

INTRANEURONAL, INTRAVACUOLAR CRYSTALLINE GRANULES IN THE SOLITARY TRACT NUCLEUS OF A 4 YEARS OLD FEMALE RAHAJI NIGERIAN CATTLE

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ABSTRACT

Ageing is a process that proved devastating on the brain. Microscopic study was performed to assess the ageing changes in the brain of Nigerian cattle involving 246 cattle of varying age groups (≤ 1 year to ≥ 12 years) and both sexes. The study revealed the evidence of intraneuronal, intravacuolar crystalline accumulation of substances that are Periodic Acid Schiff (PAS) positive. This unique intraneuronal and intravacuolar accumulation appeared in a female Rahaji cattle aged 4 years old. Its significance is however not known but might be the cause of damages in the nervous system and gangliosides leading to mental retardation, and death, since it is undegradable and cannot be removed via exocytosis.

Keywords: intraneuronal, intravacuolar, crystalline, accumulations, Nigerian cattle

INTRODUCTION

Postmitotic cells progressively accumulates brown-yellow, auto fluorescent, electron-dense, PAS positive materials called lipofuscin as ageing advances (Terman & Brunk, 2004). Lipofuscin meaning “dark fat,” drawing from both Greek and Latin, is a complex entity that is defined operationally rather than structurally (Gray & Woulfe, 2005). It is yellow-brown in appearance by conventional microscopy, detectable across a broad spectrum by fluorescence microscopy, and is available abundant in aged individuals than in young (Ju *et al.*, 2001), hence a recognized hallmark of ageing with a rate inversely related to longevity. It is primarily composed of cross-linked protein residues, formed due to iron-catalyzed oxidative processes. Whereas proliferative cells efficiently dilute it during division, its accumulation in post mitotic cells is inevitable since it is undegradable and cannot be removed via exocytosis. Finding this pigment in the neuropil may be the result of occasional exocytosis (Dahme & Schroeder, 1990) or when neuronal cells containing lipofuscin pigment

become pyknotic and die, and afterward only the extra cellular deposit can be observed (Kikuchi, 1928).

Periodic Acid Schiff (PAS) positive intravacuolar crystallized materials were observed in cattle (Figure II). Of great concern is the pyknotic neuronal debris released in localized and circumscribed granulated PAS positive substances with clear difference from lipofuscin accumulation and lysosomes into the neuropil (Figure III). Lipofuscins are usually yellow-brownish non circumscribed granules observed within the perikarya of ageing large neurons (Figure I). Lysosomes, the vacuolated organelles of 50-70nm in diameter (Lüllmann, 2005) are less found in neurons in comparison to disease-fighting cells, such as T-lymphocytes. This is because white blood cells must digest more material than neurons and other types of cells in their quest to battle bacteria, viruses, and other foreign intruders. Otherwise, it could be probable to assume that the discrete vacuoles observed are lysosomes.

This finding however is not in agreement to the report of Manickam *et al.* (2009) who observed PAS negative neuronal perikaryon inclusion and vacuolations in cattle in Kerala state, India. It however reaffirmed the reports of Akiyama *et al.* (1986) indicating that such PAS positive granulated structures are senescent structures of the brain.

This however does not correspond to the description of “hybrid organelle” with accumulated polyglycosylated complex by Ulamek-Kozioł *et al.* (2013) observed in Alzheimer’s disease but could be detrimental since its occurrences appear early in age. It has been postulated to be the cause of damages in the nervous system and gangliosides (Hickman *et al.*, 1995) leading to mental retardation, and death in early life. Alzheimer’s disease; an ageing disease of man has not been reported in cattle to the best of our knowledge.

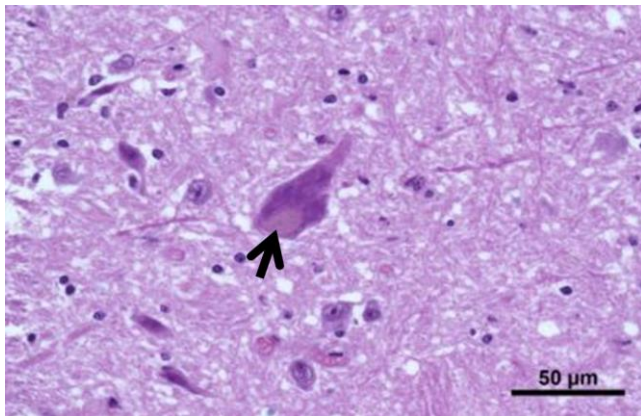


Figure I: Neuronal lipofuscin granules accumulation in the medulla oblongata of a 10 years old female Bunaji (H&Ex40)

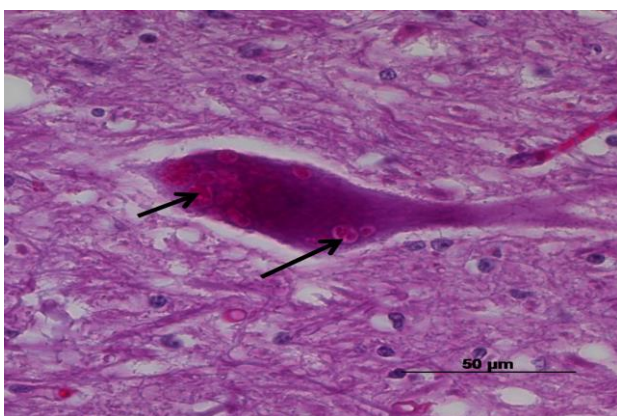


Figure II: Intravacuolar granular inclusion (arrows) in the Solitary tract nucleus of a 4 years old female Rahaji (PAS x 400).

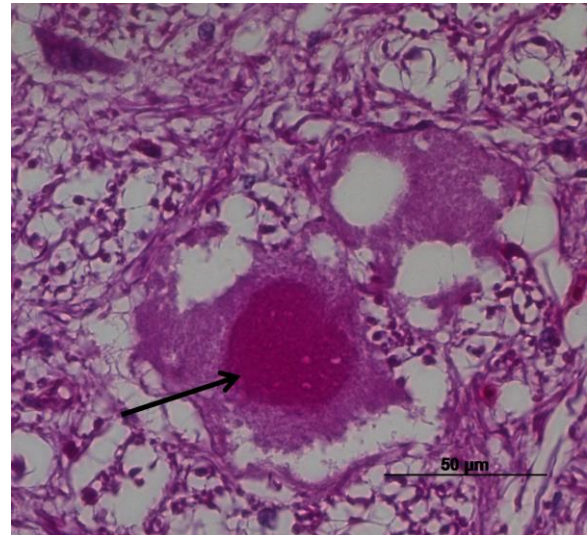


Figure III: Foamy neuron with condensed lipofuscin (arrow) and crystals in olivary nucleus of a 4 years old female Rahaji (PAS x 400).

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