# Modulating animal behaviour with olfactory sense management

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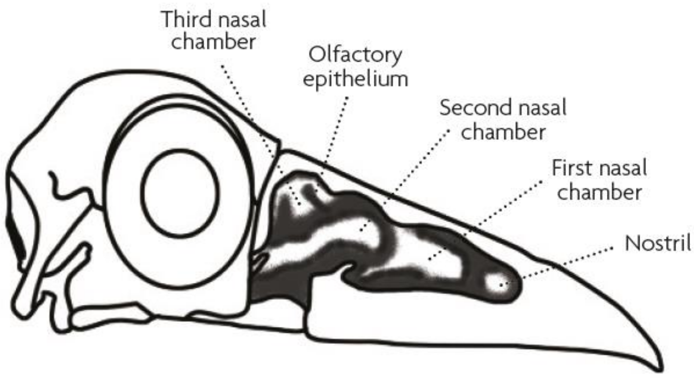
Olfaction - the most primal sense - is highly developed in most animals. Knowledge about smell is now used in a few feed additives that are able to modulate behaviour (i.e. to alleviate stress consequences and to stimulate appetite for example) in modern and large-scale poultry farms.

The olfactory bulb, which is the part of the nervous system responsible for olfactive perception, is closely related to the amygdala, which processes emotion/mood and is part of the limbic system. The sense of smell is intricately linked to the "emotional brain" and odours are able to influence well-being and certain behaviour. While certain odours can have a positive effect on mood, behaviour and appetite, negative odours can represent a source of stress.
Experts state that the formation of olfactive memory is unconscious and starts even before birth. Birds were traditionally thought to have a very poor sense of smell, but since 1999 and confirmed in 2004, the chicken genome sequence revealed a number of olfactive receptor genes comparable to those in humans! (Figure 1)
The idea behind sensory stimulation and sensory feed additives is to take advantage of the important role of olfaction and olfactive memory to stimulate appetite and generate feed loyalty in animals. The aim is also to improve well-being and reduce the impact of stress by creating a positive sensory experience.

**Figure 1: Poultry olfactive structures (from Ropper, 2001)**




Chicken have an olfactory epithelium in the third nasal chamber, and histological structure resembles that of mammals.
In birds, the sense of smell has been considerably underestimated, and very little is known about the effects of early sensory experience on the regulation of general behaviour (feeding and social).

## Chickens as a model

The centre of olfactive perception in the brain is relatively well conserved among species. Bird chicks have thus been used as a model to evaluate olfactive responses by animals to various compounds, according to the method described by Porter et al. in 1999 [1].
The authors showed that chicks that are induced to sleep in the hand respond to olfactory stimuli in predictable ways (head shakes, beak claps and peeping) that were not observed in awake chicks, allowing for assessment of the impact of odorant compounds. In this simple and non-invasive methodology, one-day-old chicks, deprived from water and feed since birth, held in the hand under a heat lamp, become inactive and close their eyes within two minutes.

**Picture 1: Sleeping one-day-old chicks (from Porter et al., 1999)**

Sleeping chicks are exposed to one odorant stimuli and a negative control (soya oil). The compound is rated according to chick behaviour (Table 1 & Picture 1).

**Table 1 - Assessment of odour perception in one-day-old sleeping chicks**

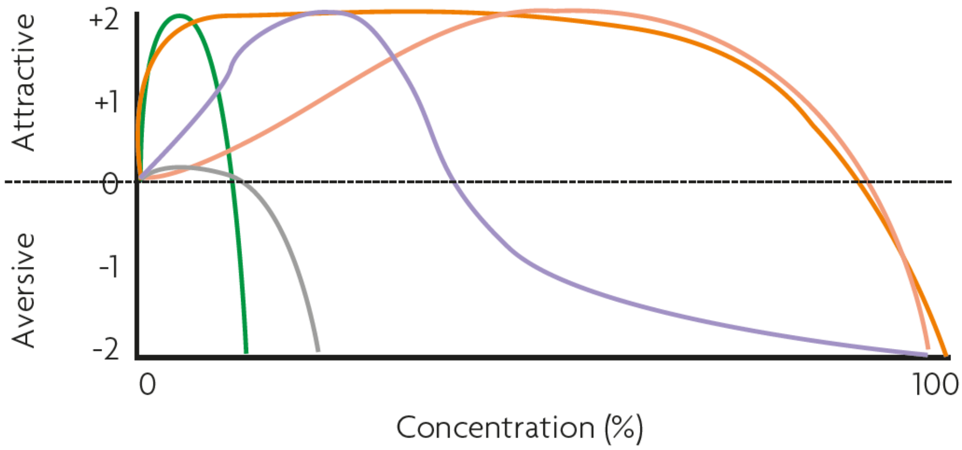
| Score | Observation | Result |
|---|---|---|
| **0** | No reaction | Neutral |
| **1** | One or more beak claps | Positively perceived |
| **2** | Head shake, silent waking | Negatively perceived |
| **3** | Sudden waking, peeping | Very negatively perceived |

Recent research at Phodé involved screening of 600 molecules and botanicals, issued from the collection of aromatic compounds authorised in Europe as feed additives. After a first selection of individual ingredients, several associations were formulated and tested at different concentrations.

Over 10,000 chicks were involved in the study: chickens, quails and pheasants. For each series of 20 chicks, two compounds were tested against the control.

The same chicks were used only once. Finally, the complex which elicited the optimal response in terms of concentration and attractivity was selected: a positive response with the lowest concentration (Figure 2).

**Figure 2: Dose-response curves for various sensorial compounds (from Porter method)**




**Legend:**

- Compound with high aversive effect from the lowest concentrations
- Compounds with attractive effect only in the lowest concentrations
- Compound with an attractive effect following with an aversive one (dose-response; model #1)
- Compound with an attractive effect following with an aversive one (dose-response; model #2)
- Specific functional and sensorial complex developed by PHODE Science

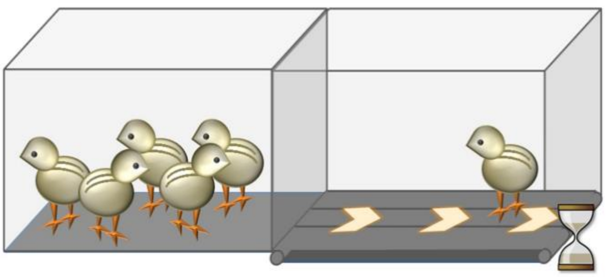
Once formulated, this sensory complex was tested on other poultry sub-species to evaluate its anxiolytic effects (stress depression).

## Improved response to stress

An experiment was conducted at INRA (1999) to assess the effect of the functional and olfactive innovation from Phodé on animal behaviour. This experimental model involved young Japanese quails, aged 6-8 days (n=180; 3 x 2 x 30).

Three strains of birds were used, characterised by their level of social motivation (their tendency to rejoin and stay close to peers): the high social motivated (S+), the low social motivated (S-), and neutral (ST).

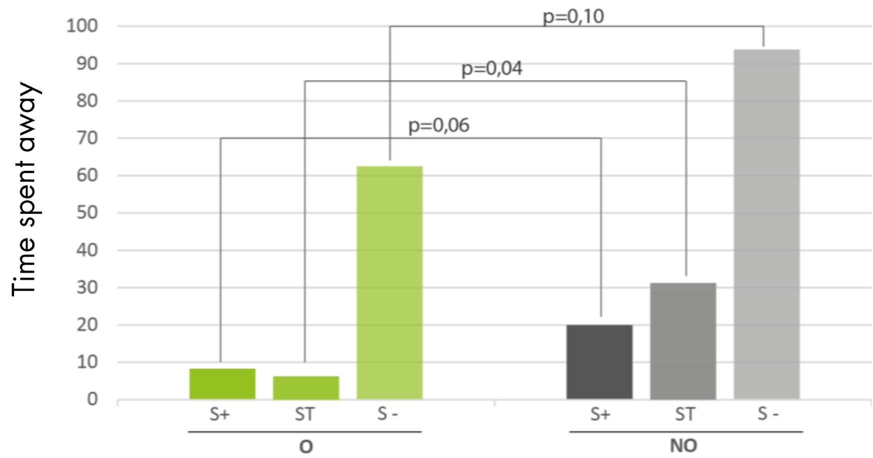
**Picture 2: Quails' Anxiety measurement device (PHODE and INRA private collaboration 1999)**



Quails group (stimuli) Separated quail on a treadmill device

For each type, two groups of 30 birds [control or with PHODE Science Solution (PSS)] were individually tested for their reaction towards a group of peers using a treadmill device (Picture 2): the amount of time the tested subject (separated quail) spends away from a "stimulus" group of congeners is recorded.
For the control group, each bird was tested separately without any sensorial enhancer (NO or PSS-).
In the tested group (O or PSS+), the air surrounding the bird was enriched with the PHODE Science Solution (continuous release by spraying).
For the three types of quails, the PSS had a positive effect on social motivation: the quails rejoined the stimulus group earlier than in the absence of odourisation. Social motivation is negatively correlated with excitability. A decrease in excitability is synonymous with an adaptation to stress. It appears that the sensory additive reduces the stress of the young quails when the animal is alone (Figure 2).

**Figure 2: Improvement of quails' social behaviour through an olfactive stress management solution**




*Legend:*
*(S+) quail strain with high social motivation model (SMM)*
*(S-) quail strain with low SMM*
*(ST) quail strain with neutral SMM*
*O: Olfactive stimulus with PHODE Science Solution*
*NO: No Olfactive stimulus (Control group)*

## *Take-home messages*

Functional olfaction can be an effective tool to manage stress in animal production. As demonstrated in the experiment, behavioural indicators help to measure the level of stress. It also can be considered as early indicators of performance.