African Journal of Biomedical. Research. (2002): Vol 5; 63 - 67

Original article

COMPARISON OF SOME PLASMA BIOCHEMICAL PARAMETERS IN TWO GENERATIONS OF AFRICAN GIANT RAT (*CRICETOMYS GAMBIANUS*, WATERHOUSE).

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The plasma biochemical parameters of apparently normal young (immature) and adult African giant rats were investigated using routine plasma biochemical assay procedures. Sixteen giant rats made up of eight young immature (four males and four females) and eight adults (four males and four females) were used. These were significant (P< 0.05) age differences were found in the mean plasma values of potassium and inorganic phosphate (PO^{-}_{4}), significantly (P <0.01) higher plasma globulin (GLOB) and albumin – globulin (A:G) ratio in both the immature and adult giant rats. no significant (P > 0.05) age differences were observed between the immature and adult giant rats with regard to their plasma sodium, (Na^{+}), chloride (Cl^{-}), bicarbonate (HCO^{-}_{3}), calcium, (Ca^{2+}), total protein (T.P) and albumin (ALB). Whereas, these were significant (P < 0.05) age and sex differences in the mean values of plasma potassium (K) and globulin (GLOB) (only between female and adult male. Similarly, there were significant (P < 0.05) age and sex differences in the mean values of plasma globulin and albumin-globulin (A:G) ratio between immature male and adult female. Furthermore a significantly higher (P < 0.01) age and sex differences were found in the plasma sodium (Na^{+}) and inorganic phosphate (PO^{-}_{4}) of the immature male and adult female. Likewise, a significantly (P < 0.01) higher age difference was only observed in the plasma inorganic phosphate (PO^{-}_{4}) between the immature and adult females well as between immature and adult male giant rats. also, a significant (P < 0.05) age differences were evident in the mean values of plasma globulin (GLOB) and albumin-globulin ratio, and plasma potassium and globulin (GLOB) between immature and adult females, and between immature and adult males, respectively. For the two categories, there were no significant (P > 0.05) age and sex differences evident in mean values of other investigated plasma biochemical parameters. Nevertheless, other only plasma potassium had significant (P < 0.05 sex difference observed between the adult male and female giant rats and no evidence of such significant difference in the immature male and female giant rats.

Keywords: Plasma electrolytes, proteins, Young, Adult, African Giant rat

INTRODUCTION

The African giant rat (AGR, *Cricetomys gambianus*, waterhouse) is a wild rodent which grows to an average weight of about 1,110gm. AGRs are widely distributed in Africa South of the Sahara (Rosevear, 1969) and adopted to several environmental conditions including lowlands and highlands (Bigalke, 1964). In previous study (in press) some aspects of plasma biochemistry (i.e enzyme and metabolite) parameters of the immature and adult AGR were determined. This present study which is a continuation of that study examines the levels of plasma electrolyte and proteins of the immature and adult AGRs

MATERIALS AND METHODS

This investigation was carried out on adult African giant rat that had been in captivity for over seven months and they littered during the period. The young ones were gradually introduced to the adult diet after about two months of age. They were fed with commercially available diet of mouse cubes (protein 21% min, fat 3.5%min., fibre 6%max., calcium 0.8% and phosphorous 0.8%[total], Lodokun Feeds Limited, Ibadan, Nigeria) and water given ad libium. Their daily intake was supplemented with processed cassava (fufu) (*Manihot utilissima* Pohl.); palm kernel fruits (*Elaeis guineensis*); pawpaw (*Carica papaya*) and locally milled groundnut cake.

Each animal was anaesthetized using a 50mg/ml ketamine 500 solution (Waterland Laboratories, Germany. Batch No. 0.6400) which was given at the calculated dose of 0.3ml and 0.6ml for young and adult giant rats, respectively. Blood was collected from the orbital sinus using heparinised capillary tubes centrifuged at 3,000g for 10 minutes to obtain plasma. Sodium (Na) and potassium (K) concentrations of plasma were determined by standard flame photometry, chloride (Cl) by the method of Schales and schales (1941), inorganic phosphate (PO_4) by the method of Gomori (1942), and Mann (1975).

Total protein was determined by the buiret method (Reinhold, 1953) and albumin by the method of Doumas, *et al*., (1971). Globulin was calculated from the difference between total protein and albumin. Activities of triglyceride (TRIG), aspartate amino transferase (ASP), and alanine amino transferase (ALT) were determined as described by TORO and ACKERMANN (1975). Alkaline phosphate (ALP) was determined according to the method of KING and ARMSTRONG (1934). Blood urea nitrogen (BUN) and creatine kinase (CK) were determined according to HARRISON (1947). Cholesterol

(CHOLES) was estimated as described by PESCE and BOUNDOURIAN (1977). Uric acid (U.A) was determined by the method of FEICHTMEIR and WRENN (1955). Total Bilirubin (TBL) was by the method described by COLES (1986).

The results were statistically evaluated using student's t-test

RESULTS

The plasma electrolyte and protein mean values of eight immature and eight AGRs investigated this study are presented on Tables 1 and 2. The results obtained (Table 1) showed that there were significant (P < 0.05) age difference due to age in the plasma mean values of K^+ and $PO^{=}_4$ being higher in N/S age (P > 0.05) difference were evident in the plasma mean values of Na^+, Cl^-, HCO^-_3, Ca^2, T.P & ALB of both eight immature and eight adult GRs adult than the immature for K^+ level and the reverse being the case for $PO^{=}_4$ levels.

The immature GR had slightly higher (P < 0.01) plasma globulin: globulin ratio. Furthermore, there were significant (P < 0.05) age and sex difference evident in the plasma mean value of globulin (lowered in the adult male than in the immature female GRAs). Similarly, there were significant (P < 0.05) age and sex difference observed in the plasma mean value of globulin (higher in the immature male than in the adult female) GRAs and in the plasma mean value ratio of (A:G) albumin: globulin (lower in immature male than in the adult female).

Table 1: Plasma Electrolytes and Proteins in mature and immature African Giant Rat

Parameters	Immature AGR (N = 16)	Adult AGR (N = 16)
Na^+	134.75 ± 3.536 (131 –142)	137.88 ± 2.59 (132 – 140)
K^+	4.53 ± 0.358 (4.0 – 5.0)	5.3125 ± 0.874 (4.6 – 7.1)$^{b\,*}$
Cl^-	102.50± 2.07 (100 – 106)	102.5000 ± 2.268 (98 – 105)
HCO_3	22. 50 ± 1.60 (8.5 – 8.9)	22.7500 ± 1.035 (22 – 25)
Ca^{2+}	8.71 ± 0.15 (8.5 – 8.9)	8.7750 ± 0.046 (8.7 – 8.8)
PO_4	5.28 ± 0.21 (7.3 – 7.5)$^{a\,*}$	4.8875 ± 0.3000^b (4.7 – 5.6)
Total protein	7.30 ± 0.21 (7.0 – 7.5)	7.0625 ± 0.441 (6.3 – 7.6)
ALB	95.50 ± 8.67$^{a\,**}$ (85 –110)	4.0875 ± 0.394 (3.5 – 4.6)
GLOB	0.2625 ± 0.05 (0.2 – 0.3)	2.9750 ± 0.071$^{b\,**}$ (2.8 – 3.0)
A:G		1.3713 ± 0.116$^{b\,*}$ (1.20 – 1.53)

Mean ± S.D (range) * P = < 0.05; ** P < 0.01; *** P < 0.001. Means with different superscripts are significantly different

While the plasma mean value of Na^+ was significantly (P < 0.01) higher in the adult male than in the immature male and the plasma $PO^{=}_4$ level was slightly high (P < 0.01) in the immature male compared to the adult female. No significant (P > 0.05) age and sex difference evident in the plasma mean values of K^+, Cl^-, HCO^-_3, Ca^2, T.P & ALB in the immature male and adult female.

Table 2: Plasma electrolytes and protein

Parameters	BF(N=4)	AF(N=4)	BM(N=4)	AM(N+4)
Na	(132-142) 135.7±4.5	(135-140) 139.0±0.8	(131-137) 133.8±2.5	(132-140) 136.750±3.404
K	(410-510) 4.5±0.5	(4.6-4.7) 4.7±0.1	(4.3-4.8) 4.5±0.2	(5.4-7.1) 5.975±0.780
Cl	(100-106) 102.2±2.6	(101-105) 103.0±1.6	(101-105) 102.8±1.8	(98-105) 102.000±2.944
$HC0_2$	(20-25) 22.5±2.1	(22-25) 23.0±1.4	(21-24) 22.5±1.3	(22-23) 22.500±0.577
Ca	8.8+0.1	8.8+0.0	8.7+0.1	8.750±0.058
$P0_4$	(5.0-5.6) 5.3±0.3	(4.7-4.8) 4.750±0.058	(5.1-5.5) 5.250±0.191	(4.7-5.6) 5.025±0.395
T.P	(7.0-7.5) 7.4±0.3	(7.0-7.3) 7.125±0.150	(7.0-7.5) 7.250±0.208	(6.3-7.6) 7.000±0.648
ALB	(3.9-4.1) 4.000±0.082	(4.0-4.2) 4.125±0.150	(3.8-4.1) 3.975±0.126	(2.8-4.6) 4.050±0.580
GLOB	(3.0-3.5)a 3.350±0.238*	(3.0) 3.000±0.000	(3.0-3.4) 3.2750±0.189	(2.8-3.0) 2.950±0.100*b
A:G	(1.11-1.33) 1.1975±0.098a*	(1.33-1.43) 1.3725±0.05b*	(1.12-1.33) 1.2175±0.086	(1.20-1.53) 1.370±0.169

Key BF & BM = Baby Female and male; AF & AM = Adult Female and Male

Values are Mean ±S.D(range)*P<0.05. Means with different superscripts along same row are significantly different (P<0.05

Table 3: Comparison of Plasma electrolyte and Protein mean values in two generations of African Giant rat and those of local chicken & Ostrich, Pangolin (Mahis tricuspis), Nigerian Fulani cattle, Goat pig, West African Dwarf sheep & Cat, Buffalo (Bos bubalis) and Human in the came sub humid tropical environment

Parameter	African Giant Rat (Present Study)		Pangolin (ManisTicuspis) Oyewole, *et al*) 1997 (N = 10)	Nigerian goat (Oduye & Adadevoh, 1976a) (N = 70)	West African Dwarf sheep (Oduye & Adedavoh, 1976b) (N = 233)	White Fulani Cattle (Oduye, & Fasanmi, 1971)	Local Nigerian Cats (Nittidge, *et al.,* 1999)			
							Adult		Kitten	
	Baby (16)	Adult (16)					Male (18)	Female (12)	Male (10)	Female (10)
Na^+ (mMol/L)	134.7 ± 3.5 (131–142)	137.8 ± 2.5 (132– 140)	142.6± 6.45	138.76 ± 9.71	138.75 ± 5.21	13480 ± 19.00	143.3 ± 1.3	143.0 ± 1.8	143.3 ± 2.9	144.8 ± 1.5
K^+ (mMol/L)	4.52 ±0.35 (4.0 – 5.0)	5.3 ±0.9 (4.6– 7.1)[b] *	0.560 ± 0.95	4.44 ± 0.49	5.29 ± 1.49	4.47 ± 0.86	4.1 ± 0.3	4.1 ± 0.3	4.1 ± 0.2	3.9 ± 0.3
Cl^- (mMol/L)	102.5 ± 2 (100 – 106)	102.5000 ± 2.268 (98 – 105)	105.10 ± 3.38	101.79 ± 6.70	100.33 ± 4.85	102.37 ± 13.70	116.3 ± 2.9	116.1 ± 3.8	115.1 ± 2.3	116.3 ± 3.1
HCO_3 (mMol/L)	22. 5 ± 1.6 (8.5– 8.9)	22.8± 1.0 (22 – 25)	21`.10 ± 2.13	ND	ND	ND	16.9 ± 1.8	18.2 ± 0.1	2.3 ± 0.1	2.2 ± 0.1
Ca^{++} (mMol/L)	8.71 ± 0.1 (8.5 – 8.9)	8.8 ± 0.05 (8.7 – 8.8)	8.18 ± 0.13	9.57± 1.51	9.59± 1.59	9.81±1.52	2.2 ± 0.1	2.3 ± 0.1	4.7 ± 0.4	5.3 ± 1.0
$PO^{=}_4$ (mMol/L)	5.3 ± 0.212 (7.3 – 7.5)[a] *	4.8 ± 0.3000[b] (4.7 – 5.6)		6.69 ± 2.14	5.68 ± 3.32	5.08 ± 1.05	4.8 ± 0.3	4.8 ± 0.4	2.3 ± 0.1	5.1 ± 0.5
Total Protein (mg/dl)	7.3 ± 0.214 (7.0 – 7.5)	7.1± 0.441 (6.3 – 7.6)	3.48 ± 0.38	6.36 ± 0.08	6.34 ± 0.70	7.55 ± 2.50	5.6 ± 1.2	6.4 ± 1.4	6.2 ± 1.1	
Albumin (mg/dl)	95.5 ± 8.7[a] ** (85–110)	4.1 ± 0.4 (3.5 – 4.6)	2.80 ± 0.26	2.58 ± 0.41	2.46 ± 0.38	2.56 ± 1.04	2.4 ± 0.5	2.7 ± 0.7	2.5 ± 0.6	2.2 ± 0.5
Globulin (mg/dl)	0.3 ± 0.05 (0.2 – 0.3)	2.9 ± 0.1[b] * (2.8 – 3.0)	3.16 ± 0.32	3.77 ± 0.76	3.87 ± 0.70	4.96 ± 2.68	3.4 ± 1.0	3.7 ± 0.8	3.7 ± 0.6	3.0 ± 0.4
A: G ratio		1.3713 ± 0.116[b] ** (1.2– 1.5)	0.90 ± 0.08	0.68	0.64	0.51	0.74 ± 0.08	0.72 ± 0.11	0.67 ± 0.11	0.74 ± 0.05

The results obtained showed that there was a high significant ($P < 0.01$) age difference in the level of $PO^{=}_4$ (higher mean value in immature female compared to adult female). Also, there was significant ($P < 0.05$) age difference in the plasma mean values of globulin (higher in immature male than adult female). No significant ($P > 0.05$) age difference was evidence in the plasma mean values of Na^+ K^+, Cl^-, HCO^-_3, Ca^2, T.P & ALB in both immature and adult males GRAs. Likewise, there were no significant ($P > 0.05$) age difference evident in the mean values of both immature and adult female GRAs with regard to Na^+ K^+, Cl^-, HCO^-_3, Ca^2, T.P & ALB and A:G ratio in blood plasma. But there were significant ($P < 0.05$) age difference observed in the plasma K (being higher in the adult male than in immature male) levels.

Furthermore no significant ($P > 0.05$) sex difference were evident in the mean values of all plasma electrolytes and proteins of the immature male and female GRs The above plasma picture was the same of the adult male and female GRs with the exception of the plasma K where there was significant ($P < 0.05$) sex difference in their mean values higher in the former compared to the latter.

DISCUSSION

There were differences attributable to age and sex in the values of some of the parameters assessed in this study. Based on age the young or immature giant rats had significantly less potassium in their plasma than the adults. They also had less amount of sodium although the values of chloride ions in both age groups were comparable. Phosphate levels were higher in the immature rats than in the adults rats. Plasma electrolyte are very essential for normal functions and health of organisms and they occur either in elemental form or incorporated into specific compounds (Hays and Swenson, 1970).

Sodium, potassium, chloride and bicarbonate ions are very important for maintenance of fluid and acid - base balance and for muscle and neuromuscular impulse transmission (Saxton and Seldin, 1986) changes in the concentration of these ions affect the extra cellular fluid volume and neuromuscular impulse transmission. Both calcium and phosphate serve as the major mineral elements concerned with the integrarity of the musculo-skeletal system (Hays and Swenson 1970). It has been suggested (Amand, 1986) that serum calcium levels must be estimated in conjunction with the serum albumin levels as the former includes the sum of both the ionized and albumin-bound fractions although the ionised fraction is the physiologically active one. In this study the calcium levels in both adult and immature giant rats were comparable but the immature rats had significantly higher phosphate levels. It is notably that despite obvious differences in mass and bodily volume between mature and immature rats, it was only in the levels of potassium and phosphate that significant differences existed in their plasma electrolyte endowments. The significance of this finding is unknown but it mat not be unrelated to their diet and stage of physical development. Growing, pregnant and especially lactating animals are said to require liberal amounts of calcium and phosphorous and the greater the need the more efficient the absorption from dietary sources (Hays and Swenson, 1970) with a greater need for dental and musculoskeletal development, it is not surprising that the immature rats had greater quantities of these electrolytes in their blood than the adults animals in which they would probably become tissue-bound. Nottridge *et al* (1999) found they kittens from Nigeria cats had higher plasma electrolyte levels than the adults. Also Higgins and Wright (1999) noted that foals and colts had different levels plasma electrolyte endowments from stallions and mares. Kaumaln *et al* (1998) found that knets had higher levels of glucose and other electrolytes in their blood than adult goats. Bush *et al* (1981) have also found age related differences in blood and serum biochemical parameters in captivity Doris gazelles with natural zoological park investigation PC.

Our findings with regard to the concentration levels of these electrolytes do not agree with sound existing data in the literature in other species. The level of plasma sodium from this study is lower than those of the Nigerian cat. (Notridge *et al*, 1999), the white bellied pangolin (Oyewale *et al* , 1997) and the local chicken and ostrich (Olowookorun and Makinde, 1998). The values are however comparable with those of Nigerian goats (Oduoye and Adadavoh, 1976) and white Fulani cattle (Oduye and Fasanmi, 1976) pigs (Fidsley, 1979) and humans (McFarlane, 1970). These ruminants attest to the conclusion that general factors including species age and dietary habits affect plasma electrolyte levels (Caper and Rosol, 1989).

When sex was introduces as a valuable (Table 2) and same sex compared baby rats had much higher phosphate blood levels than the adult female. This is perhaps understable in the contact of in the context of the immature rats getting additional source of phosphate supply from the milk from the dietary source to which both mature and immature rat had equal access. The adult female had higher plasma sodium just like the adult male . this is probably a response to an emergent necessity for the activation of a thermoregulation apparatus. Being a nocturnal around sweet glands are about or poorly electrolyzed in the adult gland rats were compared to the female (Table 3) the females, whether matured or immature, were found to have relatively higher values than the males. This valuation pattern had also been previously observed in both rumination and avian species including man (Notridge *et al* , 1999 Mc 1979, Oduye and Adadevoh, 1976; Oduye and Fasanmi, 1976; Oyewale *te al*, 1997, 1998, 1999; Olowokorun and Makinde, 1999). Many more segmentation differences were found when the sexes and ages were cross ?? (Table 4) and probably ?? from the different levels of physiological activities of the animals including hormonal??.

With regard to plasma proteins the baby rats had higher total plasma protein levels than the adults. Although, the adult had higher albumin level the globulin fraction was much higher with immature rats. this must have derived from the greater need for passive immunity in the immature rats than the adult animals (Hays and ?? 1970). The levels in plasma protein were not significantly affected by sex. while this written findings in agreement with the observations of Oyewale *et al* (1999) in the adult giant rats, of Weiss *et al* (1994) in the *Mustela vison* and Karesh *et al* (1995) in 5 different chicker species in Zaira, it is at variance with those of otesile and kasali (1992) in the sheep, Oduye and Fasanmi (1971) in cattle and Notridge *et al* (1999) in adult Nigerian cats.

Perhaps the most interesting finding from this study is the dichotomy between the values obtained here and those reported by Oyewale *et al* (1998) for adult male and female giant rats in the same locality. Our values are consistently higher than those of Oyewale and his collaborators whether they are of plasma proteins or plasma electrolytes (Table 5). Since the animals in the

faculty of Veterinary Medicine and kept under similar conditioned the only differences between the rats used here and those they used is their level of acclimatization to captivity before being used for experiments. They used giant rats that had been captured just six weeks earlier – whereas the animals used in the present study had been in captivity for over 7 months. Infact they had been so used to captive conditions that they could breed and procreate their offspring the immature ones were even 2 months old.

African giant rats in the wild are nocturnal animals and during the night when the temperatures are usually cooler the basin metabolic rate of animals are also usually down. It is suggested here that the level of adaptation to day light or captive conditions especially of nocturnal animals be taken cognizance of when designing experiments whose outcome may have to be compared with those of domesticated daytime animals. This is because adaptation include changes in plasma concentrations of metabolically and physiologically important parameters such as plasma proteins and electrolyte

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