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## Gastronomic proposal with *Cavia porcellus* Propuesta gastronómica con *Cavia porcellus*

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### ABSTRACT

*Cavia porcellus* is used as a kind of meat supply, it is part of the diet and source of sustenance in some regions of the world. In Mexico guinea pig production systems represent an opportunity to produce meat for self-consumption and even for local sale. The objective of this study was to evaluate sensorially the gastronomic proposal based on *C. porcellus* meat; which consisted of four stews (in mushroom cream, roasted, sweet and sour marinade and in yellow mole) and were tasted by 40 judges not trained by an acceptability test with a structured scale of hedonic satisfaction, the attributes considered were the appearance, smell, taste, tenderness and juiciness. Data were analysed using an Ascendant Hierarchical Classification and Principal Component Analysis to construct the quadratic mapping model of external preferences. The results indicated that for type 2 consumers there is a significant effect ( $R^2=0.976$ ,  $p<0.05$ ), determining their general acceptance in common by guinea pig cream mushrooms. It was concluded that the gastronomic proposal of the four guinea pig stews was accepted, but the most widely accepted was the cuy in cream of mushroom soup.

**Keywords:** acceptability, meat, hedonic, sensory test, organoleptic properties, unconventional.

### RESUMEN

El *Cavia porcellus* es utilizada como una especie de abasto de carne, es parte de la alimentación y fuente de sustento en algunas regiones del mundo. En México los sistemas de producción de cuyes representan una oportunidad para producir carne para autoconsumo e incluso para venta local. El objetivo de este estudio fue evaluar sensorialmente la propuesta gastronómica a base de carne de *C. porcellus*; la cual estuvo preparada por cuatro guisos (en crema de champiñones, asado, adobado agridulce y en mole amarillito) y se evaluaron sensorialmente por 40 jueces no entrenados mediante una prueba de aceptabilidad con una escala estructurada de satisfacción hedónica, los atributos considerados fueron la apariencia, olor, sabor, terneza y jugosidad. Los datos se analizaron mediante una Clasificación Jerárquica Ascendente y un Análisis de Componentes Principales para construir el modelo cuadrático de mapeo de preferencias externas. Los resultados indicaron que para los consumidores de la clase 2 existe un efecto significativo ( $R^2=0.976$ ,  $p<0.05$ ), determinando su aceptación general en común por el cuy en crema de champiñones. Se concluyó que la propuesta gastronómica de los cuatro guisos con carne de cuy fue aceptada, pero el de mayor aceptación fue el cuy en crema de champiñones.

**Palabras clave:** aceptabilidad, carne, hedónico, prueba sensorial, propiedades organolépticas, no convencional.

## INTRODUCTION

The *Cavia porcellus* (guinea pig, whose, covaia or domestic cavy) in the Andean region of South America (Peru, Ecuador, Colombia and Bolivia), is considered a species of meat supply; in this region breeding is carried out in family self-supply systems, where it is traditionally used as part of the diet of its population ([Jurado-Gómez et al., 2016](#); [Ayagirwe et al., 2018](#); [Lucas et al., 2018](#); [Dalle-Zotte y Cullere, 2019](#)). Similarly in some sub-Saharan African countries (Cameroon, Democratic Republic of the Congo and Tanzania), it has become a source of livelihood due to its social and economic importance ([Matthiesen et al., 2011](#); [Ngoula et al., 2017](#); [Ayagirwe et al., 2018](#)). Another feature to consider is the chemical composition of guinea pig meat (humidity 78.2 %, energy 96 kcal, protein 18.8–20.36 %, fat 2.7–5.1 %, calcium 29 mg, phosphorus 253 mg, iron 1.9 mg, thiamine 0.10 mg, riboflavin 0.4 mg and niacin 6 mg ([INCAP, 2018](#)), which attribute potential as an alternative source of animal protein ([Avilés et al., 2014](#); [Dalle-Zotte and Cullere, 2019](#)), low in fat, compared to meat from other livestock species ([Kouakou et al., 2013](#)).

In Mexico, with regard to the guarantee of achieving adequate nutrition, the provisions of the National Council for the Evaluation of Social Development Policy ([CONEVAL, 2019](#)) are important, which reports that the indicator of access to food describes, that in 25.5 % of the Mexican population at least one member of the family modified, decreased or dispensed with food due to economic problems; and that the income of 61.1 million people (48.8 % of the population) is insufficient to be able to purchase food and non-food baskets.

[Xicohtencatl et al. \(2013\)](#) in Nayarit, Mexico, evaluated the productive variables in guinea pigs and considered that the guinea pig production systems represent an opportunity for family farming business, such as the production of meat with nutritious quality for self-consumption and even for local sale; in addition, they specified the need to articulate academic and government efforts to promote this species.

The food safety reasons are clearly stated to justify the proposal. However, for this type of 'unconventional' or 'exotic' meat, it should be considered that it can evoke strong emotions, individual and social attitudes, controversies and even taboos for the acceptance of guinea pig meat. Due to the complexity that this implies; the objective of this study was to sensorially evaluate the meat-based gastronomic proposal of *C. porcellus*

## MATERIAL AND METHODS

### Origin of animals

The origin of *C. porcellus* (n=15) was from backyard production systems, located in the Metropolitan Area of Mexico City. Next, we mention some zootechnical aspects of the guinea pigs used: the breed was American; the pups had a lactation period of 18 days; after weaning, the males were selected and a homogeneous lotification was carried out based on weight, so that good growth and development could take place. The time from weaning to slaughter was  $5 \pm 0.7$  months of age and they obtained a live weight of  $700 \pm 62$  g. The rearing of these animals was carried out with a mixed diet [vegetable waste (70 %) and commercial concentrate for rabbits (30 %)], and the health and safety in the primary production of guinea pig meat was guaranteed.

### Descripción de la ración alimenticia Description of the food ration

In the feeding system, commercial concentrated feed was used (14.5% crude protein) and organic waste from CEDA (non-conventional) was integrated. Table 1 shows the nutritional values of the non-conventional foods used in this study, which were previously evaluated and reported by our work team ([Almaráz et al., 2012](#)). With these data, the nutritional requirements recommended by [Xicohtencatl et al. \(2013\)](#).

**Table 1. Chemical analysis of unconventional ingredients (plant waste)**

	Cabbage	Cauliflower	Corn leaves	Lettuce	Commercial concentrate
Humidity, %	88.5	89.9	81.29	94.30	12
DM, %	11.5	10.1	18.30	5.75	88
Ash, %	16.5	14.4	3.45	23.20	10
CP, %	10.7	18.3	3.70	17.20	14.50
FDN, %	18.5	22.9	69.90	26.20	18
FDA, %	13.6	16.5	32.20	19.70	13
Hem, %	4.9	6.4	37.70	6.40	--
Lignin, %	2.7	2.6	1.40	9.60	--

### Obtaining the guinea pig carcass

The sacrifice was carried out following the animal welfare protocols, desensitization was by exposure to 90% CO<sub>2</sub>, for 17 min ([AVMA, 2020](#)), and at the end of this time a cross-section was made in the jugular vein to bleed. Subsequently, the carcasses were placed in the caudo-cranial position to proceed to slaughter (skinned and gutted) ([Mota-Rojas et al., 2012](#)) and then the carcasses ( $417 \text{ g} \pm 60$ ) were stored at 4 °C for 24 h ([Rubio et al., 2014](#)); then each channel was separated according to the protocol of [Sánchez-Macías et al. \(2016\)](#), separating and identifying the portion of the long leg. Finally, the samples were placed at -20 °C ([Rodbotten, 2004](#)), for later use in sensory tests.

### Sample preparation

A slow thawing protocol was followed (24 h period), until an internal temperature of 5 °C was obtained in the samples (Font, 2006), and then the connective tissue and covering fat were removed.

### Consumer characteristics and sensory testing

The gastronomic proposal was presented to the judges-consumers, in a context of consumption as close to reality as possible, the basic criterion was to simulate the conditions of 'Gastronomic Experience' in the most reliable way possible. Despite the above, the area where the evaluation was carried out allowed control, such as lighting (white light), temperature (25 °C), noise and strange odors. The evaluation time was at 11:00 am (after breakfast and before lunch).

This gastronomic proposal consisted of four stews with guinea pig meat (in mushroom cream, roast, sweet and sour marinated and in yellow mole). The stews were made with ingredients commonly used in Mexico (Table 1), and 3 cooking systems were used; two of these analyzed in a preliminary study by this research group (Luna *et al.*, 2017). For each of the techniques, an internal temperature of 75 °C (in the geometric center) was obtained in the meat.

**Table 2. Description of stews with ingredients commonly used in Mexico**

Stew with guinea pig meat	Culinary method	Ingredients
Cream of mushroom soup <sup>a,b,f</sup>	Fried	White mushrooms, portobello mushrooms, girolas mushrooms (mushrooms), whipping cream, poultry stock, clarified butter and caramelized walnuts.
Roast <sup>a,b,c,d,e,f</sup>	Grill	Guajillo chili, tree chili and apple cider vinegar
Bittersweet marinade <sup>a,b,c,d,e,f</sup>	Immersion	Ancho chili, guajillo chili, white vinegar, oregano, peaches in syrup and salt.
Yellow mole <sup>a,b,c,d,f</sup>	Immersion	Yellow chilhuacle chili, green tomato, tomato, holy leaf, toasted sesame, oil, broth, corn dough, julienne Italian zucchini and peas.

Ingredients for more than one stew: garlic<sup>a</sup>, onion<sup>b</sup>, pepper<sup>c</sup>, clove<sup>d</sup>, cumin<sup>e</sup>, salt<sup>f</sup>

Forty consumers of both sexes were recruited, with an age range of 20 to 52 years, which indicated that they were habitual consumers of meat; they were also informed of the type of meat to evaluate. For the acceptance test, each consumer was presented with the four dishes (at 55 °C) plated (in 4 times and in plain white dishes) and they were provided with water as a cleaning agent for taste, which they used before cooking evaluation of each stew (Peachey, 2002).

The affective methodology was used (González *et al.*, 2017) with a structured 7-point hedonic satisfaction scale (I dislike it a lot: -3; I dislike it moderately: -2; I dislike it: -1; I neither dislike it nor do I like it: 0; I like it: 1; I like it moderately: 2 and I like it a lot: 3). The sensory variables evaluated were tenderness, juiciness, taste and smell.

### **Statistical analysis**

XLSTAT-Sensory software version 2015.6.01.25740 (Copyright Addinsoft 1995-2016) was used. For the acceptance study, a group of consumers was carried out that generated the types for the global appreciation variable associated with the four attributes evaluated in the sensory test. That is, an Ascending Hierarchical Classification (AHC) and a Principal Component Analysis (PCA) of the sensory attributes were used to build the quadratic model of external preferences mapping (EPM) (González *et al.*, 2017).

## **RESULTS AND DISCUSSION**

### **Study of the acceptance of guinea pig meat**

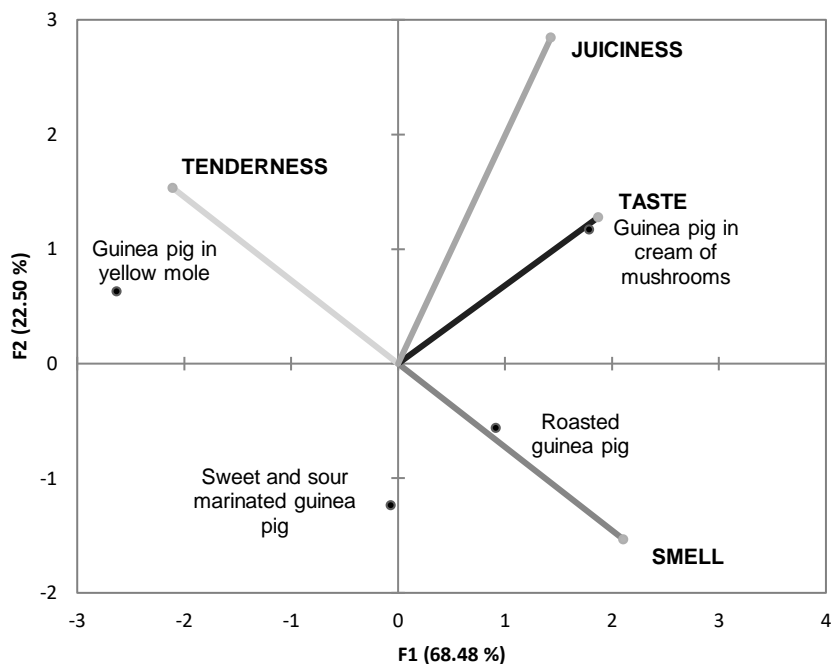
Sensory analysis can be a good tool to develop new products in a restaurant, by simulating the conditions in which this meat can be offered; the proposal allowed to evaluate their perception in a realistic situation. In the sensory space (Figure 1), the sensory attributes that are associated with the first main component (F1) are smell, taste and tenderness and the attribute associated with the second component (F2) was juiciness and represented 90.99 % of the variability of the acceptance data. Consumers were found to have different perceptions of attributes; the above, due to the culinary technique and the ingredients used.

The most widely accepted proposal was the guinea pig prepared in cream of mushrooms, locating in the positive values for both main components and in particular in the preference associated with the flavor attribute as it is stronger, since it moves away from the direction indicated by the vector. The roasted guinea pig obtained positive values for smell, flavor and tenderness, but negative for juiciness. Therefore, this culinary preparation was less accepted.

The external preference map (Figure 2 and 3) indicates that for type 2 consumers, there is a significant effect ( $R^2=0.976$ ,  $p < 0.05$ ); since this model explained the preferences of this group of consumers, determining their general acceptance in common for guinea pig in cream of mushrooms. Type 1 and type 3 have  $R^2 = 0.968$  and  $R^2=0.893$  ( $p < 0.05$ ) which determines their general acceptance in common by guinea pig in yellow mole and in cream of mushroom cream respectively.

For consumers belonging to types 4 ( $R^2=0.081$ ), the model applied in the present investigation could not explain the preferences. Type 2 and type 3 show similar preferences for guinea pig in cream of mushrooms, since this stew is the most preferred

in both types. The percentage of satisfied consumers (Figure 3) was 60-80 % for guinea pig stews in mushroom cream, yellow mole and bittersweet marinade and 40-60 % for roast guinea pig.



**Figure 1. Sensory space of the gastronomic proposal with *Cavia porcellus* meat. Sensory attributes were rated using a 7-point hedonic acceptance scale**

Barham *et al.* (2010) indicated that the judgment of the quality of a stew is a personal matter, such as the extent to which a particular meal is enjoyed or not, and that a series of conditions must be met (taste, texture, juiciness and smell), before the food is really nice. In the present work, despite the use of different culinary techniques for the preparation of these stews, the sensory scores of the structured hedonic scale (bipolar) place them in positive values, which indicates that the consumer accepted this type of meat in different presentations.

When elucidating the conditions for which the stews were described by this group of individuals under study as pleasant, it is worth mentioning the way in which they were able to meet the conditions for it; and it was through the production of raw materials (which was the same for all the stews), in the cooking process (different culinary techniques) and in the way food is presented (variable ingredients); of course, with the preparation of the stews (ingredients and their combination). In addition to the cooking process carried out in a proper way, it can lead to the quality development of a food dish. In some stews, processes that developed the flavor were involved, as observed in guinea pig in cream of

mushrooms, which obtain positive ratings for flavor and in others this can affect the organoleptic characteristics, as happened with the roast that was the least accepted and obtained negative ratings on juiciness.

Natividad *et al.* (2010) and Flores-Mancheno *et al.* (2017) elaborated sausages with guinea pig meat reporting good organoleptic characteristics and Apráez (2011), obtained acceptance for guinea pig chorizo in 21.67 % with significant differences for the category 'I like it very much', for the guinea pig chorizo . Other sensory evaluations have also been carried out for *C. porcellus* meat, in different presentations, and smoked guinea pig meat was the most widely accepted, followed by breaded guinea pig meat and croquettes (Argote *et al.*, 2009).

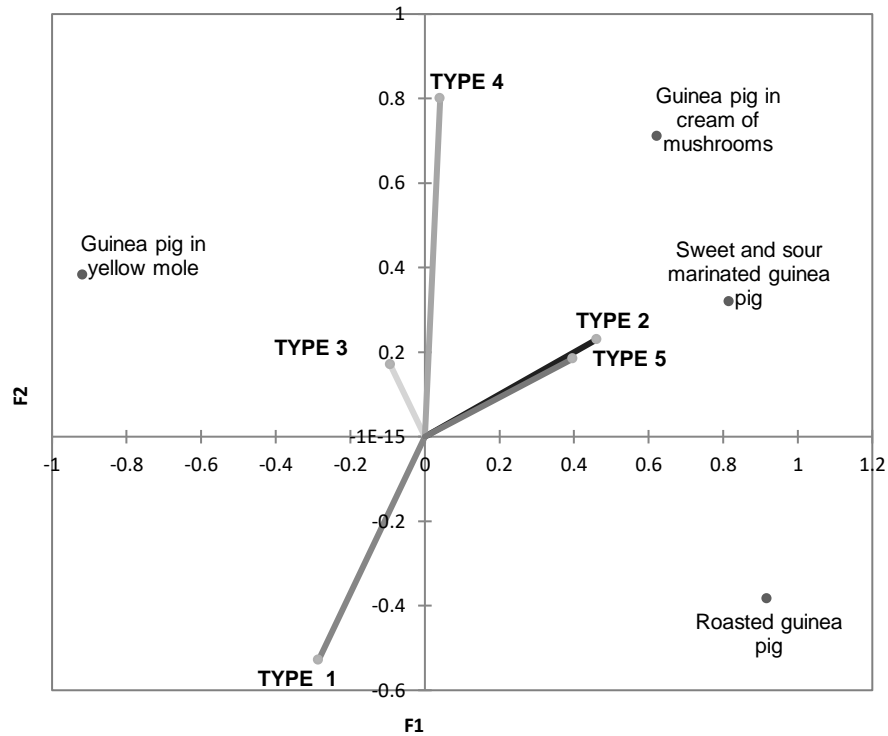


Figure 2. External map of vector model preference for the general acceptance of *Cavia porcellus* meat, rated using a 7-point hedonic acceptance scale.

Also, Argote *et al.*, (2009), using a quantitative model and random probability sampling, collected information on the preference for guinea pig meat in Colombia (traditionally consuming beef), finding that 96 % of the surveyed population has consumed meat from guinea pig, and the rest (4 %) do not do it because they do not like its taste and appearance. Therefore, the incorporation of this type of food is viable, since the results obtained in the hedonic scale for the different dishes are classified as: I like it, I like it moderately and I like it a lot.

In a similar way to the present study, [Yaguache \(2013\)](#) proposed culinary alternatives using guinea pig meat and evaluated them sensually using a hedonic scale; the prepared dishes were well accepted. 45 %, 46 %, 54 % and 44 % of consumers indicated that they really liked the guinea pig skewers, pork rinds, guinea pig wrap, and guinea pig in wine, respectively. Therefore, it was reported that guinea pig meat is liked by all palates in different ways of preparing it.

The guinea pig is gaining importance as a source of exotic meat, and consequently its importance as a meat-producing animal is increasing; but there is still research on its meat quality traits and it needs to be explored in greater depth.

However, in subsequent studies it is important to use the *C. porcellus* species adapted in Mexico and not to consider moving native animals from South America, since as suggested by [FAO \(2010\)](#), «biological diversity has an intrinsic value and must preserve itself at the highest possible level».

The acquisition of this meat may be viable, as indicated by [Xicohtencatl et al. \(2013\)](#) who indicate a production cost of a guinea pig at weaning of \$ 30.14 pesos MN and infer that guinea pig production systems can have income from the sale of guinea pigs for pets and also from the production of meat for local consumption.

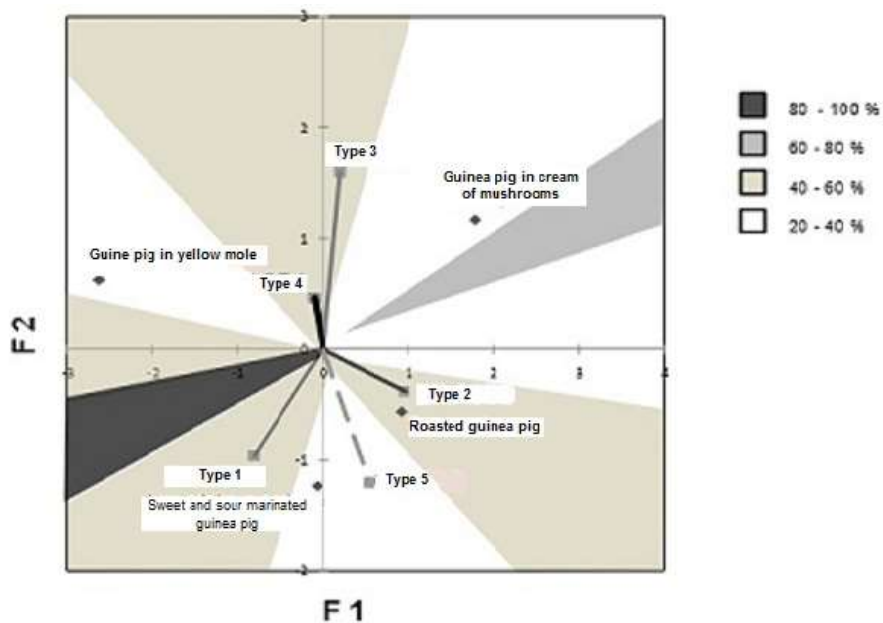


Figure 3. Preference map and contour graph of satisfaction percentages using a vector model for general acceptance for *Cavia porcellus* meat, rated using a 7-point hedonic acceptance scale.



## CONCLUSIONS

The substitution of meat from traditional slaughter animals for guinea pig meat does not affect the sensory attributes and it is accepted by consumers. This type of meat was received in a positive way, since the judges when evaluating the gastronomic proposal using guinea pig meat had a high percentage of satisfaction. Therefore, *C. porcellus* meat can be positioned as an attractive meat for the consumer. In addition, when conducting the evaluation as closely as possible to a food service experience, information was obtained to consider that guinea pig meat is an alternative as a non-traditional food source and that it can be incorporated into the gastronomic market.

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