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## MORPHOLOGICAL CHARACTERIZATION OF LONG-TERM FETUSES OF *Crotalus durissus terrificus*

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### ABSTRACT

The rattlesnake *Crotalus durissus terrificus* is a viviparous snake, with chorioallantoic placenta, whose fetuses are kept in the oviduct until the complete fetal development. Although the Brazilian rattlesnake reproductive biology is extensively studied, little is known about the morphological aspects of its fetuses. This study aimed to characterize the morphology of fetuses of *C. d. terrificus* in advanced stages of gestation. For this, the fetal membranes were dissected and the fetuses isolated and photodocumented. Terms fetuses present inoculating fang, characterizing the Solenoglyph dentition. It was possible to observe the presence of the heat-sensing pit organ, as well vestiges of the umbilical cord and, in the male specimen, the inverted hemipenis. In this stage of fetal development, the rattlesnake fetuses are similar to the fetuses of other species, oviparous and viviparous, with formed and pigmented scales.

**KEYWORDS:** *Crotalus*; Embryonic development; Rattlesnake; Viperidae.

### 1 INTRODUCTION

Serpents popularly known as rattlesnakes belong to two genera: *Crotalus* and *Sistrurus* (HOSER, 2009), with approximately 29 species (MURPHY et al., 2002). In South America the only species of rattlesnake is *Crotalus durissus* (WÜSTER; BÉRNILS, 2011), which has a wide geographical distribution, however discontinuous (OGUIURA; FERRAREZZI; BATISTIC, 2009; COSTA et al., 2010). In Brazil, it is present in all regions, found mainly in open areas such as the caatinga and cerrado, including urbanized regions (BERNARDE, 2014).

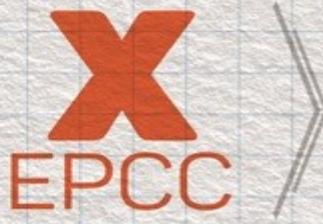
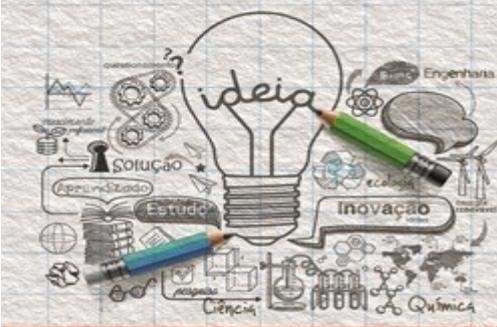
The rattlesnake is viviparous, that means the eggs are kept in the oviduct and nutrition occurs via the chorioallantoic placenta (POUGH; JANIS; HEISER, 2008; ALMEIDA-SANTOS; MIGLINO, 2013). Vitellogenesis is long, beginning in March, and gestation between October and January (BARBO; MARQUES; SAWAYA, 2011). Copulation occurs mainly in the spring, and the female can store spermatozoa for later fertilization, making pregnancy difficult and accurate. The incubation period of the eggs is approximately two months (KOLESNIKOVAS; GREGO; ALBUQUERQUE, 2006), and the births occur mainly in December (BENESI, 2007).

Studies on the reproduction of snakes mainly involve research on reproductive cycles, ecological and behavioral patterns (ALMEIDA-SANTOS; SALOMÃO, 1997; ALMEIDA-SANTOS et al., 2004; BARROS; SUEIRO; ALMEIDA-SANTOS, 2012), but little is known about the morphological description of the fetuses of viviparous species. In this sense, this research aims to describe the morphology of fetuses of *Crotalus durissus*, subspecies *terrificus*, in an advanced stage of gestation.

### 2 MATERIALS AND METHODS

This research was developed in the Gross Anatomy Laboratory, Department of Veterinary Medicine, Centro Universitário Cesumar - UniCesumar. It was used two long-term fetuses of *Crotalus durissus terrificus*, a male (SVL = 16,9 cm; tail length = 4 cm) and a female (SVL = 18,3 cm; tail length = 2,2 cm).

In order to remove placentas and fetuses, the euthanased snake was placed in the dorsal decubitus position. An incision was made in the womb, cranial to the cloaca. The gestational sacs



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were measured (figure 1A), and fetal tissues were dissected and removed (figure 1B). After removal the membranes, the fetuses were described and photodocumented (figure 1C/D/E/F).

### 3 RESULTS AND DISCUSSION

Long-term fetuses of the Brazilian rattlesnake are protected and lined by the fetal membranes chorion, amnion and allantois; the yolk sac stores the yolk, abundant content in fetuses in advanced stages of fetal development (figure 1B). All membranes are vascularized, allowing the maternal nutritional support the fetal development. Fetuses present vestiges of the umbilical cord (figure 1F), which, along with the chorioallantoic placenta, promote their nutrition until birth (ROBERTS; GREEN; SCHULZ, 2016).

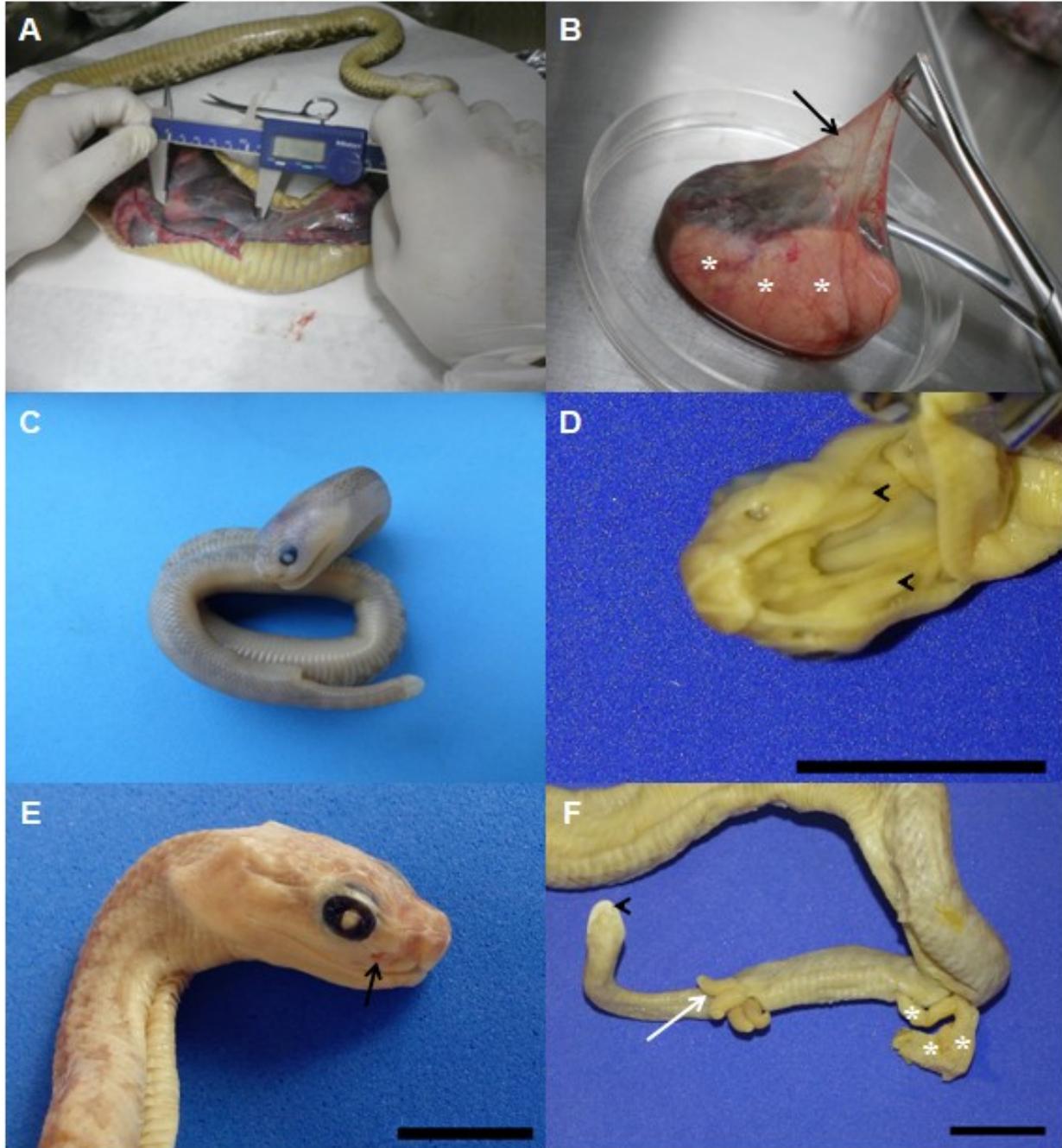
At this stage of development, the fetuses have completely formed pigmented scales, as well, in the male specimen, inverted hemipenis. The morphological pattern of the species studied is similar to stage 10 (last stage) of the embryonic development of the oviparous snakes *Naja h. haje* (KHANNOON; EVANS, 2013), *Psammophis sibilans* (KHANNOON; ZAHRADNICEK, 2016), *Boaedon (Lamprophis) fuliginosus* (BOBACK; DICHTER; MISTRY, 2012) and *Python sebae* (BOUGHNER et al., 2007), and the viviparous snake *Thamnophis sirtalis sirtalis* in stage 37 (ZEHR, 1962). Kim and Blackburn (2016) described the fetal development of *Lampropeltis triangulum* in 36 stages, but unlike rattlesnake, fetuses of this species in the last stage present the outlines of the brain still visible through the cranial scales.

Fetuses of *C. d. terrificus* present fangs (figure 1D), as well as fetuses of the serpent *Naja kaouthia* (JACKSON, 2002). Venomous snakes are born with fangs and venom glands witch composition and toxicity vary according to the age (HAYES, 1991). It was also observed the presence of heat-sensing pit organ (figure 1E), infrared receiver structures (thermoreceptors), which help in the perception of endothermic prey (KARDONG, 2016).

The caudal appendix (figure 1F), that allows the growth of the rattle is already present in fetuses; this hollow structure is located after the last caudal vertebra and has the purpose, when agitated, to promote sounds that signal the presence of the snake, intimidating possible predators (HURON; SHANAHAN, 2013).

### 4 FINAL CONSIDERATIONS

The morphological characterization of long-term fetuses of *C. d. terrificus* is similar to the morphology of fetuses of other snake species, both oviparous and viviparous. Fetuses are covered by fetal membranes, and yolk content is abundant. The male fetus presented inverted hemipenis, and was possible to observe the presence of the caudal appendix that allows the development of the rattle.



**Figure 1 (A/F):** Collection and photomacrography of fetuses of *Crotalus durissus terrificus* in advanced stages of gestation. **A)** Measurement of fetuses in the oviduct. **B)** Dissection and removal of fetal membranes. The arrow indicates the chorion. The asterisks indicate the yolk content contained in the yolk sac. **C)** Overview of the dissected fetus. **D)** Photomacrography of the hard palate region. The arrowheads indicate the fang. **E)** Right lateral photomicrograph of the head. Note the pigmentation in the eye and the presence of the loreal pit (arrow). **F)** Ventral photomicrography of the caudal region. Asterisks indicate traces of the umbilical cord; Note the inverted hemipenis (white arrow) and the caudal appendage (arrowhead). Bar: 1 cm.



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