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Comparative Morphometric Studies of the Cerebellum and Forebrain of the African Giant Rat (AGR) (*Cricetomys gambianus*-waterhouse) and That of Grasscutter (*Thryonomys swinderianus*)

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Abstract: Six AGR and ten grasscutter were used in this study. The large size of the olfactory bulb of the AGR makes them better sniffers of landmines and tuberculosis patient than the grasscutter if trained. The large size of the cerebrum of both animals makes them good animals for studies on their neurobiology.

Key words: Morphometric, cerebellum, forebrain, African giant rat, grasscutter

INTRODUCTION

The African giant rat and the grasscutter are rodent with an average weight of 4500 and 1200 g in adult life, respectively. The can grow up to 60 and 38 cm long, respectively. The National Research Council (NRC, 1991) reported that these rodents are found in grass land. In addition the AGR are also found in human habitations and farmlands. The walk and run on all their four legs usually with their tail-raised and are good climber and jumpers (Happlod, 1987).

In view of their abundance and size of these rodents they are often eaten and considered a delicacy. Their smoked carcasses of these rodents are often seen in village markets and attempts have been made to domesticate them (Ajayi, 1975; Eben, 2004).

The excessive and uncontrolled decimation of these animals for consumption poses a threat to their ultimate survival (Ajayi, 1974).

Literatures on these animals has only been documented in the areas of its biology, reproductive biology Housing and management (Oke, 1988; Adeyemo and Oke, 1990; Oke and Aire, 1989, 1995).

However, to the best of our knowledge nothing has been on the brain of these rodents within the study area that could contribute to the understanding of these rodents functional at anatomic correlations.

It is on this basis that this work was carried out to study the morphometry of the cerebellum and forebrain of the African giant rat and the grasscutter and to relate the anatomical features to functions.

MATERIALS AND METHODS

Six African giant rats and 12 grasscuters of both sexes were captured alive and transferred to the laboratory of veterinary, Anatomy Department of Ahmadu Bello University Zaria, Nigeria using laboratory rat cages. The rats were fed with locally made groundnut pellets while the grasscutter were fed with desired grasses. Water was given *ad libitun.*

The AGR and the grasscutter were weighed using a balance (metler, model P. 1210), which has a sensitivity of 0.1 g and the weighed of each AGR and grasscutter were recorded in grams. Sex difference was not taken into consideration. Both animals were later sacrificed according to method of Adeyemo and Oke (1990). Each head was perfused with Bouin's solution through the common carotid artery using 10 mL syringes and 19 gauge needle.

The skin and musculature over the cranium were removed after decapitation and a cut made over the frontal and temporal bones, using a handsaw to expose the brain thus enhancing proper penetration of the fixative. Each head was completely immersed in a labeled container containing Bouin's solution for 1 week before removing the brain according to Harper and Maser (1975). The brains were cleaned to free it of its meanings. The weight (in grams) of each brain was determined using mettler balance (which has sensitivity 0.01 g) the length of the whole brain was measured in centimeter using a meter ruler.

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The hemispheres of each of the brain were separated from the brainstem by gently widening the longitudinal fissures between the cerebral hemispheres with the thumb and finger. A scapel was inserted and the corpus callosum was cut lengthwise from the splenium to the genu making the diencephalon visible. The brain was turn upside down and a cut was made just rostral to the optic tract.

The cerebellum was separated from the brainstem by manually raising the flocculi of the cerebellum to expose the cerebellar peduncles. These penduncles were severed on both sides starting with the laterally located lateral restiformis followed by middle brachium pontis and the brachium conjunctivae.

Care was taken not to severe the lingula and uvula, which projects into the cavity of the fourth ventricles. The cerebellum and the forebrain were cleaned of the remaining meninges.

All recorded weights and lengths of the brain studied were expressed as mean±standard error of the mean (M±SEM).

RESULTS

The comparative morphometric values of the whole brain, cerebellum, olfactory bulb and the forebrain of the AGR and the grasscutter are summarized in Table 1 and 2.

The mean life weight of the AGR and that of the grasscutter in grams were 891.7±100.3 and 1181±210.2, respectively. While the weights (in grams) of the brain, cerebellum and the forebrain for these animals were 4.94±017, 0.62±0.06, 3.32±0.12 and 10.03±0.32, 1.25±0.05, 7.22±0.18, respectively which accounted for 14.0, 66.0, 12.5 and 67.5% for the cerebellum and forebrain, respectively (Table 1). There were significant differences in all probability the values in favour of the grasscutter.

The mean length of the brain, cerebellum, olfactory bulb and forebrain were 4.33±0.20, 1.13±0.06, 1.07±0.16, 2.75±0.11 and 5.95±0.12, 1.34±0.05, 0.56±0.01, 4.04±0.11 for the AGR and glasscutter respectively which accounted for 23.0, 19.0, 57.1 and 20.3, 9.0, 70.6% (Table 2), respectively. There was a significant difference in respect of the weight and length of the brain, cerebellum and forebrain ($p<0.05$). These values favour the grasscutter while the value of the olfactory bulb favours the AGR.

DISCUSSION

In the present study, the mean brain weight and length of the AGR and the grasscutter were found to be 4.94±0.17 g, 4.33±0.20 cm and 10.03±0.32 g, 5.95±0.12 cm, respectively. With that of the grasscutter being higher with a high significance difference ($p<0.05$).

Broca (1861) was of the opinion that brain size reflects intelligence. It was Broca himself who laid the groundwork for modern view of the heterogeneity of the brain. Based on Broca observation, the AGR is less intelligent compared to the grasscutter and the grasscutter being less intelligent compared to the dog, cat, Kangaroo and porcupine (Eric, 2006) but more intelligent than the squirrel, guinea pig, AGR, rat, sparrow and the viper (Eric, 2006; Sultan and Braiteberg, 1993). These findings also agrees with Nzalak *et al*. (2005) observation.

The olfactory bulb of the AGR and grasscutter measures 1.07±0.16 and 0.56±0.0 cm with a significance difference in favour of the AGR and accounted for 19.01 and 9.0%, respectively. This implies that the AGR has better sense of smell compared to the grasscutter.

The large size of the AGR olfactory bulb may facilitate many experimental procedures such as studies on the general neurobiology of olfaction as done by Carina *et al*. (1998) and Mekee (2003) observed that the

Table 1: Comparative morphometric values of the mean weight of the whole brain, cerebellum and forebrain of the AGR and the grass cutter (in grams)

Weight	AGR Mean±SEM n = 6	AGR total brain weight (%)	Grasscutter Mean±SEM n = 10	Total brain weight (%)	p<0.05
Animal weight	891.7±100.3		1181.00±210.2		0.0021
Brain	4.94±0.17	100.0	10.02±0.32	100.0	0.0001
Cerebellum	0.62±0.06	14.0	1.25±0.05	12.5	0.007
Forebrain	3.32±0.12	66.0	7.22±0.18	67.5	0.001

Table 2: Comparative morphometric values of the mean length of the whole brain, cerebellum, olfactory bulb and forebrain of the AGR and the grass cutter (in cms)

Length	AGR Mean±S.E.M n = 6	AGR total brain length (%)	Grasscutter Mean±S.E.M n = 10	Grasscutter total brain length (%)	p<0.05
Brain	4.33±0.2	100.0	5.95±0.12	100.0	0.001
Cerebellum	1.13±0.06	23.0	1.34±0.05	20.3	0.014
Olfactory bulb	1.07±0.16	19.0	0.56±0.01	9.0	0.008
Forebrain	2.75±0.11	57.1	4.04±0.11	70.6	0.001

$p<0.05$

AGR are good sniffers of tuberculosis patient if trained. Moth (2004) observed that because of the small size the AGR, they can sniff out landmines without it being detonated when compared to dogs and has exceptionally powerful nose to sense the slightest trace of compounds used in explosive (Perry, 2005). On the other hand the grasscutter are not good sniffers as the AGR.

The cerebellum of the AGR and grasscutter measures 0.62±0.06 g; 1.13±0.6 and 1.25±0.05, 1.34±0.05 cm, respectively.

Carpenter (1972) suggests that cerebellar influence practically all neuronal functions both sensory and motor types. Since, the grasscutter has a larger cerebellum, one can then deduce that they are better regulators of the sensory and motor activities when compared to the AGR.

The large size of the cerebrum of the grasscutter and the AGR, offers 2 types advantages of experimental procedures. On the other hand it makes feasible for extensive neocortical ablation studies. Additionally, it will allow neocortical recording of bioelectrical activity by mere implant of screws into the skull over the neocortex. This finding agrees with Nzalak *et al.* (2005).

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