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CASE REPORT
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Hepatic Lipidosis in Banded Armadillos (*Euphractus sexcinctus*) Bred in Captivity

Jael Soares Batista[1], Carlos Iberê Alves Freitas[1], Kaliane Alessandra Rodrigues de Paiva[1], Jardel Bezerra da Silva[1], Francisco Silvestre Brilhante Bezerra[1], Roberio Gomes de Olinda[2], Taciana Melo Fernandes[1] & Andréia Freitas Oliveira[3]

ABSTRACT

***Background*:** Wild animals bred in captivity may develop steatosis due to unbalanced dietary intake and obesity caused by sedentary behaviour. In some rural areas, six-banded armadillos are raised in captivity inside some metal barrels, with restricted space, and are often overfeed. After getting fattening, armadillos they are slaughtered and used as food. The unfavorable conditions may somehow contribute to likely underlie the development of many diseases, among them we can including hepatic steatosis. The present report aims to describe the pathological findings of hepatic lipidosis in banded armadillos (*Euphractus sexcinctus*), bred in captivity.

***Case*:** The animals were three female adult six-banded armadillos (*Euphractus sexcinctus*), caught in the native forest of the city of Natal, Rio Grande do Norte, Brazil and raised in domestic environment in a small enclosure and fed with human food leftovers. After eight months kept in these conditions armadillos had severe obesity and then were donated to the city zoo, where they were quarantined and presented clinical symptoms of anorexia for two weeks, weight loss and exhaustion. After being found dead during daily inspection carried out by the veterinarian zoo, the six-banded armadillos were sent to the Animal Pathology Laboratory of Federal Rural University of the Semi-Arid (UFERSA) for pathological examination. The animals presented with a history of anorexia were extremely obese and the autopsy detected had extensive deposits of fat in the carcass and liver. Histopathologically, the liver cells hepatocytes showed marked intracytoplasmic vacuolization and with peripheral displacement of the nucleus to the periphery, with and positive staining for lipids using scarlet Sudan III. To our knowledge, this is the first report of hepatic lipidosis in banded.

***Discussion*:** Hepatic lipidosis can be categorized into normal liver and mild, moderate, or severe fatty liver. In severe cases, it is estimated that 80% of the hepatocytes are affected. Therefore, we classified the hepatic lipidosis of the three studied female six-banded armadillos as severe, since the lipids were deposited diffusely. Based on the severity of the lesions and absence of other findings, we concluded here that hepatic lipidosis contributed to the cause of the six-banded armadillos death. The weight of the animals in this report may be associated with innapropriate enclosure dimensions and a diet based on human food leftovers. Such diet was reportedly composed of rice, beens, spaghetti, and bread, which are food with high levels of carbohydrate. The armadillos of the *Euphractus sexcinctus* species usually weigh between 3 and 6 kg and hence, the animals of this report showed twice the normal weight. The occurrence of hepatic lipidosis associated with anorexia triggered by a stressful event such as a change of environment and diet armadillos observed in the present study is in agreement with literature data pointing anorexia in obese animals as a major predisposing factors for the occurrence of hepatic lipidosis by promoting energy restriction, peripheral lipolysis and large intake of fatty acids to the liver.

Keywords: *Euphractus sexcinctus*, armadillos, anatomopathology, liver, lipidosis.

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[1]Department of Animal Sciences, Federal Rural University of the Semiarid (UFERSA), Mossoró, RN, Brazil. [2]Department of Animal Pathology, Federal University of Campina Grande (UFCG), Campina Grande, PB, Brazil. [3]Federal Institute of Education Science and Technology of Maranhão (IFMA), São Luís, MA, Brazil. CORRESPONDENCE: J.S. Batista [jaelsoares@hotmail.com - Tel.: +55 (84) 999885602]. Department of Animal Sciences – UFERSA. Av. Francisco Mota, BR 110, Km 47-59. Bairro Presidente Costa e Silva. CEP 59625-900 Mossoró, RN, Brazil.

INTRODUCTION

Hepatic lipidosis (also known as fatty degeneration, fatty metamorphosis, fatty infiltration or steatosis) is a disease characterized by excessive presence of lipids inside the hepatocytes caused by an imbalance between the hepatic uptake of fatty acids and its use [12]. Specifically, wild animals bred in captivity may develop steatosis yet due to unbalanced dietary intake and obesity caused by sedentary behavior.

Among the wildlife species in Brazil, two species are very important [3] from the point of view of distribution and number of individuals in the savanna biome: true Armadillo (*Dasypus novemcinctus*) and banded armadillo (*Euphractus sexcinctus*) [9]. To hunting the six-banded armadillo in Brazil is considered illegal. In spite of this, the species is one of the most highly appreciated as food a delicacy by native peoples and has been under constant threat of by predatory hunting in Northeast Brazilian Semiarid [2].

In some rural areas, six-banded armadillos are raised in captivity inside some metal barrels, with restricted space, and are often overfeed. After getting fattening, armadillos they are then slaughtered and used as food [1]. The unfavorable conditions may somehow contribute to likely underlie the development of many diseases; among them we can mention the including hepatic steatosis. The present report aims to describe the pathological findings of hepatic lipidosis in banded armadillos (*Euphractus sexcinctus*), bred in captivity.

CASE

This report describes the findings animals used in this work were three female adult six-banded armadillos (*E. sexcinctus*), caught in the native forest of the city of Natal, Rio Grande do Norte, Brazil and raised in domestic environment in a small enclosure and fed with human food leftovers. After eight months kept in these conditions armadillos had severe obesity and were then donated to the city zoo, where they were quarantined and presented clinical symptoms of anorexia for two weeks, weight loss and exhaustion. After being found dead during daily inspection carried out by the veterinarian zoo, the six-banded armadillos were sent to the Animal Pathology Laboratory of Federal Rural University of the Semi-Arid (UFERSA), located in Mossoro.

The necropsy was performed using the traditional method, with external examination of the animal, followed by the inspection of the thoracic, abdominal and cranial cavities. The organs were removed and a complete macroscopic study was done, including photographic documentation of significant findings. Fragments of several organs were collected and fixed in 10% formalin, processed routinely for histology, embedded in paraffin, cut at 5 μ of thickness and stained with hematoxylin-eosin (HE) [11]. Fragments of liver were cut into cryotome and stained with Sudan III scarlet.

Pathology demonstrated that the animals were extremely obese (Figure 1), weighing between 14 and 16 kg (reference range: 3 and 6 kg). Extensive deposits of intracavitary and subcutaneous fat were observed. The liver was enlarged, yellow-orange color, friable with rounded borders and pronounced lobular pattern (Figure 2), compatible with hepatic steatosis. Thin slices of liver were removed and fluctuated when placed in 10% neutral buffered formalin.

Microscopic evaluation of the liver revealed severe diffuse lipidosis, characterized by intracytoplasmic vacuolation of hepatocytes, with peripheral displacement of the nucleus (Figure 3). The lipid contents of these vacuoles were, confirmed wit positive staining for lipids using Sudan III scarlet (Figure 4). No relevant changes were seen in other tissues and organs.



Figure 1. Obese *Euphractus sexcinctus* bred in captivity.



Figure 2. Macroscopic aspect of the liver of *Euphractus sexcinctus* with severe hepatic lipidosis. Note the hepatomegaly, yellow-orange color and highlighted lobular.

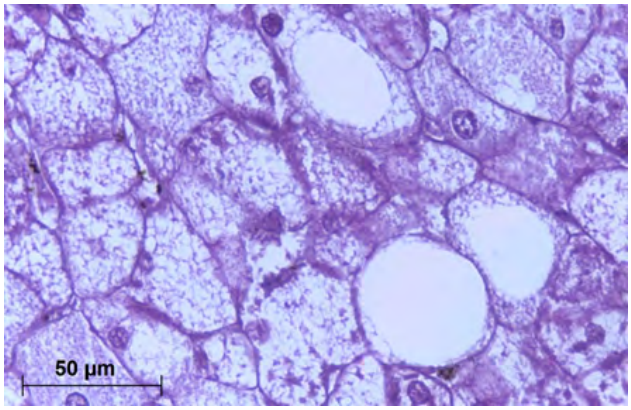


Figure 3. Microscopic appearance of liver de *Euphractus sexcinctus* with severe hepatic lipidosis. Note the diffuse intracytoplasmic vacuolation of hepatocytes and displaced nucleus to the periphery (HE, Obj. 20).

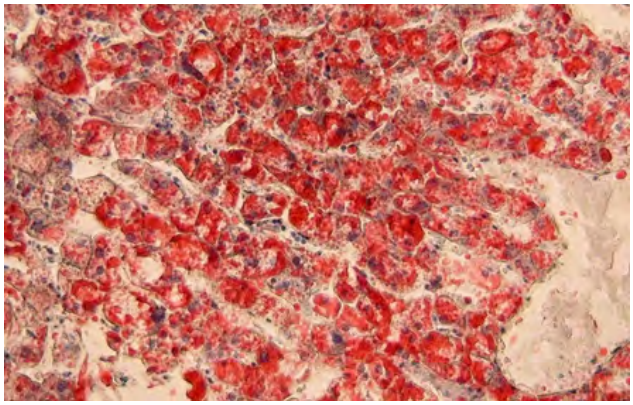


Figure 4. Microscopic appearance of liver lipidosis de *Euphractus sexcinctus*. Note the excessive presence of lipids inside the hepatocytes confirmed by staining of the lipids (Sudan III scarlet, Obj. 20).

DISCUSSION

Hepatic lipidosis can be categorized into normal liver and mild, moderate, or severe fatty liver [6]. In severe cases, it is estimated that 80% of the hepatocytes are affected [4]. Therefore, we classified the hepatic lipidosis of the three studied female six-banded armadillos as severe, since the lipids were deposited diffusely. Based on the severity of the lesions and absence of other findings, we concluded here that hepatic lipidosis contributed to the cause of the six-banded armadillos death.

The weight of the animals in this report may be associated with innapropriate enclosure dimensions and a diet based on human food leftovers. Such diet was reportedly composed of rice, beens, spaghetti, and bread, which are food with high levels of carbohydrate. The animals of the *E. sexcinctus* species usually weigh between 3 and 7 kg [1,8] and, hence, the animals of this report showed twice the normal weight.

To our best knowledge, hepatic lipidosis in Xenarthras species has not been reported in the veterinary literature. Non-awareness of the nutritional requirements of wild animals and of their feeding behavior are the main factors involved in the occurrence of nutritional disorders [10]. As a result, obesity is one of the most common veterinary conditions in wild animals raised under captivity [5].

In nature, six-banded armadillos are very active, mainly digging burrows, or moving away in search of food. This animal is omnivorous and feeds on a wide variety of items such as insects, small rodents, lizards, snakes, rotting meat, fruits and roots [13]. The confinement of these banded armadillo in a small physical limited their physical activities. Added to this, the animals were fed a high calorie diet.

The occurrence of hepatic lipidosis associated with anorexia triggered by a stressful event such as a change of environment and diet armadillos observed in the present study is in agreement with literature data pointing anorexia in obese animals as a major predisposing factors for the occurrence of hepatic lipidosis by promoting energy restriction, peripheral lipolysis and large intake of fatty acids to the liver [7].

Based on the cases observed in this report, it is suggested that six-banded armadillos when raised under captive conditions, restrained space and hypercaloric diet are predisposed to development of obesity and hepatic lipidosis.

***Declaration of interest*.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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