

# Morphometric studies of some visceral organs and gastrointestinal tract of four-toed african hedgehog (*atelerix albiventris*)

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## Abstract

**Introductions:** Morphometric studies were carried out on some visceral organs and gastrointestinal tract of African four-toed hedgehogs found in Maiduguri, Nigeria. **Materials and Methods:** Twelve (12) healthy adult hedgehogs, (6 male and 6 females) were used. The overall mean body weight was  $239.5 \pm 28.3$  g, and was statistically not significant ( $p > 0.05$ ) between the sexes. The absolute (g) and relative (%) values for nearly all the visceral organs measured were consistently higher in the female, but were statistically not significant ( $p > 0.05$ ) between the sexes. **Results:** The gastrointestinal tract morphology was simple, and lacks ceca. The overall mean length of the greater curvature of the stomach was  $7.42 \pm 0.95$  cm, with females ( $8.17 \pm 1.14$  cm) having significantly higher values ( $p < 0.05$ ) than ( $6.67 \pm 0.75$  cm) observed in the males. **Conclusions:** The results obtained in this study will be useful in comparative anatomical studies, and as basic research data in varied field of zoology and veterinary sciences.

**Keywords:** *atelerix albiventris*, morphometry, visceral organs, gastrointestinal tract.

## 1 Introduction

The four toed African hedgehog (*Atelerix albiventris*), belongs to the order *Insectivora*, family *Erinaceidae*, genus *Atelerix*, (HUTTERER, 2005; REEVE, 1994). They are the smallest of the African hedgehogs among the genus *Atelerix*. They are terrestrial, placental mammals, weighing between 200-600 grams and are nocturnally active. They are classified as 'least concern' species on the international union for conservation of nature (IUCN) Red data list (HUTTERER, 2008). Widely spread in West Africa, inhabiting steppes, savannas, and grassland (HAPPOLD, 1987) and can be found in human habitation, such as gardens, food stores, and cultivated fields (REEVE, 1994). They feed principally on invertebrate, but are considered as opportunistic omnivores, consuming a more varied diet based on food availability (SMITH, 1999).

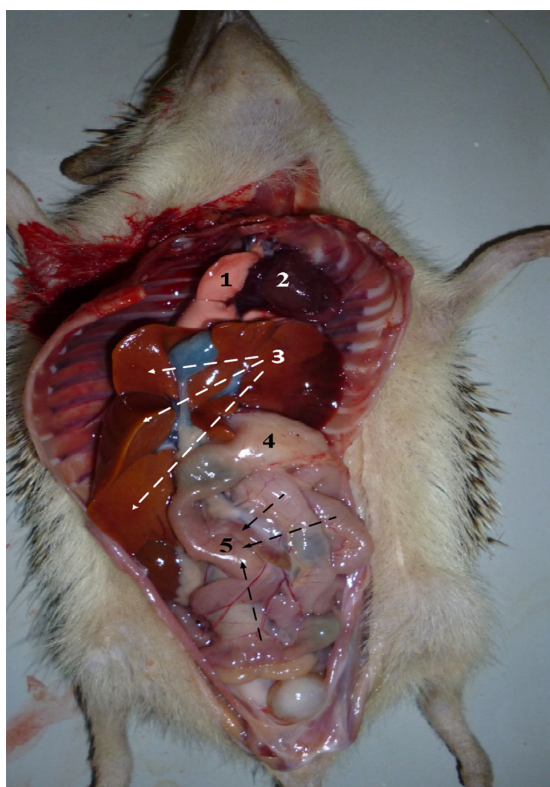
Basic data of visceral organ and body weights is a vital source of information in numerous scopes of veterinary medicine and biological science (GANGRADE, 2009). Sensitive Indicators of the effect of experimental compound can be deduced from weight of organs (MICHAEL, YANO, SELLERS et al., 2007). Deviation from normal weights could be a pointer to underlying pathology (TANNA, PATEL and KALELE, 2011) or may occur in the absence of any morphological changes (BAILEY, ZIDELL and PERRY, 2004). Considerable diversity exists in the form and structure of gastrointestinal tract among mammals reflecting adaptive and habitual diets (DYCE, SACKS and WENSING, 2009). The gastrointestinal tract morphology of insectivores is often characterized as simple, with unilocular stomach, and a hind guts that lacks cecum (STEVENS and HUME, 1995).

The aim of the present study is to document a based line data of weights of some visceral organs and gastrointestinal tract morphometry of the four-toed hedgehog (*A. albiventris*) found in Maiduguri, Nigeria.

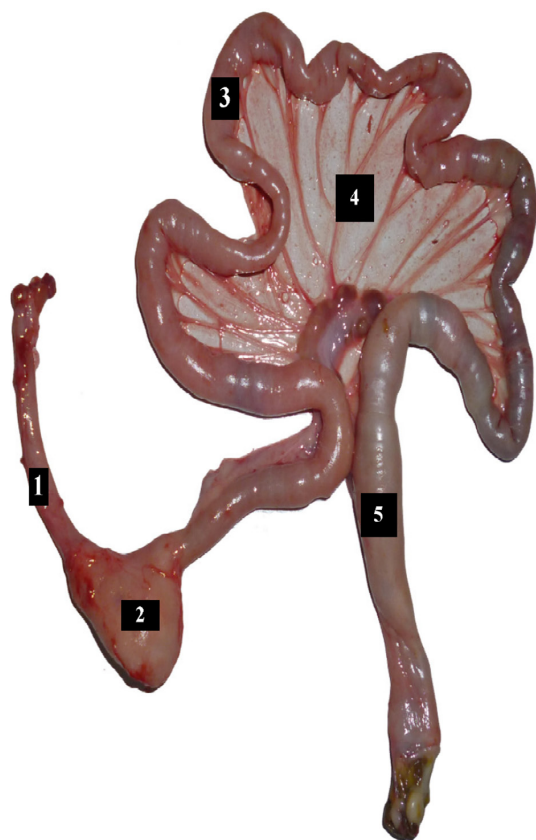
## 2 Materials and Methods

A total of ten (12) apparently healthy adult hedgehogs, comprising 6 males and 6 females, were used for the study. The hedgehogs were procured from local farmers, and were transferred to a laboratory at the department of veterinary anatomy, University of Maiduguri. The hedgehogs were carefully conditioned for two (12) weeks during which they were given food and have access to water *ad-libitum*.

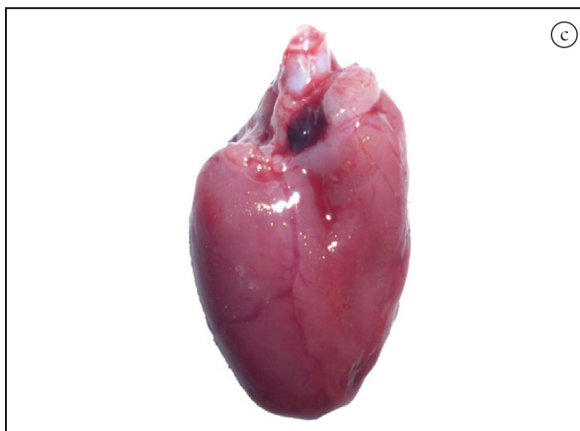
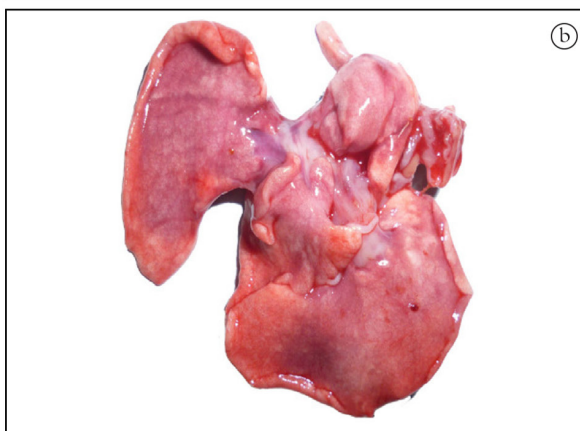
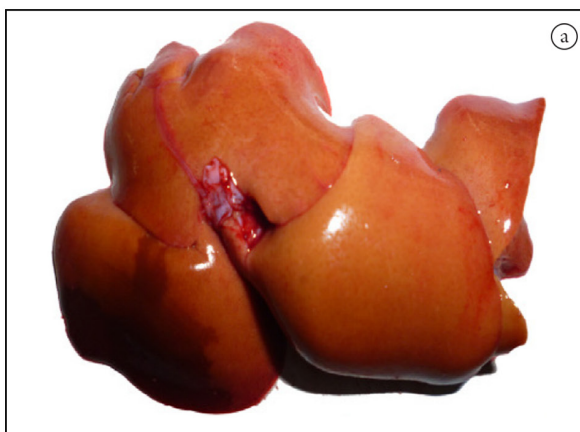
Live body weights of the hedgehogs were taken using an electronic balance (YP 5001, Shanghai <sup>(MC)</sup>) with sensitivity of 0.1g and were recorded in grams. The animals were euthanized with chloroform in an enclosed plastic container. Subsequently, the animals were placed on a surgical tray in a dorsal recumbency. The thorax and abdomen were carefully dissected with the aid of scalpel blade and scissors. The heart, lungs, liver, spleen, kidneys, and gastrointestinal tract were gently exteriorized (Figures 1, 2 and 3). Blood, peritoneal fat and other tissue attached to these structures were gently removed. The organs were weighed using Mettler® balance with 0.01g sensitivity. The gastrointestinal tract (GIT) was carefully freed of all mesenteric and omental attachment. The lengths of the esophagus, stomach curvatures, and the intestine were measured with a pliable non-stretchable cord and a ruler. The values obtained were recorded in centimeter



**Figure 1.** African hedgehog showing the visceral organs (in situ)  
Lungs, 1 Heart 2, Liver 3, Stomach 4, intestine 5.



**Figure 2.** Gastrointestinal tract of hedgehog showing the  
esophagus 1, Stomach 2, mall intestine 3, Mesentery 4, large  
intestine 5.



**Figure 3: Visceral organs of African hedgehog; A. Liver, B. Lung, C. Heart, and D. Spleen.**

(cm). The intestine (Small and large), was measured as single structure, because of the absences of cecum as well as poorly defined anatomic segmentation as observed by Johnson-Delany (2006). Photographs of the organs were taken *in situ* with the aid of a digital camera (Panasonic DMC-FH5 camera).

Landmarks for the measurements of the GITs are described as follows:

- i. Esophageal length: from the caudal aspect of the cartilages of larynx to gastro-esophageal junction.
- ii. Stomach:
  - (a). greater curvature: the convex greater surface extending from cardia to pylorus.
  - (b). lesser curvature: the concave shorter surface extending from cardia to pylorus.
- iii. Whole gut Length (small/large intestine): from gastro-duodenal junction to the terminal end of the anus.

All recorded weights of the visceral organs (Lungs, heart, liver, kidneys, and spleen) as well as length of the gastrointestinal tract were analyzed using the Statistical Analysis Package (GraphPad Instat® version 3.0). The data obtained were

expressed as Mean  $\pm$  Standard Deviation. The differences for values obtained in the male and female were further analyzed using student t-test and ( $p < 0.05$ ) were considered significant.

### 3 Results

The overall mean body weight of the hedgehog was observed to be  $239.5 \pm 28.3$  g. The mean absolute weight of the liver was  $12.5 \pm 2.24$  g, which accounted for 5.21% of the weight of the hedgehog (Table 1). The mean absolute weight of the spleen, lungs, and heart were  $3.93 \pm 2.34$  g,  $1.84 \pm 0.58$  g and  $1.01 \pm 0.16$  g respectively, representing 1.62%, 0.77%, and 0.42% of the total body weight of the hedgehogs. The mean weight of the right and left kidney were  $1.47 \pm 0.38$  g and  $1.45 \pm 0.34$  g accounting for 0.61% and 0.62% of the total body weight of the hedgehogs (Table 1 and 2). The absolute and relative values for all the visceral organs measured were statistically not significant ( $p > 0.05$ ) between the sexes (Table 1 and 2). The mean length of the esophagus was  $64.0 \pm 0.69$  cm. The mean length of the greater curvature of the stomach was  $8.17 \pm 1.14$  cm in the females, significantly higher ( $p < 0.05$ ) than  $6.67 \pm 0.75$  in the males. The overall mean length of the lesser curvature and the whole intestinal length (small/large) were ( $3.32 \pm 0.37$  cm,  $81.5 \pm 14.8$  cm) respectively (Table 3).

**Table 1.** Mean  $\pm$  SD of live body weight and some visceral organs (g) of the African four toed hedgehog (*A. albiventris*).

Organs	Absolute weight (g)		
	Male	Female	Overall mean
Body weight	$223.8 \pm 15.8$	$255.2 \pm 40.9$	$239.5 \pm 28.3$
Liver	$10.9 \pm 1.14$	$14.23 \pm 3.34$	$12.5 \pm 2.24$
Spleen	$2.98 \pm 2.89$	$4.88 \pm 1.80$	$3.93 \pm 2.34$
Lungs	$1.83 \pm 0.64$	$1.85 \pm 0.53$	$1.84 \pm 0.58$
Heart	$0.95 \pm 0.08$	$1.07 \pm 0.25$	$1.01 \pm 0.16$
Kidney Right	$1.38 \pm 0.31$	$1.57 \pm 0.46$	$1.47 \pm 0.38$
Left	$1.37 \pm 0.27$	$1.53 \pm 0.41$	$1.45 \pm 0.34$

P ( $< 0.05$ ) considered significant.

**Table 2.** Mean  $\pm$  SD of relative weight of some visceral organs (%) of the African four toed hedgehog (*A. albiventris*).

Organs	Relative weight (%)		
	Male	Female	Overall mean
Liver	$4.87 \pm 0.29$	$5.55 \pm 0.75$	$5.21 \pm 0.52$
Spleen	$1.28 \pm 1.19$	$1.96 \pm 0.80$	$1.62 \pm 1.00$
Lungs	$0.81 \pm 0.22$	$0.72 \pm 0.12$	$0.77 \pm 0.17$
Heart	$0.42 \pm 0.04$	$0.42 \pm 0.06$	$0.42 \pm 0.05$
Kidneys Right	$0.61 \pm 0.09$	$0.60 \pm 0.11$	$0.61 \pm 0.1$
Left	$0.62 \pm 0.12$	$0.61 \pm 0.13$	$0.62 \pm 0.13$

P ( $< 0.05$ ) considered significant.

**Table 3.** Mean  $\pm$  SD of gastrointestinal segments (cm) of the African four toed hedgehog (*A. albiventris*).

Gastrointestinal segments	Absolute Length (cm)		
	Male	Female	Overall mean
Esophagus	$6.57 \pm 0.79$	$6.23 \pm 0.59$	$6.40 \pm 0.69$
Stomach Greater curvature	$6.67 \pm 0.75$	$8.17 \pm 1.14^*$	$7.42 \pm 0.95$
Lesser curvature	$3.17 \pm 0.41$	$3.47 \pm 0.32$	$3.32 \pm 0.37$
Whole intestine	$78.0 \pm 12.0$	$84.9 \pm 17.6$	$81.5 \pm 14.8$

\* $p < 0.05$  vs Greater curvature male



#### 4 Discussion

In our study, the mean body weight of the female hedgehogs was heavier than the male but was statistically not significant. Conversely, Okorafor, Okete, Eleng et al. (2013) reported a higher weight in the male of African grasscutter than the female. The overall mean absolute weight of the liver was lower than values reported for male African grasscutter (AJAYI, SHAWULU and NAFARND, 2012), African giant rats AGR (NZALAK, ONYEANUSI and SALAMI, 2012), and the African pangolins (OZEGBE, OGUNSANMI and OGUNJOBI, 2000). However, the mean weight of the spleen was heavier than  $3.17 \pm 0.50$  g reported in male African grasscutter (AJAYI, SHAWULU and NAFARND, 2012) and  $2.0 \pm 0.40$ ,  $2.10 \pm 0.20$  g, in male and female African pangolins respectively (OZEGBE, OGUNSANMI and OGUNJOBI, 2000). Equally, the relative weight of the spleen was higher than 0.11% in laboratory hamsters (GATTERMANN et al., 2002), 0.2% in laboratory rat (LOSCO, 1992) and 0.19% in male African grasscutter (AJAYI, SHAWULU and NAFARND, 2012). The mean weight of the lungs and the kidneys with their relative ratios were lower as compared to values obtained in AGR (NZALAK, ONYEANUSI and SALAMI, 2012) and male African grasscutter (AJAYI, SHAWULU and NAFARND, 2012). The absolute as well as relative ratios of all the visceral organs measured were observed to be higher in the female hedgehogs, with the exception of the lungs in which the males have slightly higher values. However, the differences between the sexes were statistical not significant ( $p > 0.05$ ).

In the present study, the mean length of the esophagus was observed to be longer in the male hedgehog. Equally, the overall mean value of the esophagus in this study was higher than 5.50 cm reported by Nzalak, Onyeausi and Salami (2012) in AGR. The stomach of the hedgehog was simple, with 2 surfaces (visceral and parietal), forming the lesser and greater curvatures. The length of the greater curvature measured was longer in the females than the males. This may denotes greater cardia, fundus, and pylorus surface area in the females. The mean whole intestinal length measured was slightly higher in the females although the difference was not statistically significant. The gross morphology of the GITs in this study was simple, with absence of cecum, which conforms to general gut morphology of insectivores as reported by Langer (2002). Numerous factors may influence exact GITs morphometry. In our study, the weight of the GITs was not considered, as variation in the quantity of ingesta at the time of sacrifice could affect the results.

The study has provided a baseline data on the morphometry of the visceral organs and the gastrointestinal tract of *A. albiventris* found in Maiduguri, for comparative anatomical studies of wild and captive small mammals, and may be applicable in the field of pharmacology and toxicological studies

#### References

AJAYI, IE., SHAWULU, JC. and NAFARND, WD. Organ body weight relationship of some organ in the male African Grasscutter (*Thryonomys swinderianus*). **Journal of Advanced Veterinary Research**, 2012, vol. 2, p. 86-90.

BAILEY, SA., ZIDELL, RH. and PERRY, RW. Relationships between organ weight and body/brain weight in the rat: what is the best analytical endpoint? **Journal of Toxicologic Pathology**, 2004, July-August, vol. 32, n. 4, p. 448-466. <http://dx.doi.org/10.1080/01926230490465874>. PMID:15204968.

DYCE, KM., SACKS, WO. and WENSING, CJG. *Textbook of veterinary anatomy*. 4th ed. Philadelphia: W.B. Saunders Company, 2009.

GANGRADE, RP. Organ weights and its correlation with body weight: a post mortem study. **Journal of Forensic and Toxicology**, 2009, vol. 26, n. 2, p. 37-39.

GATTERMANN, R., FRITZSCHE, P., WEINANDY, R. and NEUMANN, K. Comparative studies of the body mass, body measurements and organ weights of wild derived and laboratory golden hamsters (*Mesocricetus auratus*). **Laboratory Animals**, 2002, vol. 36, n. 4, p. 445-454.

HAPPOLD, DCD. *The mammals of Nigeria*. Oxford: Clarendon Press, 1987.

HUTTERER, R. *Atelerix albiventris*. International Union for Conservation of Nature and Natural Resources (IUCN) *Red list of threatened species*. Version 2009.2. 2008.

HUTTERER, R. Order erinaceomorpha. mammal species of the world: a taxonomic and geographic reference. In: *Mammal Species of the World: a Taxonomic and Geographic Reference*. WILSON, DE. and REEDER, DM. (Eds). Baltimore. Maryland: John Hopkins University Press, 2005.

JOHNSON-DELANEY, C.A. Anatomy and physiology of the gastrointestinal system of the ferret and selected exotic carnivores. In *Proceedings from the association of avian veterinarians*, 2006. p. 29-38.

LANGER, P. The Digestive tract and life history of small mammals. **Mammal Review**, 2002, vol. 32, n. 2, p. 107-131. <http://dx.doi.org/10.1046/j.1365-2907.2002.00101.x>.

LOSCO, P. Pathobiology of the aging rat, normal development, growth, and aging of the spleen. In: *Normal structure and function of the histology of the spleen*. MOHR, U., DUNGWORTH, DL. and CAPEN, CC. (Ed). Washington: ILSI Press, 1992. p. 75-94.

MICHAEL, B., YANO, B., SELLERS, RS., PERRY, R., MORTON, D., ROOME, N., JOHNSON, JK., SCHAFER, K. and PITTSCH, S. Evaluation of organ weights for rodent and non-rodent toxicity studies: a review of regulatory guidelines and a survey of current practices. **Journal of Toxicologic Pathology**, 2007, August, vol. 35, n. 5, p. 742-750. <http://dx.doi.org/10.1080/01926230701595292>. PMID:17849357.

NZALAK, JO., ONYEANUSI, BI. and SALAMI, SO. Macrometric study of the digestive system of the african giant rat (*Cricetomys gambianus* Waterhouse 1840). **European Journal of Anatomy**, 2012, vol. 16, p. 113-118.

OKORAFOR, KA., OKETE, JA., ELENG, IE. and ODAIBO, AB. Seasonal variation in the mean body weight, length, and capture rate of cane rats. (*thryonomys swinderianus*) ibadan, oyo state, nigeria. **European Journal of Experimental Biology**, 2013., vol. 3, p. 301-306.

OZEGBE, PC., OGUNSANMI, AO. and OGUNJOBI, EO. Weights and linear measurements of the body and some organs of the adult male and female african white bellied tree pangolins (*Manis tricuspis*). **Nigerian Veterinary Journal**, 2000, vol. 23, p. 54-60.

REEVE, N. *Hedgehogs*. London: T. & A.D. Poyser, 1994.

SMITH, AJ. Husbandry, and nutrition of hedgehogs: veterinary clinic of North America. **The Journal of Small Animal Practice**, 1999, vol. 2, p. 127-141.

STEVENS, CE. and HUME, ID. *Comparative physiology of the vertebrate digestive system*. 2nd ed. Cambridge: Cambridge University Press, 1995. p. 1-23.

TANNA, JA., PATEL PN., and KALELE, SD. Relationship between organ weights and body weights in adult population of bhavnagar region: a post mortem study. **Journal of Indian Academy of Forensic Medicine**, 2011, vol. 33, p. 57-59.

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