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# Ethological characterization of the Canarian camel breed

Iglesias, C.[1]; Navas, F.J.[1]; Ciani, E.[2]; Arando, A.[1]; González, A.[1]; Marín, C.[1]; Nogales, S.[1] and Delgado, J.V.[1]

[1]Department of Genetics. Faculty of Veterinary Sciences. University of Córdoba. Córdoba. Spain.
[2]Departament of Biosciences, Biotechnologies and Biopharmaceutics. Faculty of Veterinary Sciences. University of Bari "Aldo Moro". Bari. Italy.

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## SUMMARY

Growing interests in the application of behavioral sciences to animal production has enabled the progressive development of techniques for the improvement of handling practices aiming to reach high productive yields in a sustainable framework. Selective and differential reproduction for specific and desirable behavioral traits in the Canarian camel breed *(Camelus dromedarius)*, after ethofuncional characterization, can be applied to achieve an increase in the adaptive value of the animals to the pressures of the livestock production systems in which they are reared. This initiative is part of a strategic plan for the conservation, improvement and promotion of an autochthonous endangered breed through alternative ways of profitable and sustainable use of the breed and its products. The qualification of the human team involved, as well as the mechanical optimization of the camel rearing systems, are pivotal objectives in applied ethology.

**Caracterización etológica de la raza camellar canaria**

Palabras clave adicionales
Camello canario.
*Camelus dromedarius.*
Comportamiento.
Cognición.
Lenguaje corporal.

## RESUMEN

El interés creciente en la aplicación de las ciencias del comportamiento a la producción animal ha posibilitado el desarrollo progresivo de técnicas para el mejoramiento y ajuste de los sistemas de manejo con vistas a obtener rendimientos productivos elevados en el marco de la sostenibilidad. La reproducción selectiva y diferencial para rasgos conductuales específicos y deseables en la raza camellar canaria *(Camelus dromedarius)*, previa caracterización etofuncional, puede aplicarse a lograr un incremento del valor adaptativo de los animales a las presiones de los sistemas de producción pecuaria en que se encuentran. Esta iniciativa se enmarca en un plan estratégico de conservación, mejora y fomento de una raza autóctona amenazada a través de vías alternativas de rentabilidad y utilización sostenibles de la raza y sus productos. La cualificación del equipo humano implicado, así como la optimización técnica y mecánica de las infraestructuras en los sistemas de producción camellar, se convierten en objetivos de consideración prioritaria en etología aplicada.

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fjng87@hotmail.com

## INTRODUCTION

The scientific and applied study of animal behavior is a growing discipline. Closely linked to the concept of animal welfare has allowed articulating complex adapted agricultural systems that seek maximum profitability through the correct satisfaction of the animals' basic need (Ortega Cerrilla & Gómez Danés 2006). The rethinking of the relationship between humans and animals in agrosystems emphasizes the economic nature of temperament or animal behavior in the optimization of productive yields (Aguilar & Paranhos 2009).

Since the set of actions and reactions of an organism against the stimuli present in its environment depends on motivational factors and decisions and are the result of adaptation to the environment in which they live, knowledge of these behavioral traits is a tool of transcendental importance in the comparative study between these and the typical

**Table I. Operant conditioning behavioral test to assess cognitive processes. Adapted from (Navas et al. 2018)** (Prueba de comportamiento de condicionamiento operante para evaluar los procesos cognitivos. Adaptado de (Navas et al. 2018)).

| Stage | Description | Visual stimuli | Auditive stimuli | Reinforcement methods |
|---|---|---|---|---|
| Stage 1: soft voice | Oilcloth is presented to the camel for the first time. Using a lead rope and soft voice, rope leader tried to comfort the camel to make it cross the oilcloth on the floor, but without pulling from the rope if the camel refused to move | Frontal unknown | N/A | Neutral |
| Stage 2: pressure to leading rope | Using a lead rope with applied pressure to make the camel cross over the oilcloth. Rope leader released the pressure when the camel moved to cross the oilcloth | Frontal known | N/A | Negative |
| Stage 3: treat | Lurer offered a familiar treat to lead the camel to cross over the oilcloth (the treat offered depended on the owner's tastes and therefore the animals were familiar to it) | Frontal known | N/A | Positive/Luring |
| Stage 4: motivator | Rope leader applied pressure to the lead rope at the same time lurer made a noise from behind the camel with a so-called "camel motivator" (plastic bag tied on the end of a stick). The camel was led by slightly pulling the rope until it crossed the oilcloth completely | Frontal known | Rear unknown | Negative |
| Stage 5: double rope leading | Using two lead ropes attaches on either side of the halter, rope leader and lurer encouraged the camel across, releasing the pressure when the camel moved and then reapplied when it stopped until it crossed the oilcloth completely | Frontal known | N/A | Negative |
| Stage 6: clapping | Clapper clapped his hands from behind the camel to make it move forward. Rope leader applied pressure on the lead rope and while the camel was led across by the auditory sound of the claps. Pressure and sound were released or stopped when the camel moved and reapplied when it stopped until the camel had completed the task | Frontal known | Rear unknown | Negative |

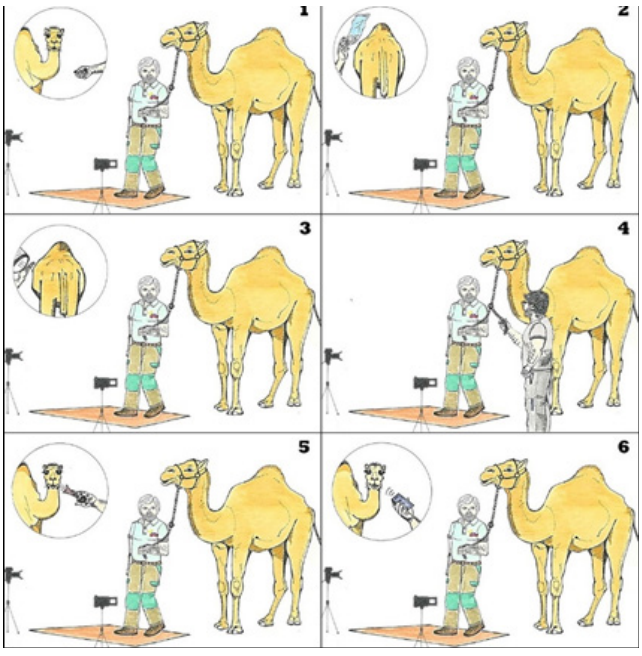


**Figure 1. Operant conditioning behavioral test depiction** (Representación de la prueba conductual de condicionamiento operante en camellos).

natural behaviors and fixed action patterns of an animal species.

The reaction to a given stimulus is a complex, individualized behavior that can be consistent in different situations or over time (Boissy 1995). Behavior can, therefore, be considered characteristic for each animal or species, a non-transitory or unpredictable phenomenon submitted to selective pressure in the same way as any anatomical feature and/or physiological process (Asensio Herrero 2014).

Regarding to cognitive processes, responsible for the analysis and individual processing of the information received from the environment, cognitive ethology seeks to recognize and quantify the mental processes that take place in non-human animals and in what measure could be considered explanatory variables of their behavior (Álvarez González et al. 2010). In this context, the adaptive value of learning could be considered as one of the most important mechanisms in ontogeny and behavioral evolution (Johnston 1982).

**Table II. Description of the six intelligence traits evaluated in camels. Adapted from (Navas *et al.*, 2017)** (Descripción de los six rasgos de inteligencia evaluados en camellos. Adaptado de (Navas et al., 2017)).

| Intelligence cluster | | | |
|---|---|---|---|
| Trait | Definition | Scale | Description |
| Concentration | The animal collaborates during the assessment sesión and does not get distracted by the environment | 1 | Distracted |
| | | 2 | Poor |
| | | 3 | Inconstant |
| | | 4 | Intermediate |
| | | 5 | Concentrated |
| Curiosity | The animal is interested in the novel stimuli being presented and moves towards them | 1 | Never (0%) |
| | | 2 | Rarely (5-10%) |
| | | 3 | Sometimes (50%) |
| | | 4 | Frequently (70%) |
| | | 5 | Always (100%) |
| Memory | The animal remembers the stimuli being presented | 1 | Scattered |
| | | 2 | Poor short-term memory |
| | | 3 | Average short-term memory |
| | | 4 | Average long-term memory |
| | | 5 | Good long-term memory |
| Stubbornness | The camel rejects following the requests of the assessor | 1 | Stubborn (Cautious) |
| | | 2 | Indifferent |
| | | 3 | Moaner |
| | | 4 | Reluctant |
| | | 5 | Obedient |
| Docility | The camel easily follows the orders of the instructor | 1 | Stubborn |
| | | 2 | Indifferent |
| | | 3 | Moaner |
| | | 4 | Reluctant |
| | | 5 | Obedient |
| Alertness | The animal shows avigilant or alert status focusing on the stimulus around | 1 | Untamed |
| | | 2 | Unwilling |
| | | 3 | Reticent |
| | | 4 | Adaptable |
| | | 5 | Docile |

In this multidisciplinary appraisal of behavior and its immediate causes, behavioral genetics tries to find out what is the individual or coordinated influence of a particular set of genes on a specific pattern of behavior, a fact that can be evaluated from the differences observed between species, races or related individuals for a defined behavioral trait. Thus, systematic artificial selection programs makes possible to increase the frequency of genes associated with specific desired behaviors based on mathematical models estimating heritability of these phenotypic traits (Álvarez González et al. 2010).

In turn, pioneering studies in behavioral physiology in production animals have identified the relationship between behavioral phenotypic characteristics and various physiological parameters under specific management systems (Cunningham, Van Tienhoven & De Goeijen 1987; Fenwick & Green 1986; Lyons & Price 1987; Majchrzak et al. 2015; Stephens & Toner 1975). The direct practical application of these results comprises the design and implementation of behavioral assessment methods based on behavioral indexes that allow quantify the adaptability of animals to confinement systems under human influence aiming to their genetic improvement and selective breeding (Fatnassi et al. 2014; Wilson 1990).

In animal species of emerging production systems and relative unknowledge of their ethological patterns, the integrated qualitative and quantitative analysis of the psychophysiological processes associated with their specific behavioral records, constitute the first phase for development of future programs looking for the improvement of handling practices and production techniques.

**Table III. Description of the seven general cognition traits evaluated in camels. Adapted from (Navas et al. 2017)** (Descripción de los siete rasgos de cognición general evaluados en camellos. Adaptado de (Navas et al. 2017)).

| Cognition cluster | | | |
|---|---|---|---|
| Trait | Definition | Scale | Description |
| Dependence | The camel is comfortable when separated from the main herd | 1 | Dependent |
| | | 2 | Restless |
| | | 3 | Stable |
| | | 4 | Adapted |
| | | 5 | Calm |
| Trainability | Ability of the animal to be trained into the fulfillment of the tests | 1 | Never (0%) |
| | | 2 | Rarely (5-10%) |
| | | 3 | Sometimes (50%) |
| | | 4 | Frequently (70%) |
| | | 5 | Always (100%) |
| Cooperation | The camel cooperates with its handlers during the daily tasks | 1 | Never (0%) |
| | | 2 | Rarely (5-10%) |
| | | 3 | Sometimes (50%) |
| | | 4 | Frequently (70%) |
| | | 5 | Always (100%) |
| Emotional stability | The animal is not predictable from one to another stimulus | 1 | Unpredictable |
| | | 2 | Surprising |
| | | 3 | Stable |
| | | 4 | Balanced |
| | | 5 | Predictable |
| Perseverance | The animal is patient when completing several sequential tests | 1 | Impatient |
| | | 2 | Generally impatient but easily handled |
| | | 3 | Patient but pushes the operator occasionally |
| | | 4 | Patient without pushing the operator |
| | | 5 | Awaits the operator's orders |
| Get in/out of stables | The animal shows no problem when leaving or entering its housing facilities | 1 | Never (0%) |
| | | 2 | Rarely (5-10%) |
| | | 3 | Sometimes (50%) |
| | | 4 | Frequently (70%) |
| | | 5 | Always (100%) |
| Ease of handling | The animal shows sympathy towards humans | 1 | Mistrustful towards humans in general |
| | | 2 | Mistrustful towards unknown people |
| | | 3 | Comfortable with familiar people, but mistrustful to unknown people |
| | | 4 | Comfortable with the human presence |
| | | 5 | Increased sympathy for human presence |

In a scenario that combines the special protection by public administrations of the animal genetic heritage of Spain and its potential as an alternative and emerging agrolivestock system, the ethofunctional characterization of the Canarian camel becomes crucial (Abdoun et al. 2012), as it is officially cataloged as an autochthonous endangered breed. With this objective, the validation of a test battery for the assessment of ethofunctional characters of this camel breed are the first step for further selective enhancement basing on their learning abilities. The improvement in behavior will be reflected in a reduction of costs and an increase in benefits.

## MATERIAL AND METHODS

During the correlated presentation of different stimuli within six stages of evaluation, intelligence, and cognitive traits and body language signals presented by the animals, are fully recorded.

**Table IV. Ordinal scale according to the interest or attitude reaction that camels present towards the stimuli during the operant conditioning test. Adapted from (Navas et al. 2017)** (Escala ordinal para la evaluación de la intensidad de la respuesta o actitud del camello durante la presentación de los diferentes estímulos del test de condicionamiento operante. Adaptado de (Navas et al. 2017)).

| Scale | Mood/Attitude | Description | Response type | Scale | Degree/ Intensity |
|---|---|---|---|---|---|
| 1 | Distracted | No reaction. Pays attention to other stimuli around | Hyporreactive | 1 | |
| 2 | Depressed | No reaction. Paysreduced attention to it. Overall, bodyposture shows lowered head and neck, roundness to spine and tucked tail | Hyporreactive | 1 | |
| 3 | Indifferent or nonresponsive | No reaction. Pays attention to it | Hyporreactive | 1 | |
| 4 | Calm | Reaction, but stands still. Pays attention to other stimuli at the same time | Neutral | 2 | |
| 5 | Awaiting | Reaction, but stands still. Only focuses on the stimulus presented | Neutral | 2 | |
| 6 | Curious | Reaction. Pays attention and stands still moving its head towards the stimulus | Neutral | 2 | |
| 7 | Cautious | Reaction. Pays attention and slightly moves towards the stimulus | Neutral | 2 | |
| 8 | Mistrustful | Reaction. Pays attention and moves towards the stimulus slowly and doubtfully | Neutral | 2 | Scored from 1 to 5 |
| 9 | Surprised | Reaction. Only focused on the stimulus being presented. Gets startled but moves towards the stimulus calmly | Hyperreactive | 3 | |
| 10 | Nervous | Reaction. Only focused on the stimulus being presented. Gets startled, and tries to move apart from it at first. Able to move towards it if led by the operator | Hyperreactive | 3 | |
| 11 | Fearful | Reaction. Only focused on the stimulus being presented. Tries to move apart from it. Unable to move towards it if led by the operator | Hyperreactive | 3 | |
| 12 | Rejection | Reaction. Only focused on the stimulus being presented. Gets startled, and moves apart from it noticeably. Pulls apart from the leading rope when the operator tries to move towards the stimulus | Hyperreactive | 3 | |

[a]Pay attention: the camel held direct visual contact with and/or directed its ear/s towards the element being presented.

An operant conditioning behavioral test is performed in an open are, that is the area where the animals develop their daily activity, so that the only alteration present in the environment are the novel stimuli used for the test (**Figure 1**). The whole experiment is videotaped by two cameras (1080 p, 50 Hz, shutter speed:1/250 seconds) located in diffrent positions of the study area. A detailed description of the operant conditioning test is presented in **Table I**.

To carry out the behavioral assessment, we evaluate thirteen behavioral traits related with the ability or mental capacities of camels to adapto to their environment and training works due to informatio processin (Navas et al. 2019). These thirteen traits are divided in two different clusters: 'Intelligence cluster' comprises six traits (**Table II**) while 'Cognition cluster' are composed by seven traits (T**able III**). **Table IV** sumarises the adjectives considered for the camel's mood/emotion towards the different stimuli presented to them during the operant conditioning test.

Lastly, when assessing body language in camels, we developed a specific ethogram (**Table V**) that allows the recognition of body language signs reporting camel's mood or temperament patterns and their potential collateral implications on early diagnosis and follow-up of morbid processes or threatening situations. Correlation between body language and response intensity or mood is a worthwile method intending to improve camel-human communication and interaction during handling practices.

## INTERPRETATION OF RESULTS AND CONCLUSIONS

The behavioral characterization will allow enriching the selection criteria based on better cognitive skills, which can be extrapolated to a better use of available resources and remarkable ease of dressage or adaptation to training protocols. This condition,

**Table V. Camel ethogram** (Etograma camellar).

| Body region | Description | Definition |
|---|---|---|
| Head (front and side view) | Straight | Head straight perpendicular to ground |
| | Head up | Poll above withers |
| | Head down | Poll below withers |
| | Turned left | Head perpendicular and looking to the left |
| | Turned right | Head perpendicular and looking to the right |
| | Twisted – nose to left | Head tipped to left side of the vertical axis |
| | Twisted – nose to right | Head tipped to right side of the vertical axis |
| | Nose out | Nose stretched forward |
| | Nose in | Nose pulled backwards |
| Ears | Ears erect and parallel | Both ears vertical with pinnae facing forwards |
| | Ears forwards | Both ears forward with pinnae facing forwards |
| | Both ears erect & to side | Both ears erect and pinnae point to side (divergent) i.e., 180° different directions to the side |
| | One ear forward & one to side | Both ears erect one to the front, and one to the side with pinna pointing to side, 90° different directions |
| | One ear to side and one back | One ear to the side (divergent) and one pinned back - 90° different directions |
| | One ear forward & one back | One ear erect and facing forwards and one pinned backwards |
| | One ear forward and one down | One ear erect and one ear tip pointing towards ground |
| | One ear to side and one down | One ear to the side (divergent) and one ear tip pointing towards ground |
| | Both ears back | Both ears erect pinned back towards the neck |
| | Ear(s) missing | One or both ear mutilated and missing |
| | Both ears down | Ear tips pointing towards ground |
| Eyes | Intense stare | Glazed look |
| | Eye round shape | Round-shaped eye |
| | Eye almond shape, relaxed | Almond-shaped eye |
| | Eye narrow shape | Eye lid partially closed, eye |
| | Eye white showing | Sclera exposed |
| Eyelids | Orbital tightening not present | Eye lids are apart, not closed, round shaped eye |
| | Orbital tightening moderately present | Eye lids partially closed, almond shaped |
| | Orbital tightening obviously present | Eye lids closed more than half |
| | Tension above the eye | Tension of elevator *anguli oculi medialis* muscle, round shaped eye |
| | Tension caudal to the eye | Contraction of muscles making zygomatic arch more easily visible |
| Nostrils | Relaxed, neutral | Nostril cartilage in neutral positon, tear-drop shaped |
| | Open wide | Nostril cartilage lifted - mediolateral widening, circular in shape |
| | Tense | Lateral rim of nostril pulled back or down towards the lips, angled sides |
| | Wrinkle between nostrils | Wrinkle between nostrils |
| | Wrinkle between nostril and lip | Wrinkle folds ventral to nostril towards lip |

together with the emotional state of the animals, has been found to be closely correlated with the number of trials needed to learn a task in a learning experiment (Heird, Lokey & Cogan 1986).

A general strategy to analyze the adaptive value of learning, conceived as a phenotypic trait present to a greater or lesser extent in an animal and being one of the most important mechanisms in behavioral development, is to examine the benefits and costs that are associated to it (Johnston 1982). This type of analysis makes possible to construct empirically falsifiable hypotheses about those adaptations, such as the ability to learn, that are more likely to evolve under specific ecological, social, physiological and genetic conditions.

In this regard, selective breeding should pursue the maintenance of previously acquired desirable learning abilities and the development of new capacities adapted to particular circumstances. However, the favorable or unfavorable evolution of a desired phenotypic trait is immersed in a complex process in which other diverse factors of a genetic,

**Table V (cont.). Camel ethogram** (Etograma camellar).

| | | |
|---|---|---|
| Mouth | Relaxed and neutral | Lips closed |
| | Lips slightly separated | Lips separated, cannot see teeth |
| | Lips separated some teeth visible | Lips separated can see some teeth, but no gum, and teeth are not apart |
| | Lips separated some teeth visible | Lips separated can see some teeth, but no gum, and teeth are apart |
| | Lips separated and teeth visible but apposed | Lips open showing teeth and gum and teeth which are apposed |
| | Mouth open, teeth exposed and separated, but no tongue | Mouth open i.e., teeth slightly separated, but cannot see tongue |
| | Mouth open, teeth exposed and widely separated, but tongue not visible | Mouth open i.e., teeth widely separated, but cannot see tongue |
| | Mouth open, teeth exposed and separated and tongue visible | Mouth open i.e., teeth widely separated, exposing tongue |
| | Mouth open, teeth exposed and separated and tongue visible | Mouth open i.e., teeth slightly separated, exposing tongue |
| | Mouth open, teeth exposed and tongue hanging out | Mouth open, teeth exposed and separated and tongue outside of oral cavity |
| | Jaw crossed | Jaw crossed and upper and lower teeth not aligned |
| | Salivation | Signs of salivation seen |
| Upper lip | Relaxed | Muzzle relaxed with curved contour in line with lower lip |
| | Muzzle tense | Muzzle tense and angled |
| | Muzzle tense and upper muzzle extended | Muzzle tense and angled and upper muzzle extended |
| Lower lip | Relaxed | Muzzle relaxed with curved rim |
| | Muzzle tense | Muzzle tense and angled |
| Neck | Relaxed | Angle between back and neck 120° |
| | Elevated | Angle <120° |
| | Lowered | Angle > 120° |
| Back/loin | Relaxed | Spine straight |
| | Rounded | Spine curved round convex |
| | Hollowed | Spine curved round concave |
| Rump | Relaxed | Tuber coxae line to tuber ischiadicum 45° degree |
| | Tucked | >45° |
| | Elevated | <45° |
| Tail | Relaxed | Hanging loosely down |
| | Clamped | Tucked between buttocks |
| | Up | Base of the tail lifted away from the buttocks |
| Stands | Normal | Leveled back, even weight distribution, legs perpendicular to ground |
| | Abnormal | Arched back, favouring on or more limbs, sinking of the pastern is evident, spread stands. Legs are angled (not perpendicular to ground) |

physiological and environmental nature also play an important role.

Closely linked to this condition, the qualification of human capital in charge of animal management should also be a priority in these cases. Specially relevance acquires the interpretation of body language of animals for the expressive or communicative meaning of their body movements.

In general terms, the scientific literature presents the camel as an animal of calm and balanced character, with a noticeably developed gregarious instinct. Individual circumstances associated with hereditary personality factors or driving conditions can trigger an obstinate temperament in some specimens (Khan, Arshad & Riaz 2003; Manefield & Tinson 1997). The recognition and interpretation of their emotions and their potential alterations, as well as allowing the expression of the natural behaviors of the species, are two basic pillars on which animal welfare policies applied to sustainable production in confined systems are based.

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