

## NERVOUSNESS OR FEARFULNESS AND SOCIAL BEHAVIOUR IN MALE MULE DUCKS: A UPDATE REVIEW

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### ABSTRACT

Due to the expression of abnormal behaviors, referred as nervousness, increasing rearing difficulties of mule ducks are presently reported. Therefore, several experiments have been realized to characterize different behavioral and physiological responses of ducks of various species (Muscovy and Pekin ducks), hybrids (mule and hinny ducks) or genotypes and/or phenotypes (color patterns) and submitted to different rearing conditions (with or without familiarization to human). The results obtained suggest that there is no major link of causality between the "white plumage" phenotype and nervousness. On the other hand, the current genotypes of mule duck are very fearful and social; two traits that can be the causes of the increasing rearing difficulties encountered. Familiarization to human had positive effects, but the variability between subsequent trials did not permit to propose practical solution. Genetic variability has been observed and a dominant effect of Pekin duck suggested. Heritability of different traits was estimated and some are sufficient to allow selection. As a follow up, a multidisciplinary research program "CaNervosisme" has been launched in 2006.

**KEY WORDS:** Mule ducks, Selection, Rearing conditions, Behavior, Corticosterone.

### INTRODUCTION

In the recent years, plumage color of mule ducks, reared for foie gras production, have been whitened to satisfy market demand. In the meantime, increasing rearing difficulties, due to the expression of abnormal behaviors (quoted as nervousness), resulting in panic movements and fear of humans, have been reported. In last 5 years, numerous trials have been conducted in our laboratory with multidisciplinary approaches (genetics, ethology, physiology, *etc...*), in an aim to characterize this behavioral problem and suggest solutions to solve it. Indicators used to assess the nervousness of animals were either behavioral (Tonic Immobility duration or TI, openfield behaviour or OF, collective and individual human awareness or cHA and iHA, unfamiliar object awareness or UOA) or physiological (basal corticosterone levels (B), levels after tonic immobility, open-field or restraint tests (placement in a net: N), and maximum response capacity after pharmacological challenges [PC; 1-24 ACTH]). This review presents the major results obtained and the future prospects, especially those of the "CaNervosisme" research project.

## 1- Plumage color and Nervousness

Simultaneity of nervousness appearance and plumage whitening suggested a possible relationship between both traits, as previously reported in different species of mammals selected for white coat (Keeler *et al.*, 1968). Two experiments have been thus conducted to test this hypothesis, by comparing mule ducks of different colors (Gobin, 2000; Guémené *et al.*, 2002, Bouy, 2003; Guémené *et al.*, 2004).

In a first trial (Exp. 1: Gobin, 2000; Guémené *et al.*, 2002), white and colored ducks were compared. In a second trial (Bouy, 2003; Guémené *et al.*, 2004), male mule ducks of a all range of colors from white to complete black from an experimental INRA flock under whitening process were compared. In both trials, no significant difference in reaction to human was found between white and colored ducks. Only punctual differences could be observed, but they could not be attributed to plumage color. These studies therefore infirmed the possible relationship between color and nervousness in ducks.

Another conclusion from these studies was to detect the high fearfulness of mule ducks, as assessed by their long duration of tonic immobility. Our tests also suggested that these ducks are very social, with whiter ducks being possibly more socials.

## 2 –Familiarization to human and Nervousness

Rearing conditions, especially familiarization to human, can impede behavioral and physiological responses to challenges (for review see Rushen *et al.*, 1999). Recent changes in rearing conditions and decrease in the level of positive interactions with human could thus be the main causes of nervousness. Experiments have therefore been conducted in our laboratory (Gobin, 2000; Guémené *et al.*, 2002; Val-Laillet, 2001, Bouy, 2003) and on farm (unpublished) to evaluate the impact of familiarization to human on nervousness.

In a 1<sup>st</sup> trial, one half of the mule ducks from 2 commercial genotypes were subjected to frequent human presence and manipulation, or to limited contacts (Gobin, 2000; Guémené *et al.*, 2002). Familiarization had a large positive effect on behavior expressed in the HA tests, indicating lower fearfulness in presence of human for ducks both at 3 wk and 9 wk. The approach distance was always longer in presence of a man, compared to an unfamiliar object, thus comforting the hypothesis of a specific fear response towards human. Similar behavioral impact was observed in a field trial during which, the caretaker was asked to limit care and attention to one flock of ducks. The experimental tests also led to lower B increases in B levels for the ducks, which had been previously familiarized. All together, these experimental results showed that such a familiarization treatment had positive consequences in both behavioral and physiological terms.

Additional experiments were therefore intended in order to refine optimal familiarization conditions (Val-Laillet, 2001, Bouy, 2003). Conditions tested were different frequencies of duck manipulation and age at manipulation (early, late or continuous). These experiments confirmed the positive effect of familiarization assessed by HA tests and B levels after tonic



immobility. Effects on movements at young age in the HA test, on B levels following TI at 10 weeks of age and flight distance from the forcefeeder (Val-Laillet, 2001) were all in agreement with the previously observed positive results. Moreover, significant effects of the operator factor were found in the TI tests and on B response, depending upon familiarity (familiar vs. unfamiliar operator) (Val-Laillet, 2001). Bouy (2003) found that ducks submitted to the most intense familiarization moved more and performed more shouts, during the HA test, as well as more wing flapping during the OF test. At the opposite, the least familiarized mule ducks position in the presence of a man was different from the more familiarized ducks, which could be the result of anticipation of man arrival. The results obtained are coherent with the hypothesis of a positive impact of familiarization upon fearfulness. Nevertheless, due to the large disparity in the amplitude and nature of the observed effects, we cannot provide any specific practical recommendation at present.

### **3 - Genotype and Nervousness**

"Nervousness" rate of expression reported from the field appeared to differ widely according to environmental factors, but also to genotypes. A comparison of mule ducks from two different genotypes (GA and GB, Gobin, 2000; Guémené *et al.*, 2002) showed that avoidance reactions to humans appeared at a younger age in GA (3 wk) than in GB (9 wk). Moreover, TI duration were also longer for GA, even if they were very long for both genotypes. Otherwise, GA ducks moved and jumped more during the OF test performed at 3 weeks of age, which might relate to social request. Differences of precocity in apparition of fear reactions between genotypes were thus observed, GA being more precocious. However, at a later age (9 wk), their fear responses were higher and did not differ anymore between genotypes.

Mules are the result of an inter-species cross. It was therefore interesting to compare reactions of the two pure species and their cross. In collective and individual HA tests (Val-Laillet, 2001), mule ducks stayed further from human, than Muscovy ducks and Pekin ducks. In Muscovy ducks, the lower distance to man can possibly be attributed to a lower activity during the test (less movements, more sleeping time) and to a lower fearfulness (found in 6 of 8 behavioural tests and 5 measures of B levels out of 6). Mule ducks behavioral responses were, comparable, intermediate or higher to those of the parental species whereas their B levels were intermediate. Pursuit behavior, evoking one of the behaviors associated with nervousness, was incidentally observed for Pekin and mule ducks, but not for Muscovy ducks.

### **4 - Genetic determinism and genetic parameters**

Comparing genotypes gave a first indication of possible implication of genetics in the determinism of nervousness. However, in order to confirm the results it was necessary to estimate genetic parameters of different nervousness indicators. Heritability of different characters were estimated for mule ducks and among those, three were above 0.3, therefore compatible with selection: B levels after OF and constraint test as well as, of movement frequency in OF. As mule ducks results from an inter-species cross, it is also especially

important to establish whether dominance or maternal effects are present. A comparison of reciprocal crosses (mule and hinny ducks) was used by Arnaud (2004) to detect such possible maternal effects. As results obtained for the two hybrids were comparable, this hypothesis was rejected. On the opposite, while Muscovy ducks expressed lower fear responses than Pekin ducks, both hybrids were more mobile than the parental species in the behavioral tests (individual HA, OF), which suggests the presence of an heterotic effect.

## **5 - Conclusion and Future prospects**

No link of causality between the "white plumage" phenotype and nervousness could be established, while mule ducks appeared to be very fearful and social animals, two behavioral characteristics which have been thought to be deleterious for a good adaptation to current intensive rearing conditions (Faure *et al.*, 1996). These characteristics may explain the problems of nervousness currently observed in field practice, notably with large group sizes, or after reallocation and change in rearing conditions. Positive consequences of familiarization with human have been observed, but, due to the extreme variability of the observed effects, we cannot provide practical recommendations at this stage. Genetic variability has been observed. Heritabilities for different traits were estimated and the one for B response appeared sufficient for selection. In Quail, selection on B responses to physical stress (Satterlee and Johnson, 1988) has been shown to affect not only the physiological parameter, but also fear response and social behavior (Jones *et al.*, 1992).

In this perspective, we proposed to implement the "CaNervosisme" research program. The objectives will be first to complete the characterization of the behavioral profiles (fear, social) of mule ducks from commercial origin and of their parental species. A second objective is to estimate the heritability of B response in Pekin ducks and assessing the effects of a divergent selection program. Lastly, further investigation regarding the consequences of rearing conditions, familiarization and group sizes, might be realized.

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