INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

Www.scienceandnature.org

PHYSIOLOGICAL RESPONSE OF BREEDING GILTS TO VARYING PROTEIN DIETS

Machebe Ndubuisi Samuel, Ezekwe Arinze G. & Anaenugwu Maureen O.
Department of Animal Science, University of Nigeria, Nsukka.

ABSTRACT
The blood profile of twenty seven (27) 5-6 months old Large White x Landrace crossbred gilts weighing 48.03 ± 1.03 kg were studied after exposure to dietary protein treatments. Three iso-caloric dietary treatments with 16% (T1), 18% (T2) and 20% (T3) crude protein (CP) levels were used in the study. Blood samples were collected and analyzed weekly to obtain haematological and serum biochemical indices. Results obtained showed a significant ($P<0.05$) dietary treatment effect on haemoglobin concentration (Hb), packed cell volume (PCV), red blood corpuscle (RBC) and Mean cell haemoglobin concentration (MCHC). There was no significant ($P>0.05$) dietary treatment effects on Mean cell haemoglobin (MCH) and Mean cell volume (MCV). Serum biochemical analysis of the blood samples recorded no significant ($P>0.05$) variation among the dietary treatments in bilirubin (Bil), Aspartate transaminase (APT) or SGOT, and Alanine transaminase (ALT) or SGPT. However, a significant dietary treatment effect ($P<0.05$) was obtained for serum Alkaline phosphate (ALP). The serum electrolyte concentrations (Iron, Fe^{3+}; Phosphorus, P^{5+}; Calcium, Ca^{2+}; Sodium, Na^{+}; Potassium, K^{+}) studied were similar ($P>0.05\%$) among the treatments. From the results, it was concluded that 18% CP dietary provision should be the most appropriate dietary crude protein required by finishing gilts for efficient physiological balance and improved reproductive processes in the tropics.

KEY WORDS: Blood, pigs, enzymes, homeostasis, haemoglobin.

INTRODUCTION

The quality and quantity of ration given to an animal affects its physiological condition. Several reports (Babatunde and Pond, 1987; Wilson and Medd, 1978) have reiterated that nutrition interferes with the myriads of metabolites and other constituents found in the blood. Ramirez *et al*. (1963), Opara *et al*. (2006) and Madubuike and Ekenyen (2006), reported that knowledge of the haematological values of animals could serve as an index used in predicting the effect of any ration given to the animal. For instance, Ramirez *et al*. (1963) reported that increase protein absorption from the gut produced an increase in plasma protein concentration leading to an increase in the relative blood volume. Therefore, for effective improvement in any pig enterprise, the overall balance of the diet is of major importance in its development because according to Bowland (1973) numerous interactions exist between nutrients and optimum performance. Several factors have been implicated in respect to the erratic reference values reported for pig. Among these factors are number of animals, age, breed, sex, management practice, and physiological state of the animal e.t.c (Egbunike and Akusu, 1982; Opara *et al.*, 2006). In order to alleviate these problems and provide diagnostic baseline for the routine management of pigs, Faustini *et al.* (2000) suggested that "normal" values should be determined by each laboratory, considering age of subjects, sample size and methods of analysis. In a study with weaner pigs, Ranjhna (2001) reported a slight deviation in the blood indices when compared with normal haematological reference values for pigs, while Uchegbu, *et al.* (2007) reported no significant difference in the haematological indices of weaner pigs. Thus, any study directed toward examining the effect of nutrition on the blood indices of pigs is a giant step towards the production of healthy pigs thereby increasing the supply of good quality pork to the consumers. The present study was intended to establish baseline blood profile of breeding gilts fed varying protein diets.

MATERIALS AND METHODS

Experimental site

The study was carried out at the piggery research unit of the Department of Animal Science, University of Nigeria, Nsukka Teaching and Research farm.

Management of Experimental Animal

A total of twenty seven (27) six (6) months old breeding gilts (Large White x Landrace crosses) with an average live weight of about 48.03 ± 1.03 kg were used for this study. The animals were housed in well ventilated and fly-proof pig house with concrete floor. They were given preventive doses of IvomecPlus® for ecto-and endo-parasites and Berenyl® injection for trypanosome infections. The pigs were fed 4% of their average body weight as ration (Santiago and Tegbe, 1987). The ration was an iso-caloric diets with 16% (T1), 18% (T2) and 20% (T3) crude protein levels (Table 1). Each experimental treatment (T) had three (3) replicates with three (3) pigs per replicate. Weekly live weights of the pigs were taken before morning feeding using AVERY® FARM scale.

Table 1: Percentage composition of the experimental diets

Ingredients (%)	T1 (16%)	T2 (18%)	T3 (20%)
Maize	23.00	20.00	15.00
Cassava	20.00	20.00	20.00
Wheat Offal	28.00	26.00	24.00
Palm kernel cake	18.50	20.50	22.50
Groundnut cake	12.00	17.00	23.00
Palm oil	3.00	3.00	3.00
Bone Meal	2.00	2.00	2.00
Salt	0.50	0.50	0.50
Methionine	0.25	0.25	0.25
Vit./Minera Premix*	0.25	0.25	0.25
Total	**100**	**100**	**100**
Calculated			
Crude Protein (%)	16.07	18.24	19.62
Energy (kcalME/kg)	3083	3053	3092

** Each 2.5kg premix contains the followings: Vitamin A 15, 000,000IU; Vit. D_3 3,000,000IU; Vit. E 30,000IU; Vitamin K 3,000 mg; Vit. B_1 3,000 mg; Vitamin B2 6,000 mg; Vitamin B6 5,000 mg; Vit B_{12} 40 mg; Biotin 200 mg; Niacin 40,000 mg; Pantothenic acid 15,000 mg; Folic acid 2,000 mg; Choline 300,00 mg; Iron 60,000 mg; manganese 80,000 mg; Copper 25,000 mg; Zinc 80,000 mg; Cobalt 150 mg; Iodine 500 mg; Selenium 310 mg; Antioxidant 20,00 mg.*

Sample collection and analysis

Blood was taken once weekly between 8.00hr and 10.00hr by puncturing the ear vein (Blood *et al*., 1979) into 10ml sample bottles using disposable syringes and needle. Blood samples for the determination of haematological values were taken into containers with ethylene diaminotetra-acetic (EDTA) as an anticoagulant while for serum collection, tubes without anticoagulant were used. The containers for serum were centrifuged within 2 hours at 2,000 x g for 10 min. The collected samples were stored in a freezer at - 6 **°C** until when needed for analysis. Blood samples were analyzed for haematological and biochemistry parameters. The haematological indices namely - erythrocyte count (RBC), white blood cell count (WBC), haemoglobin concentration (HB), packed cell volume (PCV), mean cell haemoglobin concentration (MCHC), mean cell haemoglobin (MCH), mean cell volume (MCV)) were determined using standard techniques as reported by Jain, (1986). The serum biochemistry (Bilirubin, Serum Glutamic Oxaloacetic transaminase (SGOT), Serum Glutamic Pyruvic transaminase (SGPT), and Alkaline phosphase (ALP)) of the blood samples were estimated using commercial enzyme assay kits (Randox^R Laboratory Ltd., Antrim, United Kingdom and the protocol used were according to the manufacturers' instruction. The serum electrolytes - sodium (Na), potassium (K), inorganic phosphorus (P), calcium (Ca) and iron (Fe) were determined using the procedure of A.O.A.C (1990).

Statistical analysis

The data collected were analyzed using the PROC ANOVA of SAS statistical software (SAS, 1999) and significant differences in means among the treatments were separated using Duncan's procedure of the same software.

RESULTS AND DISCUSSION

Mean values of haematological and biochemistry parameters of gilts are presented in Tables 2 and 3, respectively.

Table 2: The effects of varying protein levels on haematological indices of gilts

	Treatments			
Blood parameters	T1 (16%CP)	T2 (18%CP)	T3 (20%CP)	SEM
HB(g/100ml)	13.03^b	14.61^a	13.25^b	0.30*
PCV (%)	38.91^b	43.53^a	39.55^b	0.93*
RBC(x10^6/mm^3)	4.33^b	4.89^a	4.40^b	0.13*
MCHC (%)	32.49^b	35.56^a	32.50^b	0.54*
MCH (%)	30.09	29.67	30.58	0.18^{NS}
MCV (%)	89.90	90.00	90.10	0.02^{NS}
WBC(x10^3/mm^3)	6.70	6.49	5.94	6.37^{NS}

$^{a,b.}$-Row means with different superscript are statistically significant at 5%. (-P<0.05),NS: Not Significant; SEM: Standard error of mean*

Table 3: The effects of varying protein levels on biochemical indices of gilts

	Treatments			
Parameters	T1 (16%CP)	T2 (18%CP)	T3 (20%CP)	SEM
BIL(µmol/L)	15.82	14.96	14.96	0.41^{NS}
APT(µ/L)	10.03	9.40	9.68	0.30^{NS}
ALT(µ/L)	11.96	11.25	11.46	0.30^{NS}
ALP	11.19^b	16.28^a	11.83^b	0.42*
FE (mg/100ml)	126.66	123.84	129.49	1.21^{NS}
P (mg/100ml)	170.27	166.52	160.63	11.0^{NS}
Ca (mg/100ml)	216.82	212.35	204.55	10.3^{NS}
Na (ppm)	169.60	172.57	175.00	0.72^{NS}
K (ppm)	200.80	197.52	196.96	5.06^{NS}

$^{a,b.}$-Row means with different superscript are statistically significant at 5%. (-P<0.05)NS: Not Significant; SEM: Standard error of the mean.*

The results showed that Haemoglobin (Hb), Packed Cell Volume (PCV), Red Blood Cell (RBC), and Mean Corpuscular Haemoglobin Concentration (MCHC) were all significantly (P<0.05) affected by dietary treatments. There were no significant (P>0.05) treatments effect on the Mean Corpuscular Volume (MCV), Mean Cell Haemoglobin (MCH) and White Blood Cell (WBC). The data showed that gilts reared on 18% CP diet (T2) had higher (P<0.05) supply of Hb (14.61 g/100ml), PCV (43.53%), RBC (4.89 x 10^6/mm^3) and MCHC (35.56%) in their blood whereas mean values for T1 and T3 were statistically similar (P>0.05). The effect of treatments on MCH, MCV and WBC were not significant (P>0.05). Haematological indices obtained in this study fall within the range of normal haematological values of pigs (Orji *et al*., 1987; Onyimonyi, 2002 and Opara *et al*., 2006). However, mean PCV values of 40.63% obtained in this

study differed from 156.6g/100ml of blood reported by Haparin *et al*. (2003) for wild boar. The observed difference may be as a result of breed difference, age of animal, and sex (Faustini *et al.*, 2000 and Opara *et al*., 2006). It may be pertinent to infer that dietary protein affects the physiological processes involved in erythropoietin production. Earlier reports by Swenson (1993) and Guyton and Hall (2002), had indicated that any factor that could cause decreased tissue oxygenation will increase erythropoietin production and consequently increase red blood cell and haemoglobin concentration in the blood. In breeding animals, provisions are made for protein and energy requirements (Aduku, 2005). Therefore, it could be argued from the present result that the usual dietary protein recommendation of 14-16% CP might be inadequate given the physiological and developmental needs of the animal. Since a specific amount of protein is required to maintain protein homeostasis (Beitz, 1993), the 20% dietary crude protein may have been in excess of the animal needs. Thus, the excess protein is removed in the form of urea or ammonium ion by the liver in the process of deamination. In line with report by Madubuike and Ekenyem (2006), it is possible that 18%CP diet is the optimum protein level required by the pigs to maintain protein homeostasis as indicated by its higher Hb, PCV, RBC and MCHC concentrations in the blood.

The serum biochemistry values obtained in this study showed no significant (P>0.05) dietary treatment effect on bilirubin, Aspartate transaminase (SGOT) and Alanine transaminase (SGPT) except for Alkaline phosphate (ALP) values which differed (P<0.05) among treatments. Values obtained for these parameters concur with reports by Benjaminsen and Dishington, (1981) and Zvorc *et al*. (2006). The physiological state of an animal interferes with the level of these enzymes in the blood. These enzymes according to Zimmerman (1978) have been used to check the extent of hepatic, cardiac and kidney damage. There was no significant (P>0.05) dietary effect on the serum electrolytes (Iron, phosphorus, calcium, sodium and potassium) studied. These ions are needed to maintain proper osmotic and electrolyte balance in the body fluid of the animal. The fact that dietary protein levels did not influence these ions suggests that both 16% and 20% CP ration would be adequate to support normal osmotic and electrolyte environment in the breeding gilts. However, looking at the general effects of the three protein levels on the blood profile of the gilts, it could be inferred that the 18% CP ration was most appropriate for the gilts.

CONCLUSION

The result of this study suggests that 18% CP is the most appropriate dietary crude protein required by finishing gilts for efficient physiological balance and improved reproductive processes in the humid tropics.

ACKNOWLEDGEMENT

We wish to acknowledge Mr. Lawrence Ugwuowo and his Technical Assistants in the Piggery unit of the Department of Animal Science, Teaching and Research Farm, University of Nigeria, Nsukka for their wonderful assistance during the course of the study. The unreserved contributions by the Farm Manager, Mr. S. Chime is also noted and appreciated.

REFERENCES

Aduku, A. O. (2005) *Tropical Feedstuff Analysis Table*. Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria.

A.O.A.C (1990) Association of Official Analytical Chemist. *Official Methods of Analysis*, 15th Ed. Washington D.C.

Babatunde, G. M. and Pond, W. G. (1987) Nutritive value of Nigeria rubber seed meal and oil III. Performance characteristics, relative organ weights, haematocrit and plasma metabolites of growing female rats fed corn diets, containing rubber seed meal, soya bean meal or casein. *Animal Feed Science and Technology* 20: 125 - 133.

Beitz. D. C. (1993) Protein and amino acid metabolism. In: Swenson, M. J. and Reece, O. W. (Ed): *Dukes' Physiology of Domestic Animal*. 11th Edn. Cornell Univ. Press., New York. pp

Benjaminsen, E., and Dishington, W. I. (1981) Plasma constituents in the sow. Minerals, glucose, urea-N, protein and transaminases in relation to weaning. *Acta Vet. Scand.* **22**:328-390.

Blood, D. C., Handerson, J. A. and Radostits, O. M. (1979) *Veterinary Medicine*. 5th Edn. Baillière Tindall and Cassell Publishers, London, PP841–847

Bowland, P. (1973) Progress in Swine Nutrition for the Veterinary. *Canadian Veterinary Journal* (**14**)1-14.

Faustini, M., Munari, E., Colombani, C., Russo, V., Maffeo, G. and Vigo, D. (2000) Haematological and plasma biochemistry of Stamboek pre-pubertal gilts in Italy: Reference values. *Journal of Veterinary Medicine* **47:** 525-532.

Guyton, A. C. and Hall, J. E. (2002) *Textbook of Medical Physiology*. 17th Ed. University of Mississippi Medical Center. Jackson Mississippi. P233-236.

Haparin, I. J., Bedrica, I. J., Hahn, V., Sostoric, B., and Gracner, D. (2003) Haematological and biochemical values in blood of wild boar. Vet. Archive 73(6)333-334.

Jain, N.C. (1986) *Schalm's Veterinary Haematology* (4th Ed.) Lea and Febiger, Philadelphia, U.S.A. P149-162.

Madubuike, F. N. and Ekenyem, B. U. (2006): Haematology and serum biochemistry characteristics of grower pigs fed varying dietary levels of *ipomoea asarifolia* leaf meal. *Pakistan Journal of Nutrition* **6**(6):603-606.

Onyimonyi, A. E. (2002) Nutritional evaluation of cassava (*Manihot utilisima* Pohl) peel and Bambara (Voandzeia subterrenea Thouars) waste in pig diets. Ph. D. Thesis, University of Nigeria, Nsukka.

Opara, M. N., Ike, K. A. and Okoli, I. C. (2006) Haematology and Plasma Biochemistry of the wild adult African Grasscutter (*Thryonomis swinderianus, Temminck*). *Journal of American Science* ***2****(2):17-22.*

Orji, B. I., Okeke, G. C. and Akunyiba, A. O. (1986) Haematological studies on the guinea fowl (*Numida meleagris* pallas): I. Effect of age, sex and time of bleeding on the haematological values of guinea fowls. *Nigerian Journal of Animal Production,* **13**:94-99.

Ramirez, C. G, Miller, E. R, Ullrey, D. E., and Hoefer, J. A. (1963) Swine Haematology from birth to maturity. III. Blood volume of the nursing pig. *Journal of Animal Science,* **22**:1068-1074.

Ranjhna, S. K. (2001) Animal Nutrition in the Tropics. Vikas Publishing House PUV Ltd.

Santiago, F. V. and Tegbe, T. S. B. (1987) The digestibility of nutrient of iso-nitrogenous wheat offals by young pigs. *Journal Animal Production Research,* 7 (1): 41-50.

SAS Institute (1999) *SAS/STAT. User's guide version 8 for windows*. SAS Institute Inc. Cary, NC. USA

Swenson, M. J (1993) Physiological properties and cellular and chemical constituents of blood. In: *Dukes' Physiology of Domestic Animals*. M. J. Swenson and R. O. William (Ed) 11th Edn. Cornell University Press, New York.

Uchegbu, M. C., Ogbuewu, I. P., Abakporo, J. U., Durunna, C. S. and Opara, M. N. (2007) Performance of weaner Pigs fed diets containing fermented maize milling waste. *Animal Production Research Advances,* **3**(1):23-27.

Wilson, P. N. and Medds, R. K. (1978) Blood profile as a guide to nutritional status in animals. British Society of Animal Production (**1**):155-162.

Žvorc, Z., Mrljak, V., Sušić, V., and Pompe Gotal, J. (2006) Haematologiacl and biochemical parameters during pregnancy and lactation in sows. *Veterinary Archives,* **76**: 245-253.

Zimmerman, H. J. (1978) *Hepatotoxicity*. New York, Appleton-Century- Crofts. New York. P300-320.