efficiency of clinical or sub-clinical deficient cows and heifers (Theiler, Green and Du Toit, 1928; Dunlop, 1947; Hignett and Hignett, 1951, 1952; Morrow, 1969; Little, 1975;) the implication of phosphorus on reproduction in Nigeria merited investigation.

This study was carried out to determine the effect of bonemeal supplementation on pregnancy in White Fulani (Bunaji) cattle.

MATERIALS AND METHODS

Animals:

Thirty-two White Fulani cows, aged 2 to 8 years, were selected from a herd of 72 at the University Farm. The cows were divided into two groups of 16 based on age and current reproductive status. One

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group of 16 served as controls and the other received 84 g of bonemeal (equivalent to 12.6 g of phosphorus) per cow per day. The bonemeal was mixed with sodium chloride at a ratio of 4.2:1 to improve its palatability, and placed in half-drums in the night paddock. The supplemented and control cows grazed together with the rest of the herd during the day and at night were placed in separate paddocks.

The study lasted from February 1975 to April 1976 when the animals were then returned to the herd. For the purpose of this study, the year was divided into three seasons — rainy season (April — September), early dry season (October — December) and late dry season (January — March). The cows were maintained on grazing alone throughout the study period.

Grazing consisted mainly of native grasses with *Andropogon gyanus* (Gamba grasses), *Pennisetum Pedicellatum*, *Brachjarai jubata*, and *Hyperthelia dissoluta* predominating. The cows had occasional access to a paddock containing cultivated *Stylosanthes humilis*. The compositions of these grasses and the bonemeal used in this study are shown in Table 1. The herd from which the cows originated has been on a mineral lick supplement containing 7.5% phosphorus.

Two mature bulls ran with the entire herd during the day and on alternate nights, one bull was placed in with the supplemented or control group. Pregnancy status of each cow was determined monthly by rectal examination for the period of the study and for two months after.

TABLE 1

Mineral Concentrations (%) of Bone Meal and Pasture Forage — October 1975

						P	Ca	Mg
Andropogon gayanus	..	..	..	..	..	0.12	0.40	0.18
Pennisetum pedicellatum	..	..	..	..	..	0.12	0.17	0.17
Brachiara jubata	..	..	..	..	..	0.09	0.37	0.39
Hyperthelia dissoluta	..	..	..	..	..	0.11	0.55	0.19
Stylosanthes humilis	..	..	..	..	..	0.09	1.38	0.23
Bone meal	..	..	..	..	..	15.00	37.00	0.59

Sample Collection

Twenty ml of blood was collected once a month from each cow from February 1975 to March 1976 except in October 1975, January and February 1976, for plasma phosphorus, calcium and magnesium determinations. The blood was collected with a sterile syringe via the jugular vein. The blood was transferred to a test tube containing heparin, gently mixed, and placed in an ice box. The samples were taken to the laboratory, centrifuged at 3000 g for 10 minutes, the plasma decanted into sample tubes, and then stored at -20°C until analyzed. All sampling began around 0800 hours.

All glassware was thoroughly washed and rinsed thrice in distilled water before use.

Biochemical Analysis Procedures

Plasma samples were analyzed for inorganic phosphorus by the modified method of Fiske and Subbarow (1925). Plasma calcium and magnesium were determined by atomic absorption spectrophotometry¹ as described by Willis (1960a, b; 1961). The samples were diluted 1:50 with 0.1 percent (w/v) strontium chloride to eliminate possible phosphate interference with calcium determination.

RESULTS

Monthly rainfall and mean plasma values of inorganic phosphorus, calcium and magnesium are presented in Table 2.

The monthly mean plasma levels of

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TABLE 2

Monthly Rainfall and Mean Plasma Levels of Phosphorus, Calcium, and Magnesium (mg/100 ml) for Bonemeal-supplemented and Control Cows

Month	Rainfall (mm)	Phosphorus		Calcium		Magnesium	
		Supp.	Control	Supp.	Control	Supp.	Control
Feb. '75	0.0	5.51±1.13	5.17±0.88	9.87±1.59	9.99±1.15	2.76±0.39	2.65±0.37
Mar.	0.3	6.64±0.96*	5.93±0.89	10.65±1.67*	9.58±1.05	3.07±0.36*	2.77±0.35
Apr.	85.8	4.63±0.52	5.11±0.90	11.80±1.32**	10.19±0.86	2.32±0.11	2.35±0.25
May	130.1	5.86±1.01**	3.07±1.08	12.11±0.88	10.78±1.04	2.36±0.24	2.35±0.23
June	135.5	6.46±1.04	5.95±1.14	11.92±0.79**	10.28±0.53	2.70±0.17**	2.44±0.29
July	343.1	6.60±1.13**	4.03±1.13	10.47±0.50	12.88±1.11**	1.81±0.15	2.77±0.31**
Aug.	113.4	8.09±1.06**	7.09±0.98	10.70±0.72	13.75±1.02**	2.62±0.28	2.66±0.32
Sept.	212.2	5.92±1.08	5.71±1.33	10.68±0.57*	10.15±0.84	2.82±0.23	2.82±0.18
Oct.	8.3	—	—	—	—	—	—
Nov.	0.0	5.29±0.95*	4.62±0.89	12.28±1.22	13.99±1.00**	3.19±0.37	3.40±0.20**
Dec.	0.0	5.72±1.36	5.38±1.23	13.36±1.28	13.58±0.66	3.50±0.48	3.30±0.32
Jan. '76	0.0	—	—	—	—	—	—
Feb.	0.0	—	—	—	—	—	—
Mar.	0.0	4.77±1.21**	3.66±0.96	10.27±0.46	9.95±1.04	2.75±0.46	2.81±0.31

* $P < 0.05$ ** $P < 0.01$

—, Not determined

inorganic phosphorus for the bonemeal-supplemented cows ranged from 4.63 to 8.09 mg 100ml in contrast to 3.07 to 17.09 mg/100ml for the controls. The level in the supplemented cows in the rainy season (July and August) was significantly higher than in the controls ($P < 0.01$). The differences in early dry season (November) and late dry season (March) were less significant ($P < 0.05$).

For calcium, the control values over

supplemented were significant for July, August and November ($P < 0.01$) and March and September ($P < 0.05$). For Magnesium, the control values over supplemented were significant for July and November ($P < 0.01$) and supplemented over controls for June ($P < 0.01$) and March ($P < 0.05$).

The Ca:P ratios for the 13-month period are presented in Table 3.

TABLE 3

Plasma Calcium: Phosphorus Ratio in Bonemeal-supplemented and Control Cows

Month	Supplemented							Controls
February 1975	..	..	..	..	..	..	..	1.8
March	..	..	..	..	..	..	..	1.6
April	..	..	..	..	..	..	..	2.6
May	..	..	..	..	..	..	..	2.1
June	..	..	..	..	..	..	..	1.9
July	..	..	..	..	..	..	..	1.6
August	..	..	..	..	..	..	..	1.3
September	..	..	..	..	..	..	..	1.8
October	..	..	..	..	..	..	..	—
November	..	..	..	..	..	..	..	2.3
December	..	..	..	..	..	..	..	2.3
January, 1976	..	..	..	..	..	..	..	—
February	..	..	..	..	..	..	..	—
March	..	..	..	..	..	..	..	2.2

The effect of bonemeal supplementation on conception and calving is summarized in Table 4.

DISCUSSION

Low reproductive performance of indigenous nomadic cattle is a major constraint in the development of the Nigerian cattle industry. The primary factors involved in the low reproductive efficiency are considered to be nutritional and the traditional Fulani husbandry methods (Zemjanis, 1974; Osori, 1976). Nutritional factors are likely to be multiple and include deficiencies of phosphorus, vitamin A, protein, and protein-carbohydrate interaction. The

There were some months in which the plasma inorganic phosphorus for the control animals were below or close to the lower limit of 4.5mg/100ml for cattle (Underwood, 1966). This must have contributed to the poorer reproductive performance observed in these animals when compared with those on bone meal supplementation. Roberts (1971) regards plasma phosphorus level below 4mg/100ml as unsatisfactory for efficient reproduction. Morrow (1969) noted 2.1 and 2.8 services per conception were required when plasma phosphorus was 3.9 and 4.0mg/100ml respectively compared to 1.3 services per conception when the plasma phosphorus was raised to 6.5mg/100ml by phosphorus supplementations.

TABLE 4

Summary of the Effect of Bonemeal Supplementation on Bovine Pregnancy and Calving

	Supplemented	Controls
No. Cows	16	16
No. calving monthly*		
December, 1975	0	0
January, 1976	0	0
February, 1976	1	0
March, 1976	3	3
April, 1976	4	1
Total 30/4/76	8	4
%	50.0	25.0
% of cows calving by 30/6/76	50.0	43.75
% of cows pregnant or calving (total conception) by 30/6/76	100	87.50

* Calving on or before November 1975 was attributed to conception before bonemeal supplementation (based on 280 day gestation).

low fertility of nomadic cattle in the Northern grazing areas of Nigeria (with a long dry season) suggests phosphorus deficiency as one of the major aetiological factors. As all forage investigated in the northern savanna grazing areas were found to be phosphorus-deficient (Kapu, 1975), phosphorus was selected as the first nutritional factor to be investigated. Chemical composition of the forages available to the animals used in this study confirmed this low phosphorus concentration (Table 1). Bonemeal was selected as an economical and practical means of supplementing phosphorus which should be compatible with existing traditional Fulani method of husbandry.

The plasma calcium for both supplemented and control cows were in general similar to the values for the healthy male and female White Fulani cattle at the National Animal Production Research Institute Station, Shika (Akerejola 1976). There were some months, however in which these values were high in the control animals relative to the plasma phosphorus level. This resulted in high calcium: phosphorus ratio (Table 3) a finding similar to that of Reed *et al.*, (1974) for unsupplemented cattle in their study.

Magnesium has no direct bearing on fertility but its plasma level was determined in this study because of the close

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relationship between its metabolism and those of calcium and phosphorus (Anon, 1968; Irving, 1973). Hypomagnesaemic tetany in cows and ewes is, in most cases, accompanied by hypocalcemia and by low, normal or high serum inorganic phosphorus (Underwood, 1966; Anon, 1968). Both the control and supplemented animals in our study had satisfactory levels of magnesium and all were within, or very slightly above, the normal range of 1.8 to 3.2mg/100ml. (Underwood, 1966).

Bonemeal-supplemented cows conceived and calved earlier than the controls. At the end of the supplementation period, 50% of the animals receiving bonemeal calved in contrast to 25% of the controls. Two months later, 3 more of the control cows calved raising the calving rate to 43.75%. At the same time, 8 more animals in the supplemented group became pregnant in contrast to 6 in the control group. These brought the total conceptions in the supplemented and control groups to 100% and 87.50% respectively (Table 4).

The cows had adequate exposure to bulls day and night and the monthly rectal examinations revealed that they were cycling. Both the supplemented and control cows had access to a mineral lick containing 7.5% phosphorus in the original herd of 72 before their selection for this study and the farm records revealed reasonable fertility in the herd. The calving rate in this herd in 1974 was 58% which is much better than the 40% that Zemjanis (1974) indicated obtains in the nomadic herds. Withdrawal of access to the mineral lick lowered the fertility of the control cows. In contrast, the 16 supplemented cows had better access to the bonemeal in their night paddock than would be expected in the large group of 72 in the original herd.

Like in some earlier studies (Theiler *et. al.*, 1928; Dunlop, 1947), bonemeal supplementation in this study showed beneficial effect in increasing calving rate. The study indicates that bonemeal supplementation can be used to improve the

fertility of cattle in the phosphorus-deficient grazing areas of Nigeria. Bonemeal would be a practical method for supplying phosphorus to animals in these areas without interference with the present husbandry methods.

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