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Selected plasma biochemical parameters in improved indigenous NIGERHYB pigs in Southwestern Nigeria

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ABSTRACT: This study was to assess the biochemical parameters of apparently healthy NIGERHYB pigs and comparison of age and sex related differences in these parameters. One hundred and thirty five NIGERHYB pigs (35 boar, 35 sow, 30 weaned boar piglets and 35 weaned gilt piglets) obtained from intensively managed pig farms in Abeokuta suburbs were screened for parasites. The total protein, albumin, globulin, Na⁺ and K⁺ values of apparently healthy ones were determined using standard methods. Data were analysed using descriptive statistics and ANOVA. The total protein, albumin, globulin, Na⁺ and K⁺ values showed no significant ($p > 0.05$) differences in both sexes of adult and piglets. However, the mean values of total protein, globulin and K⁺ were significantly higher in the adult than young. There were significant ($p < 0.05$) differences in mean values of Na⁺ and K⁺ in sow, boar and gilt piglets compared to the boar piglets. No significant ($p > 0.05$) age and sex difference evident in the mean HCO₃⁻ of young and adult pigs. The relationship between these biochemical parameter and those of other animal species in this environment were discussed.

KEYWORDS: NIGERHYB pigs, Plasma biochemistry, veterinary science.

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INTRODUCTION

Traditionally, the indigenous breeds of pigs found in many Nigerian villages roam, scavenge and graze at will. These local breeds have been noted to be more robust in susceptibility to diseases, tolerance of high parasitic load and extremes in temperature (Adebambo, 1982). Feed utilization especially the low protein diet is better in indigenous breeds than exotic ones, the local breeds are well adapted to low quality feeds (Ilori, 1974). However they are deficient in productivity parameters like litter size, milk production, conversion of feed to muscle/meat when compared with exotic breeds. The NIGERHYB breed of pigs was developed using selective indices in the combination of indigenous species with pure exotic species like Landrace, Large white, Hampshire and Duroc (Adebambo and Onakade, 1983). The

hybrids have been shown to exhibit sustained productive capacity and fairly rapid growth under improved management. The multiplier effect of these findings in the NIGERHYB is the increase in their commercial production in rural and peri-urban settings of South Western Nigeria.

With the increase in production of more NIGERHYB, there is need to generate healthy baseline data. Currently there is a dearth of baseline biochemical parameters from NIGERHYB pigs raised under varying farm conditions. Biochemical plasma values are altered when there is a shift in normalcy in health, nutritional intake or normal physiological status (pregnancy, infancy and old age). Biochemical parameters thus provide information on the range of values in normal health, faulty metabolism and it is a veritable diagnostic aid and tool. Assessment of the plasma biochemical parameters

of animals can provide important information on health, metabolism and is a practical diagnostic tool in evaluating and monitoring the health status of both companion and research animals (Kayali *et al.*, 2009; Wesche, 2009).

The findings will contribute to the build-up of a functional and reliable biochemical baseline data for the NIGERHYB. This will serve as a diagnostic aid of their physiological, nutritional and pathological conditions.

MATERIALS AND METHODS

Animals

Niger hybrid of pigs (NIGERHYB) reared in University of Agriculture, Abeokuta, Teaching and Research Farm and those obtained from pig farms within the University environs in the outskirts of Abeokuta metropolis were used for the study. These farms lie at 7° 10' and 3° 2' E, in tropical climate with mean annual rainfall of about 1037 mm. The vegetation is an inter phase between the tropical rain forest and the derived savannah. Animals were housed on concrete floored pens equipped with watering and feeding facilities. Pigs on selected farms were fed twice daily with compounded ration which contained Palm kernel Cake (PKC) maize offal, brewers dry grains, bone meal, dried cassava peelings and premix (vitamin and minerals). They were fed at 3 to 5% of their body weight. These breeds were identified using colour markings phenotypically. The history of the origin of pigs was obtained from the written farm records.

Blood sampling

Blood samples were collected from identified pigs through the anterior vena cava following head restraint (Hassan *et al.*, 2009). Diurnal variations in values of blood parameters were minimized by collecting blood samples at circa 08.30 to 10.30 a.m. Approximately 6ml of blood was collected: 4ml was dispensed into plastic tube containing lithium heparin and remaining 2ml into sterile tube containing EDTA (disodium ethylene diamine tetra acetic acid). Samples were transported to the laboratory using Carman® (Coleman, USA) cooler containing ice packs.

Blood examination

Parasitology

Blood samples collected into EDTA tubes were used to screen sample for trypanosomes using micro haematocrit buffy coat technique (Murray *et al.*, 1977). Thin and thick blood smears were made, fixed with methanol and stained with 10% Giemsa (Jain, 1986) for detection and identification of haemoparasites.

Plasma chemistry

Blood samples collected into lithium heparin tube were used to determine plasma protein and albumin using Biuret and Bromocresol Green methods respectively according to (Tietz, 1995). The bicarbonate ion was also determined according to Van Slyke method while both Sodium and potassium ions were determined using colorimetric methods (Tietz, 1995).

Table 1: Selected plasma biochemical values of NIGERHYB pigs of different sexes and ages

Parameters	Sows (n=30)	Boars (n=25)	Gilt piglets (n=30)	Boar piglets (n=25)
Total protein (g/dl)	7.35±2.33 ^a	7.42±1.67 ^a	6.71±1.25 ^b	6.79±1.88 ^b
Albumin (g/dl)	4.02±1.20 ^a	3.98±1.15 ^a	3.83±0.83 ^a	3.63±1.00 ^a
Globulin (g/dl)	3.34±1.88 ^{ad}	3.44±1.89 ^a	2.88±1.13 ^d	3.21±1.81 ^{ad}
Na ⁺ (mmol/l)	142±2.12 ^a	142±1.86 ^a	138±2.12 ^a	138±2.07 ^{ad}
K ⁺ (mmol/l)	11.8±1.81 ^a	8.73±1.81 ^a	6.18±0.63 ^d	4.95±0.30 ^d
HCO ₃ ⁻ (mmol/l)	24.9±0.46 ^a	24.7±0.60 ^a	25.9±0.49 ^a	26.2±0.49 ^a

Data on the same row with different superscript differ significantly ($p < 0.05$) from each other

Table 2: Comparison of selected plasma biochemical values in NIGERHYB and those of exotic breeds in both humid and temperate environment

Parameters	NIGERHYB (Humid tropical) Present study	Exotic Pig (Humid tropical) [1]	Exotic Pig (Temperate) [2]	Exotic Pig (Temperate) [3]
Total protein (g/dl)	70.64±1.78	78.90±1.10	84.00±5.0	74.00±0.6
Albumin (g/dl)	38.72±1.05	26.70±0.69	25.90±7.1	34.00±0.16
Globulin (g/dl)	32.08±1.68	50.80±0.88	58.60±5.7	40.00±0.21
Na ⁺ (mmol/l)	140.06±2.04	134.00±16.12	ND	ND
K ⁺ (mmol/l)	8.02±1.14	6.49±1.56	ND	ND
HCO ₃ ⁻ (mmol/l)	25.44±0.51	ND	ND	ND

[1] Ayoade *et al.*, 1996; [2] Kaneko *et al.*, 1997; [3] Maxine *et al.* 2007.

Faecal sampling

Faecal material was collected per rectum using gloved fingers from every pig on the study into universal bottle. Faecal samples were screened for helminth eggs using saturated Sodium chloride and Magnesium sulphate floatation methods (Hansen and Perry 1990).

Data analysis

The data were analysed using the Statistical Analysis System (SAS) package version 8.0 developed in 2003. The data were tested for significant differences between groups. All significant differences were at 0.05 levels. The age and sex dependent changes in plasma biochemistry were tested with the non-parametric Mann Whitney test. Differences with value of $p < 0.05$ were considered statistically significant.

RESULTS

A total of 135 NIGERHYB pigs were sampled from intensively managed piggeries. Out of this number 110 pigs (81.5%) were apparently healthy. Samples from apparently healthy pigs were computed in the data analysis. However, 25 pigs had haemoparasites or helminth 40% had Eperythrozoonosis, 20% were positive for Babesiosis while 20% had Eperythrozoonosis in combination with *Ascaris suum* and 10% had *Ascaris suum* only. Out of the One hundred and ten healthy pigs, 55 were of the mean age 1.9 years consisting 25 boars and 30 sows; while 55 were weaned piglets made-up of 25 boar piglets and 30 gilt piglets (mean age 3.4 months).

The mean plasma biochemical values of both sexes of adult and weaned piglets NIGERHYB examined are presented in Table 1, and there were no significant ($p > 0.05$) differences in total protein, albumin, globulin, Na⁺ and K⁺ values of both sexes in adult and piglets. However, the mean values of total protein, globulin and K⁺ were significantly higher in the adult than young. There were significant ($p < 0.05$) differences in mean values of Na⁺ and K⁺ in sow, boar and gilt piglets compared to the boar piglets. No significant ($p > 0.05$) age and sex difference evident in the mean HCO₃⁻ of young and adult pigs.

DISCUSSION

There is paucity of baseline plasma chemistry data and age related differences in these parameters for the NIGERHYB. This poses a challenge considering the wide acceptance of NIGERHYB pigs as preferred alternative for swine production in South Western Nigeria. However, blood samples are often difficult to obtain from the ear vein. Blood sampling from the anterior vena cava allows the collection of relatively large volume in these pigs up to 6 ml, which is sufficient for analysis of plasma chemistry parameters and haemoparasite screening.

This study evaluated age and sex influences on K, Na, total protein, albumin, globulin and bicarbonate in NIGERHYB pigs. There were differences attributable to age and sex in the values of some of the parameters assessed in this study. Based on an 8 months age cut off for the adult NIGERHYB pigs, they had significantly higher total protein and globulin values in their plasma than in the piglets. A general increase

in total protein and globulin levels with increase in age has been reported in other species including hystricomorph rodents (Kitagaki *et al.*, 2005), degus (Jekl *et al.*, 2011) and dogs (Kaneko 1997; Nottidge *et al.*, 1999; 2005). In contrast, significantly lower globulin levels in immature African Giant rat compared to the adult were reported (Nssien *et al.*, 2002). These findings thus indicated total protein globulin and albumin are indicators of adequacy of protein in terms of quality and quantity in the diet. These parameters similarly show whether there are protein malnutrition, alterations in the dietary intake and utilization, and possibly the extent of muscle wastage (Eggum, 1970).

The values of total protein, albumin and globulin in NIGERHYB in this study were not significantly affected by sex in both young and adult. These findings agreed with the observations, in adult African giant rat (*Thyromys swinderianus*) (Oyewale *et al.*, 1997), in the American mink (*Mustela vison*) (Weiss *et al.*, 1994,) and sympatric avian species in zoo (Karesh *et al.*, 1995). However, it is at variance with those of cattle (Oduye and Fasanmi 1971), and sheep (Otesile and Kasali 1992).

The result obtained from this study showed that significant ($p < 0.05$) age differences in the level of Na^+ and K^+ , while no significant difference was observed in sexes of adult and young. However, no significant differences were observed in HCO_3^- level in the different ages and sexes of both adult and piglets. The sodium, potassium, chloride and bicarbonate ions are very important for maintenance of fluid and acid-base balance and for muscle and neuromuscular impulse transmission (Saxon and Seldin, 1986). The changes in the concentration of these ions affect the extra cellular fluid volume and neuromuscular impulse transmission.

The higher levels of K^+ as reported in exotic pigs in sub humid environment (Ayoade *et al.*, 1996) corroborated the finding in this study where K^+ value was significantly higher in sow than the boars. This could be a response of pigs to emergent necessity for the activation of their thermoregulatory apparatus as consequence of non-existence of sweat gland in the porcine specie owing to the high ambient temperature in the tropical environment. These results could explain lower levels of K^+ pattern observed in ruminant, avian and canine species especially in the female

Table 3: Comparison of selected plasma biochemical values in NIGERHYB pigs and those of African Giant rats, Pangolin, Nigerian sheep and goats, white Fulani cattle and Nigerian cat in the same sub humid tropical environment.

Parameters	NIGERHYB pigs (present study)				African giant rat [1]		Pangolin [2]
	Adult	Adult	Piglet	Piglet	Adult	Baby	
	Female	Male	Female	Male			
Total protein (g/dl)	7.35±2.33	7.42±1.67	6.71±1.25	6.79±1.88	7.3±0.2	7.1±0.4	3.48±0.38
Albumin (g/dl)	4.02±1.20	3.98±1.15	3.83±0.83	3.63±1.00	5.5±0.7	4.1±0.4	2.8±0.26
Globulin (g/dl)	3.34±1.88	3.44±1.89	2.88±1.13	3.63±1.00	3±0.05	2.9±0.1	3.16±0.32
Na^+ (mmol/l)	142±1.88	142±1.86	138±2.12	138±2.07	137.7±3.5	137.8±2.5	142.6±6.45
K^+ (mmol/l)	11.8±1.81	8.73±1.81	6.18±0.63	4.95±0.30	4.52±0.35	5.3±0.90	5.60±0.95
HCO_3^- (mmol/l)	24.9±0.46	24.7±0.60	25.9±0.49	26.2±0.49	22.5±1.6	22.8±1.0	21.1±2.13

Parameters	Nigerian Sheep [3]	Nigerian Goats [4]	White Fulani Cattle [5]	Nigerian cats [6]			
				Adult	Adult	Kitten	Kitten
				Male	Female	Male	Female
Total protein (g/dl)	6.34±0.7	6.36±0.08	7.55±2.5	5.6±1.2	6.4±1.4	6.4±1.2	
Albumin (g/dl)	2.46±0.38	2.58±0.41	2.56±1.04	2.4±0.5	2.7±0.7	2.5±0.6	2.2 ±0.5
Globulin (g/dl)	3.87±0.70	3.77±0.76	4.96±2.68	3.4±1.0	3.7±0.8	3.7±0.6	3.0±0.4
Na^+ (mmol/l)	138.75±5.2	138.76±9.71	134.8±19	143.3±1.3	143.0±1.8	143.3±2.9	144.8±1.5
K^+ (mmol/l)	5.29±1.49	4.4±0.49	4.47±0.86	4.1±0.3	4.1±0.3	4.1±0.2	3.9±0.3
HCO_3^- (mmol/l)	ND	ND	ND	16.9±1.8	18.2±0.1	2.3±0.1	2.2±0.1

[1] Nssien *et al.*, 2002; [2] Oyewale *et al.*, 1998; [3] Oduye and Adadevoh 1976b; [4] Oduye and Adadevoh 1976a; [5] Oduye and Fasanmi 1971; [6] Nottidge *et al.*, 1999.

(Oduye and Fasanmi, 1971; Oduye and Adadevoh, 1976; Oyewale et al., 1997; 1998; Olowokorun and Makinde, 1999).

In conclusion, some selected plasma biochemistry references values for the NIGERHYB of pigs have been established in this study. Based on data processed here, it can be concluded that total protein, globulin, Na⁺ and K⁺ levels undergo noticeable changes associated with age in NIGERHYB pigs.

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