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QUALITY OF SAUSAGES DERIVED FROM THE MEAT OF THE MEXICAN HAIRLESS PIG

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Abstract: The Mexican Hairless Pig from Yucatán represents a contribution to family sustenance, since its rusticity and resilience facilitates its production in rural areas. The objective was to evaluate the bromatological characteristics (Moisture, Protein, Fat, Ash) and physicochemical characteristics (Aw, pH) of the sausages. The pigs were fed for three months before slaughter, with non-conventional diets based on the incorporation of 15% of Tithonia diversifolia, 25% of Brosimun alicastrum, 25% of Mucuna pruriens and a Control Diet.
Three meat products were made: Cooked Ham, Pepper Cake and Spanish Chorizo. To evaluate the results, descriptive statistics, analysis of variance and Tukey test ($P<0.05$) were used. In Cooked Ham, it was found that there is a significant difference ($P<0.05$) for humidity between Tithonia d. and Mucuna p., in ashes between the Tithonia d. and Brosimun a. Regarding the Pastel Pepper, there was a difference ($P<0.05$) in humidity for the Tithonia d. regarding other diets; In terms of protein they were Tithonia d. and the control diet different from the rest of the diets, finally in the ashes, the Tithonia d. and Brosimun a. were different with the rest of the diets. In the case of the Spanish type chorizo, there was no difference ($P>0.05$) in humidity, protein, fat and ash, but in the physicochemical characteristics a difference was found ($P<0.05$) in Tithonia d. with a lower value in Aw than the rest of the diets; For pH, the control diet has a higher value (4.96), which differs significantly from that of Mucuna p. (4.60). The inclusion of tropical shrubs in the diet of the Mexican hairless pig from Yucatan represents an alternative for rural pig farming, and gives added value to its derived products.
Keywords: product quality, Creole pork, feeding alternatives

INTRODUCTION

The global demand for pork is such that, for 2023, a global production of 114.1 million tons is estimated, with the largest producers being China, the European Union and the United States, contributing together with 78.9% of world production. This production is related to the estimated consumption of 113.2 million tons, with China being the main consumer. Although in Mexico, pork production represents 22.0% of the meat industry, the volume of production is not enough to cover national demand (Fideicomisos Institución en Relación con la Agricultura [FIRA], 2023).

Mexico faces a growing deficit in the production of foods of animal origin, essential for the development of its population, which is why it has to import large volumes of meat at very high costs. As a result, per capita consumption is low, especially in the rural population (Sierra, 2000; Huerta et al., 2018). Given this, pork constitutes an important source of high-quality protein in the diet of several countries, including Mexico, where it occupies third place nationally and represents the productive activity with the highest demand in the production of forage grains (Alarcón et al. al., 2005), the largest meat producers being the States of Jalisco, Sonora, Puebla and Yucatán (National Service of Health, Safety and Agri-Food Quality [SENASICA], 2022). In this sense, the Mexican hairless pig of Yucatán (CPM) has gained importance, since it represents a contribution to family sustenance, coupled with its great rusticity and resilience, which facilitates its production in rural areas at low cost. Furthermore, in recent times, the national consumer tends to consume healthily and is favored by the availability of a healthy product, hygienically produced and with high nutritional content; However, information on the quality characteristics of the carcass, meat and sausages of this locally adapted breed is unknown, so it is necessary to propose studies in order to seek its social revaluation and contribute, at the same time, to its conservation. and use (López et al., 1999; Dzib et al., 2022). The objective of the work was to evaluate the bromatological characteristics (moisture, protein, fat, ash) and physicochemical characteristics (Aw, pH) in different industrialized products derived from the meat of the Mexican hairless pig in Yucatan, fed with unconventional diets.

MATERIALS AND METHODS

STUDY AREA

The work was carried out in the experimental field "la posta" of the Tecnológico Nacional de Mexico Campus Conkal, Yucatán. In the meat products workshop, which is located at kilometer three of the Conkal-Chablekal highway. The bromatological, physical and chemical analyzes were carried out in the Laboratory of Food Science and Technology of the Tecnológico Nacional de Mexico Campus Mérida. The coordinates of the area are 21° 5' North Latitude and 89° 32' West Longitude, with an Awo-type climate, which is characterized by being warm subhumid, rainfall of 850 mm and an average annual temperature of 25.5°C, according to the Köppen classification modified by García (2004).

STUDY ANIMALS

Eight pigs were used, four castrated males and four females, of the locally adapted breed Mexican hairless pig from Yucatán (CPM), which were chosen randomly. They had 50.68± 4.8kg of average live weight at the time of slaughter, they were fed during the last three months prior to slaughter with three experimental diets based on the incorporation of 15% of Tithonia diversifolia (False sunflower), 25% of Brosimun alicastrum

(Ramón), and 25% of Mucuna pruriens (Velvet Bean) in addition to a control diet.

PREPARATION OF SAUSAGES

The preparation of the meat products was carried out using the meat obtained from the dissection of all the pieces of the carcass, from each of the pigs used. The meat used was clean of fat, fascia and blood vessels. Three meat products were made: cooked ham, pepper cake and Spanish-type chorizo.

The cooked ham type sausage developed in this project is a cooked meat product subjected to the action of curing agents. The meat was obtained from the loin and leg of the pig, all residue of subcutaneous fat, fascia and nerves were removed. After making the ham, the weight was recorded to determine the yield and it was subsequently sliced for the corresponding analyses. For the pepper cake, the meat from the shoulder and loin head was used, the meat was cut into pieces without removing the fat, then the meat was ground, once ground, the ingredients were weighed based on the amount of meat obtained. At the end of the production of this sausage, the weight of each mold was recorded to determine the performance and, finally, they were sliced for physical and chemical analysis. Spanish-type chorizo is a cooked meat product, subjected to the action of curing agents, which is used to prepare the skirt, shoulder and fat. The meat and fat were cut into pieces, then ground to mix with the additional fat. Once the preparation time had elapsed, they were removed and allowed to cool, before being placed in the cold room for 24 hours at a temperature of -4°C. and later proceed to carry out their physical and chemical analyzes (Mendoza, 1998; Ministry of Agriculture, Fisheries and Food, 2005; Lesur, 1992; Toldrá, 2010).

BROMATOLOGICAL ANALYSIS

It was carried out in the Laboratory of Science and Technology of Foods of Animal Origin of the Technological Institute of Mérida, where humidity, ash, fat and proteins were determined, using the procedure proposed by the Association of Official Analytical Chemists [A.O.A.C.] (1990). This same technique was used to determine Moisture in cooked Ham, Pepper Cake and Spanish type Chorizo.

DETERMINATION OF PHYSICOCHEMICAL CHARACTERISTICS

The determination of Water Activity (Aw) and the determination of pH were carried out according to the Official Methods proposed by the A.O.A.C (1997). This technique was used for determination in ham, chorizo and pepper cake.

STATISTIC ANALYSIS

Descriptive statistics (mean, standard deviation, coefficient of variation, standard error) were calculated. An analysis of variance (ANOVA) was performed for all study variables; a comparison of means was also performed using the Tukey test ($P<0.05$). For this, the SAS statistical package for Windows version 8.0 was used in its GML procedure.

ETHICS

The ethics, care, welfare, management and slaughter of the pigs followed the guidelines of the official Mexican standards: NOM-051-ZOO-1995 and NOM-062-ZOO-1999, NOM-033-SAG-ZOO- 2014. Furthermore, the experiment was carried out following good livestock practices approved by the Technological Institute of Conkal, Yucatán; This study is part of a final report on postgraduate studies.

RESULTS AND DISCUSSION

BROMATOLOGICAL AND PHYSICOCHEMICAL CHARACTERISTICS OF COOKED HAM

The results of the analyzes carried out on the Cooked Ham are presented in Table 1.

Ruíz and López (2004), in Iberian pork ham, observed that the fat content is mainly responsible for the juiciness of the product, while the moisture content does not seem to affect it. This is of great importance because the juiciness of the ham seems to have a direct relationship with acceptability, that is, the higher the fat content, the greater the acceptability of the Iberian Ham. García et al. (2005), determined the effect of meat raw material from commercial pigs on the quality of Cooked Ham, where they obtained humidity (74.37%), fat (2.71%) and protein (17.87%), these values being higher than the present one. job. Morales et al. (2004), made a comparison of a pork sausage with extenders, fermented with raw starter cultures, where they found moisture (39.16%) being lower than all the diets in this study, protein (18.3%), fat (37.05%) and pH (5.37) being higher than all the diets evaluated, the values in ash (2.84%) were similar with the Tithonia d diets. and control, while for Aw (0.92) it was slightly lower than the diets of this study.

Asencio et al. (2018), in a work with different genetic lines of Iberian pig, found that, in cured shoulders, the percentage of protein (30.77%) was higher than the present work and lower in fat (6.78%) and humidity (51.11%), which could be due to the characteristics of the genetic lines.

BROMATOLOGICAL AND PHYSICOCHEMICAL CHARACTERISTICS OF PEPPER CAKE

Table 2 shows the significant difference ($P<0.05$) found in humidity for Tithonia d. being inferior compared to other diets; As for protein, Tithonia d. and the control diet, were lower than the rest of the diets; Regarding fat, no significant difference was found ($P>0.05$), but the Brosimun diet a. It tends to be lower compared to the other diets and, finally, in the ash it is observed that Tithonia d. and Brosimun a. They tend to be low with the rest of the diets.

BROMATOLOGICAL AND PHYSICOCHEMICAL CHARACTERISTICS OF SPANISH TYPE CHORIZO

In Table 3, it can be seen that there is no significant difference ($P>0.05$) in humidity, protein, fat and ash. But in the physicochemical characteristics, a significant difference ($P<0.05$) was found in Tithonia d. with a lower value in Aw than the rest of the diets; For pH, the control diet has a higher value (4.96), which differs significantly from that of Mucuna p. (4.60).

Pérez et al. (1999), verified the advantages of using CPM meat in high-quality processed and matured sausages, as is the case of Pamplona-type chorizo. At 14 days of maturation, the humidity (49.75%) was similar to what was reported in this study. work, regarding the diet of Mucuna p. Villa (2005) found 39.7% for the same characteristic. Regarding protein, Pérez et al. (1999) obtained 7.11%, similar to the control diet and Tithonia d., but lower than Brosimun a. and Mucuna p. with 10.04% and 10.67%, respectively. As for the Ashes (5.12%), it was similar to those found in this work for the case of Brosimun a., Mucuna p and control diet, but lower than Tithonia d.

	Bromatological				Physicochemical	
Diets	**Humidity**	**Protein**	**Fat**	**Ash**	**Aww**	**pH**
Tithonia d.	60.84^{b}±2.5	7.85^{a}±2.5	14.72^{a}±1.0	2.72^{b}±0.1	0.973^{a}±0.002	5.90^{a}±0.16
Brosimun a.	66.05^{ab}±0.7	6.95^{a}±0.02	15.37^{a}±1.0	2.43^{c}±0.0	0.972^{a}±0.002	5.845^{ab}±0.1
Mucuna p.	69.58^{a}±1.0	7.82^{a}±1.7	12.86^{a}±4.5	3.12^{a}±0.1	0.973^{a}±0.000	5.740^{ab}±0.1
Diet C	67.35^{a}±4.4	6.99^{a}±0.89	15.36^{a}±2.6	3.14^{a}±0.0	0.978^{a}±0.009	5.585^{a}±0.19

Table 1. Bromatological and Physicochemical Characteristics of Cooked Ham

Different letters in the same column indicate significant difference (P<0.05).

Aw= water activity

	Bromatological				Physicochemical	
Diets	**Humidity**	**Protein**	**Fat**	**Ash**	**Aww**	**pH**
Tithonia d.	66.08^{b}±0	8.29^{ab}±0	19.31^{a}±0	2.79^{c}±0	0.971^{a}±0.001	5.915^{a}±0.03
Brosimun a.	70.8^{a}±1.5	11.1^{a}±1.3	8.56^{a}±9.6	3.10^{b}±0.3	0.970^{a}±0.003	5.805^{a}±0.13
Mucuna p.	70.92^{a}±0.1	10.65^{a}±0.4	13.58^{a}±0.0	3.76^{a}±0.0	0.969^{a}±0	5.840^{a}±0.10
Diet C	69.82^{a}±2.0	6.56^{b}±2.62	14.04^{a}±9.2	3.56^{a}±0.0	0.971^{a}±0.002	5.915^{a}±0.09

Table 2. Bromatological and Physicochemical Characteristics of the pepper cake

Different literals in the same column indicate a significant difference (P<0.05).

Aw= water activity

	Bromatological				Physicochemical	
Diets	**Humidity**	**Protein**	**Fat**	**Ash**	**Aww**	**pH**
Tithonia d.	41.01^{a}±7.0	6.10^{a}±0	28.78^{a}±4.5	6.96^{a}±2.1	0.877^{b}± 0.02	4.680^{ab}±0.12
Brosimun a.	40.06^{a}±5.2	10.04^{a}±1.7	25.93^{a}±3.9	5.49^{a}±0.3	0.922^{a}± 0.03	4.665^{ab}±0.01
Mucuna p.	48.49^{a}±4.3	10.67^{a}±2.1	26.14^{a}±3.0	5.65^{a}±1.5	0.923^{a}± 0.00	4.60^{b}±0.08
Diet C	45.77^{a}±2.4	6.77^{a}±3.93	31.11^{a}±2.9	5.70^{a}±0.0	0.920^{a}± 0.00	4.960^{a}±0.28

Table 3. Bromatological and Physicochemical Characteristics of Spanish-type Chorizo

Different literals in the same column indicate a significant difference (P<0.05).

Aw= water activity

The pH (4.53) was similar to that found in the present work for all diets and, finally, the Aw (0.97) was identical to that found in Brosimun a., Mucuna p and control diet, but higher than Tithonia d.

CONCLUSIONS

The inclusion of local tropical bushes in the diet of the Mexican hairless pig from Yucatan and subsequent preparation of sausages with the meat from this breed, represents an alternative for rural pig farming, since it can reduce production costs for feeding, by At the same time, it gives added value to the derived products since their nutritional contribution is maintained; It is suggested to continue with these studies.

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