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Original Article

Catecholamines Profile as Physiological Indicator Trait for Selection on Docility in Grasscutter *(Thryonomys Swinderianus)*

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ABSTRACT

The present work is designed to investigate the link between plasmatic concentrations of catecholamines (adrenaline, noradrenaline) and glycaemia as well as the docility and coat color in grasscutter (*Thryonomys swinderianus).* Docility test were performed on animals, using a scoring method along the lines with Kukekova. Experimental animals were then submitted to blood sample collection and assaying of plasma concentration of catecholamines by HPLC coupled with an electrochemical method. Glycaemia were determined using Trinder's approach. AOV reveal that docility status of animals and coat color are significant for variation in the physiological traits assayed. These results show that, autonomous nervous system influenced both the temperament and the coat color of the grasscutter in the process of domestication.

Key words - catecholamines, docility, glycaemia, grasscutter, stress

1. INTRODUCTION

Grass cutter is a rodent which is widespread in sub-Saharan Africa and also in Benin. Its meat is highly demanded for human consumption because of its organoleptic quality. Domestication of grasscutter began in Benin [1] because the hunting pressure on the wild population became a threat for extinction of this

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species. Domestication of this rodent in Benin involve breeding in tied captivity and selection on both behavioural trait (docility) and productive characters (growth rate, litter size). Selection can induce significant changes in ethological and reproductive traits and accelerate so with the process of differentiation and fixation leading to domesticated breeds. Thus Belyaev (1979) [2], found that selection on docility resulted in destabilization of the neuroendocrine ontogenesis control system and reproduction in silver fox. It is well known that the neurotransmitters control the state of stress in animals [3]. For example, the neurotransmitters dopamine, noradrenalin and adrenalin which are involved in the stress response, have the same biochemical precursor as the melanin pigment (Ferry and Zimmerman, 1964) [4]. Consequently, the catecholamines (Adrenalin, noradrenalin and dopamine) may be used as physiological indicators for selection on docility in grasscutter. The dosage of blood catecholamines may therefore be a good alternative to the measurement of docility by visual appreciation of animal behaviour by human presence. In addition, selection on docility using physiological indicator traits, if efficient, may speed up the domestication process in grasscutter. The present work is aimed to assess the plasma concentration of catecholamines in grasscutter and to provide some evidence of their influence on docility and coat color in species undergoing domestication process.

2. MATERIALS AND METHODS

2.1 Animal material

Experimental animals consists of male grasscutters aged three to five months sampled throughout four departments of Benin i.e. Atacora, Atlantic, Mono and Littoral as indicated in Table 1. Sampling of animals took place from March 2012 to November 2013.

Table 1: Numbers of the animals sampled by locality and department

Department	Locality of source	
Atacora	Natitingou	4
Atlantique	AV	5
	Ayimevo	3
	Dekoungbé	6
	Pahou	8
	PK_14	38
	SEAG	2
	SO_AVA	4
Mono	Ahieme	9
Littoral	Agla	1
	Akpakpa	8
	Gbégamey	5
Total		93

2.2 Test on docility

The docility test were carried out early in the morning before feeding. A scoring method using a behavioural scale [5-7] was performed. The experimenter presents himself in front of the cage of the animal. The score of the animal is 4, if it flees because of fear. It obtains score 3, if it flees when the experimenter moves towards him. It is given score 2 when it flees only by the attempt of the experimenter to touch him. It obtains score 1, if it lets itself gently stroke.

2.3 Blood sampling and biological analyses

Animals received first an anaesthetic dose of 0.1 ml per live weight. Anaesthetic was administered by intramuscular injection at the underside of the tail's base. It is a compound in equal proportion of Xylazine hydrochloride: ROMPUNND and Ketamine hydrochloride: KETAVETND. The Blood was taken from fasted animals, early in the morning (07 o'clock) and was directed by cardiac puncture [8] Blood samples was collected in EDTA tubes and centrifuged at 3000 revolutions per minute. From blood plasma samples, catecholamines were assayed by HPLC [9, 10] whereas glycaemia was determined by Trinder's method [11].

2.4 Statistical analysis

Statistical analysis was performed using the SAS package [12] and the procedure GLM for AOV. Variables

studied were docility (DOC), glycaemia and plasmatic concentrations of adrenalin (ADR) and noradrenalin (NADR). The levels of the factor coat colour were: normal, light grey and dark grey as shown in Fig 1

Light grey

Dark grey

Fig 1: Coat colour pattern in the studied grass cutters

3. RESULTS AND DISCUSSIONS

The plasmatic concentrations of adrenalin, noradrenalin and glucose assayed as influenced by the factors docility and coat color are presented in the Table 2.

Table 2: Significance of docility and coat color for variation of plasmatic concentrations of catecholamines (adrenalin, noradrenalin) and glucose

Groups		Adrenalin (ng/ml)	Noradrenalin (ng/ml)	Glycaemia (g/l)
Docility **		**	*	*
1.	Tame	0. 020^{b}	0. 454^{b}	1.242^{b}
2.	Moderately tame	0. 033^{ab}	0.641^{ab}	1.482^{b}
3.	Untame	0. 044^{a}	0. 836^{a}	2.007^{a}
Color **		**	**	n.s.
1.	Light grey	0. 018^{b}	0. 492^{b}	1.508^{a}
2.	Normal	0. 02^{ab}	0. 429^{b}	1. 48^{a}
3.	Dark grey	0. 040^{a}	0. 907^{a}	1. 42^{a}

** = p<0.05; **= p<0.01; ***= p<0.001;*
n.s. nonsignificant; In the same column, averages with the same letters are not significantly different.

Results presented in Table 2 and the Fig 2 show that the factor docility is significant (p<0.01) for variation in the plasmatic concentration of adrenalin. Thus, the tame animals have a plasmatic concentration of 0.02 ng/ml against 0.044 ng/ml in their untame counterparts here referred to as "cowards". The moderately tame animals, have an intermediate average concentration (0.033 ng/ml) of adrenalin.

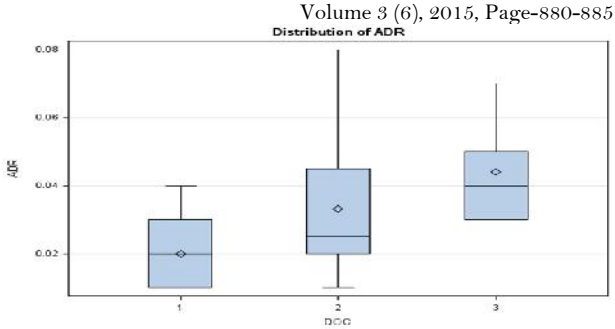

Fig 2: Variation of the plasmatic concentration of adrenalin according to docility

AOV results (Table 2) reveal that the plasmatic concentration of adrenalin is significantly affected by the factor coat color (p<0.01). Indeed, the plasmatic concentration of adrenalin is very high (0.040 ng/ml) in the grasscutters with dark grey coat color, compared to those with light grey coat color (0.018 ng/ml). Mean values of plasmatic concentration of adrenalin are significantly different as shown in Fig 3.

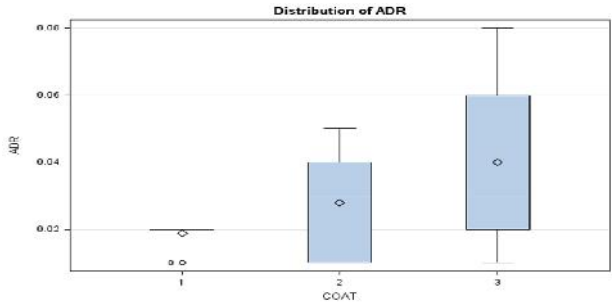

Fig 3: Variation of the plasmatic concentration of adrenalin according to the coat color

Fig 4 shows that the factor docility significantly affects ($p < 0.05$) the plasmatic concentration of noradrenalin in grasscutters. The untame grasscutters have a plasmatic higher noradrenalin concentration (0.836 ng/ml) unlike to tame (0.464 ng/ml) and moderately tame (0.641ng/ml) ones. This result thus shows that plasmatic noradrenalin is significantly influenced by docility.

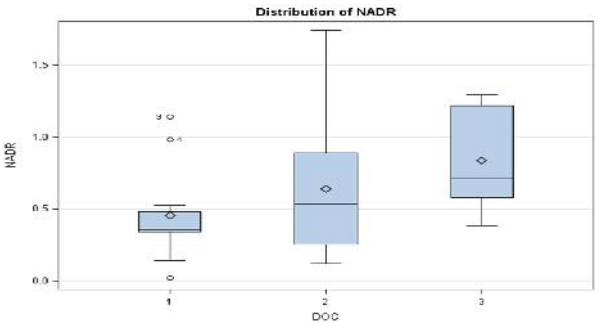

Fig 4: Variation of the plasmatic concentration of noradrenalin according to docility

Results also show (Table 2) that coat color explains significantly ($p<0.01$) the variation in plasmatic noradrenalin concentration. Fig 5 presents the variation of the plasmatic noradrenalin concentration according to the coat color. This figure shows a very high concentration (0.907 ng/ml) of noradrenalin for dark grey coat color and a weak concentration (0.492 ng/ml) for light grey and normal (0.429 ng/ml) ones. However, the plasmatic noradrenalin concentrations of light grey and normal coat colored animals are not significantly different from each other. In contrast dark colored animals are significantly different from both normal and light grey animals with regard to plasmatic concentration of noradrenalin.

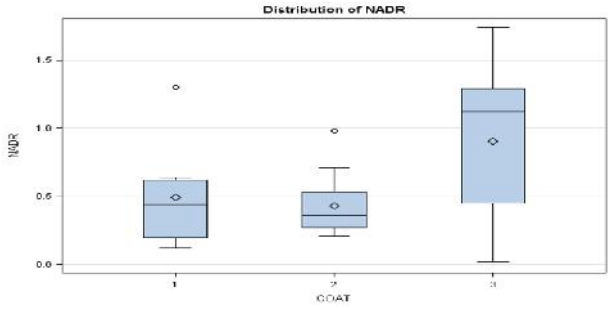

Fig 5: Variation of plasmatic concentration of noradrenalin according to the cat color

Results show that the glycaemia ($p<0.05$) is significantly influenced by the docility in experimental animals (Table 2). Fig 6 shows that blood concentration of glucose in the tame animals (1.42 g/l) and moderately tame (1.48 g/l) ones are lower than that of the untame (2.01 g/l) subjects. The significance of the plasmatic concentration of glucose was also reported by Thompson et al. (1977) [13] and Montané et al. (2002) [14], respectively to the sheep and the roe-deer. These authors report that the glycaemia is significantly higher in the stressed animals, compared with the less stressed subjects. However, De Boer (1990) [15] and Tabatabai-Mir et al. (2012) [16] reported that the temperament (stressed versus calms) does not exert any significant influence on the variation of the glycaemia, respectively in the rat and the mouse.

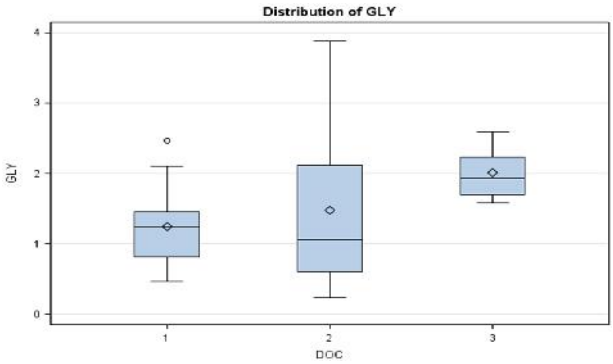

Fig 6: Variation of the glycaemia according to docility

Results show (Table 2) that the coat color doesn't significantly affect the variation of glycaemia in the grasscutters. As a consequence, the differences observed in the mean plasmatic concentrations of glucose (Fig 7) were not significant ($p>0.05$) for with light grey, normal and grey dark animals. These are 1.51 g/l, 1.50 g/l and 1.42 g/l respectively for the animals coat color.

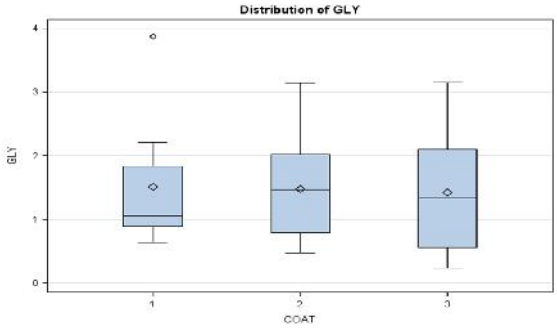

Fig 7: Variation of the glycaemia according to the coat color

The different results show that docility and coat color influence significantly the variation in plasmatic concentration of catecholamines (adrenaline,

noradrenaline). On the other hand, glycaemia is only influenced by docility but not by coat color. Result show that the two catecholamines could be implied in the distribution of the coat color in the grasscutters. This assumption is consistent by the work of Ferry and Zimmerman (1964) [4], which reported that the neurotransmitter dopamine and the hormones noradrenaline and adrenaline, which are involved in the stress response, have the same biochemical precursor as the melanin pigments. In addition, dopamine directly influences pigment production by binding to the pigment-producing cells. Dopamine indirectly influences pigment production by inhibiting pituitary melanotropin, also known as melanocyte stimulating hormone (MSH), which is responsible for stimulating pigment cells to produce pigment. According the Hanson (2006) [17], a change in coat color during domestication may therefore be an incidental by product of selection for tameness. Hanson (2006) also reported that the pigment cells are also found in the autonomous nervous system, which releases adrenalin and noradrenalin. These results reveal that docility and the coat color are both influenced by the endocrine system.

3. CONCLUSION

The present work show that there is a correlation between the temperament of the grass cutters and plasmatic concentrations of neurotransmitters (adrenalin, noradrenalin) and blood glucose released by these animals as response to the stress caused by human presence. The results show that plasmatic concentrations of catecholamines and glucose can be used as physiological indicators of docility and coat color in the grasscutters. As a consequence, tame and untame grasscutters can be identify based on their plasmatic concentrations of catecholamines. This work also shows that the autonomous nervous system exert an influence on both the docility and coat color in grass-cutters in the process undergoing domestication.

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