Histological and Histochemical Studies of the Colon in the African Giant Rat (*Cricetomys gambianus,* Waterhouse 1840)

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Abstract

Forty AGRs were used for the present study. Histologically, the different segments of the colon were observed to be lined by simple columnar epithelium with numerous goblet cells and intestinal glands. The tunica muscularis was observed to present a thick band of longitudinal muscles. Histochemical studies showed that the goblet cells and the intestinal glands of the entire colon were AB, PAS and AB-PAS positive, signifying the production of acidic and neutral mucin.

Key words

histological, histochemical, colon, AGR.

Introduction

There is a great need to enhance food production in the developing countries. According to Paarlberg (2000), the UN's Food and Agriculture Organization (FAO) recently reported that one out of every five citizens from the developing countries (approximately 828 million people) are suffering from chronic malnutrition. The situation may even be more disastrous on the African continent as a whole, with an estimated population of about 776 million inhabitants (FAO, 2002). Most of these people live under deplorable conditions, with little or no hope of significant future development in sight. The shortage of protein rich food in some areas has reached serious levels.

Protein, an essential constituent of our daily diet, like fat and carbohydrates, can also serve as a source of energy for the body. Protein is also the only source of amino acids, especially essential amino acids. A regular daily intake is absolutely ne-

cessary to maintain normal levels of peptides and other nitrogen-containing substances in the tissues.

One alternative source of protein is the African Giant rat (*Cricetomys gambianus*- Waterhouse). Its meat is habitually consumed in most areas of Africa where these large rodents occur naturally. A study carried out in Nigeria showed that 71.4 % of the people find it acceptable to use the animal as food (Ajayi and Olawoye, 1974). Despite taboos and prohibitions that exist in some areas of Democratic Republic of Congo (DRC), the meat of this rodent is generally well appreciated. They are omnivorous animals, feeding on vegetables, insects, crabs, snails and other items but apparently preferring palm fruits and palm kernels. They can support themselves in sewage areas and rubbish dumps of large towns, where they do little damage and on farms where their status as pest is in little doubt (Booth, 1991). However, there are reports that the rats are reservoir hosts for monkey pox virus (Maggie, 2003).

The rats are distributed in all parts of Nigeria. In the rain forest zone, they are restricted to farmlands, grasslands and human habitations. They are frequently seen at night crossing roads, running along drains and in house compounds. They are social animals and as such several individuals live together in a burrow. In Nigeria, these rodents are often incorrectly called “rabbits” or “Nigerian rabbits” (Delany and Happold, 1979).

In view of their abundance and size, the rodents are often eaten by the people and considered a delicacy. Their smoked carcasses are often seen in village markets. Attempts have been made to breed and rear the animal in captivity for food (Ajayi, 1975). The AGR has a good potential for use as a laboratory animal (Dipeolu *et al*., 1981) and has been shown to be a good host for the laboratory passage of *Schistosoma mansoni* and *Trypanosoma evansi* (Lariviere Buttner, 1961). Recently, the rodent has been used to detect tuberculosis and to sniff out landmines in Mozambique (Lindow, 2001).

The excessive and uncontrolled consumption of this animal poses a threat to the ultimate survival of this species and Ajayi (1974) had attempted to study its biology and domestication. As a contribution towards this pioneering effort, several attempts at characterization of the reproductive organs have been made by Oke (1988), Oke *et al.,* (1989, 1990, and 1995) and Ali

(2009). Other works on the AGR include those on the brain by Nzalak (2002), Nzalak *et al*., (2005, 2008) and Ibe *et al.,* (2010).

The dietary requirement and feeding habit of the African giant rat cannot be properly understood without a detailed knowledge of the digestive system. It is also a well known fact that the subfamily, *Cricetomyinae,* exhibits food storing behavior (Ewer, 1967).

The morphology of the gastrointestinal tract (GIT) has been reported in a number of other animals such as the cattle, sheep, pig, horse, dogs (Getty, 1975), man (Haroldy, 1992), laboratory rats (Olds and Olds, 1991) and birds (Devyn *et al*., 2000). Despite the features of this rat that have been studied, the digestive system is yet to be fully investigated. The only work done on the digestive system of this rodent in Northern Nigeria is on the morphometry of some aspects of the digestive system (Ali *et al*., 2008 and Dauda, 2009). Moreover, even basic information on the histology and the histochemistry of the colon of the African giant rat is not readily available. For example, there are no reports of histochemical studies on its mucous secretion which is a common feature of the colon of other species. This work seeks to describe the histology and histochemistry of the colon of the African giant rat.

Materials and Methods

Forty adult African giant rats, (AGR) *Cricetomys gambianus,* of both sexes were captured alive in the wild around Samaru and Bomo villages in Zaria, Kaduna State, Nigeria from January to April 2009 using metal cage traps. They were transferred into standard laboratory rat cages in the Department of Veterinary Anatomy, Ahmadu Bello University, Zaria and were fed with standard laboratory animal feed during an acclimatization period of one month. Water was given *ad libitum* during the period. Moreover, they were physically examined under careful restraint in the cage to ascertain their health status.

Histological and histochemical studies

The rats were starved of food and water twenty fours prior to the experiment. They were then euthanized by intra-peritoneal injection of lethal dose of Thiopental Sodium (Rotexmedica, Trittau. Germany). Following euthanasia, they were placed on dorsal recumbency and an incision was made from the first cervical vertebra up to the level of the pelvic region to expose the gastrointestinal

tract. The entire gastrointestinal tract was exteriorized, excised, washed with distilled water and rinsed with physiologic saline solution. Segments were taken from the descending, transverse and ascending colon.

These tissues were immediately fixed by complete immersion in 10% normal formalin and labeled and kept for two days. They were dehydrated through a series of graded alcohol (70%, 80%, 90%, 95% and 100%). They were later cleared in xylene and infiltrated with molten paraffin wax. Transverse sections of 5µ thick were cut from the embedded tissues using disposable microtome knives. These sections were mounted on grease free clean glass slides and stained at room temperature using a haematoxylin and eosin (H&E) method for routine histological studies.

For histochemical studies, transverse sections from the embedded tissues were cut and stained with Alcian blue (AB) at a pH of 2.5, for acidic mucin identification, periodic acid-schiff (PAS), for identification of neutral mucin and Alcian blue at a pH of 2.5 together with Periodic acid-schiff (AB-PAS) for the identification of both the neutral and acidic mucins.

The slides were studied using light microscope (Olympus binocular microscope) at X 100, X 250 and X 1000 magnification. Photographs of the prepared slides were taken using a digital camera. These pictures taken were transferred to a computer and detailed histological studies were carried on them. Relevant areas and structures were printed labeled.

Results

The different segments of the colon of the AGR were observed to be lined by simple columnar cells with abundant goblet cells and intestinal glands. The tunica muscularis was represented by thick bands of longitudinal muscles (Fig 1).

When the colonic epithelium was reacted with AB, the mucous granules of the goblet cells and the intestinal glands stained positively (Fig 2).However, when the same colonic epithelium was stained with PAS, the goblet cells and the intestinal glands of the colon were also observed PAS positive (Fig 3) and when reacted AB-PAS both structures at the lower crypts and those in the mucosa at the mucosal surface were black. (Fig 4).

Discussion

The histology of the colon of the AGR was characterized by the absence of villi and the presence of goblet cells and intestinal glands. The epithelium lining this region was observed to be simple columnar with long irregular microvilli, suggesting an absorptive function and formation of fecal mass in addition to the production of mucus to lubricate the intestinal surface. This observation agrees with the finding of Byanet *et al.,* (2008).The thickening of the muscularis is correlated with the temporary storage and expulsion of fecal materials from this area. This observation agrees with that of Pakowadee *et al.,* (2008)

In the present study, the pattern of staining for acidic and neutral muco substance with PAS at the mucosal surface and AB throughout the colon suggested the presence of neutral and acidic mucins.

An increase in number of goblet cells in the colon implies of the need for increase mucosa protection and lubrication for fecal expulsion. The presence of large number of mucous secreting cells provides a mucous layer around the fecal pellets, facilitating its release and protecting the epithelium as was described by Ahmed *et al.,* (2009).

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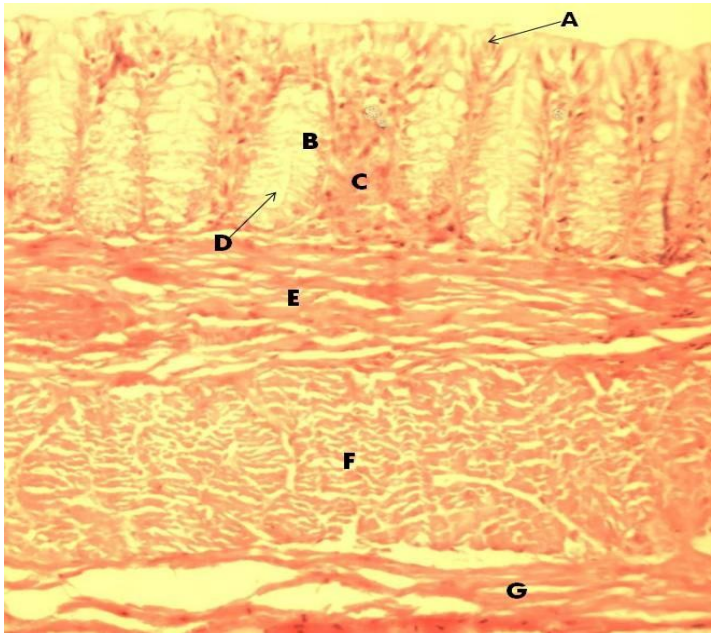

Fig (1): Transverse section of the colon showing the epithelial lining (A), goblet cells (B), muscularis mucosa (C), intestinal glands (D), Submucosa (E), Tunica muscularis (F) and tunica serosa (G). H&E X 40.

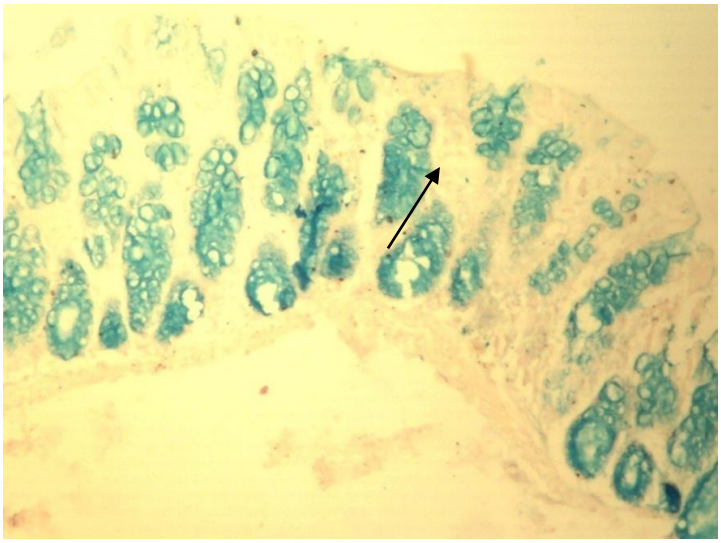

Fig (2): The intestinal glands and the Goblet cells of the Colon showing AB Positive (arrow) X100.

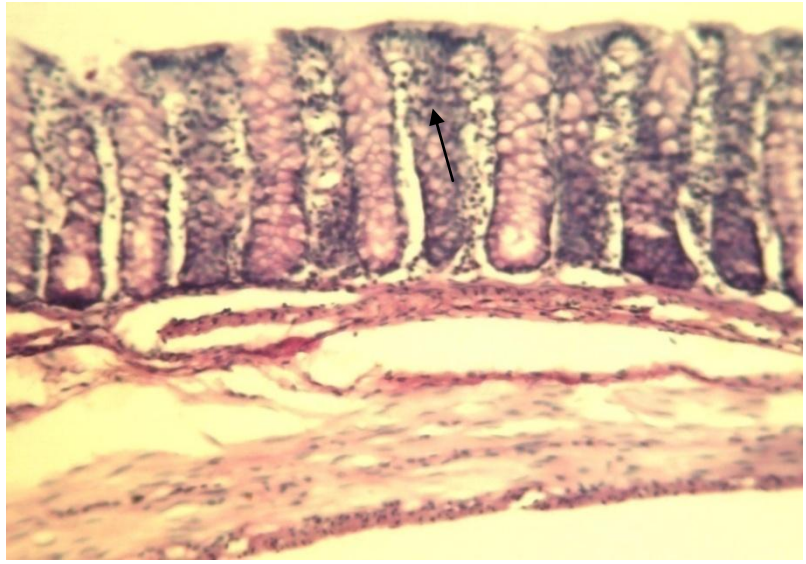

Fig (3): The intestinal glands and the Goblet cells of the colon showing PAS positive (arrow) X100.

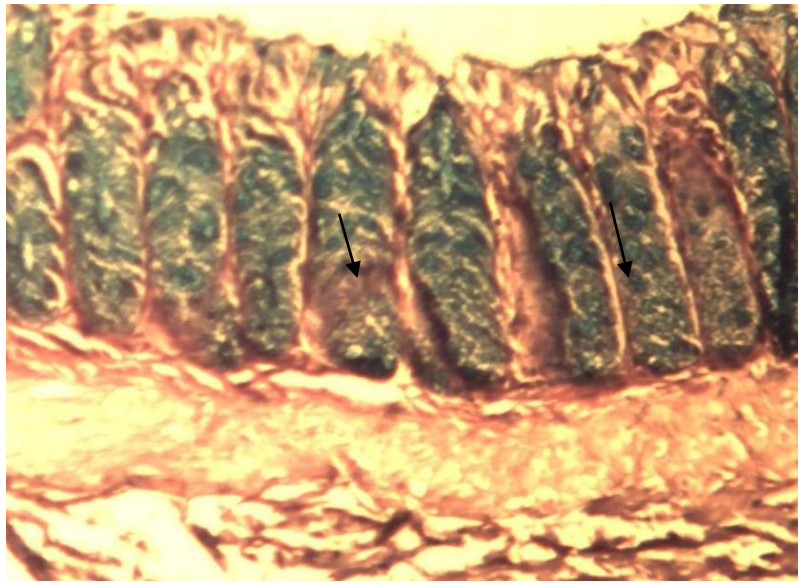

Fig (4): The intestinal glands and the goblet cells of the colon showing AB-PAS positive (arrows) X100.