

## Nutrient digestibility and digestible energy of ground paprika (*Capsicum annuum*) in guinea pigs (*Cavia porcellus*)

### Digestibilidad de nutrientes y energía digestible de la p prika molida (*Capsicum annuum*) en cuyes (*Cavia porcellus*)

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#### Abstract

The objective of this study was to determine the nutrient digestibility coefficients and estimate the digestible energy of ground paprika (*Capsicum annuum*) through *in vivo* digestibility trials in guinea pigs. The experiment was conducted in the laboratories of the National Agrarian University of La Molina [UNALM], Lima, Peru. The adaptation period was 7 days. During these seven days, the percentage of wheat by-product was progressively reduced, and the inclusion of ground paprika in the experimental diet was increased, while the control group received a diet with 100% wheat by-product. Over the following 10 days, food consumption was recorded, and feces were collected daily. The digestibility coefficients of ground paprika were 69.77% for dry matter, 86.76% for crude protein, 89.32% for ether extract, 40.85% for crude fiber, 69.56% for ash, and 80.70% for nitrogen-free extract. The digestible energy was 3,448.6 kcal kg<sup>-1</sup> of dry matter. In conclusion, ground paprika is a highly digestible and energy-dense local input, with potential for use as an alternative ingredient in the formulation of balanced feeds for guinea pigs.

**Keywords:** digestibility coefficient, intake, paprika, wheat subproduct.

#### Resumen

El objetivo del estudio fue determinar los coeficientes de digestibilidad de los nutrientes y estimar la energ a digestible de la p prika molida (*Capsicum annuum*) mediante ensayos de digestibilidad *in vivo* en cuyes. El experimento se llev  a cabo en los laboratorios de la Universidad Nacional Agraria La Molina [UNALM], Lima, Per . El periodo de adaptaci n tuvo una duraci n de 7 d as; durante estos siete d as se redujo progresivamente el porcentaje de subproducto de trigo y se increment  la inclusi n de p prika molida la dieta experimental, mientras que el grupo control recib  una dieta con 100% de subproducto de trigo. En los 10 d as siguientes se registr  diariamente el consumo de alimento y se recolectaron las heces. Los coeficientes de digestibilidad de la p prika molida fueron 69,77% para materia seca, 86,76% para prote na cruda, 89,32% para extracto et reo, 40,85% para fibra cruda, 69,56% para ceniza y 80,70% para extracto libre de n tr geno. La energ a digestible fue de 3.448,6 kcal kg<sup>-1</sup> de materia seca. En conclusi n, la p prika molida es un insumo local altamente digestible y energ ticamente denso, con potencial para su uso como ingrediente alternativo en la formulaci n de alimentos balanceados para cuyes.

**Palabras clave:** coeficiente de digestibilidad, consumo, p prika, subproducto de trigo.

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## 1. Introduction

Guinea pigs (*Cavia porcellus*) were domesticated in the Andean region of South America over 3,000 years ago from wild varieties of *Cavia tschudii*, and became the first rodent intentionally raised for human consumption (Kimura et al., 2016; Pigière et al., 2012). *Cavia porcellus* is an important species in the Andean diet, especially in Peru (Chicaiza Sánchez et al., 2024), where it constitutes a source of high-quality animal protein (20.3%) and low-fat content (7.8%) in comparison to other meats (Rosenfeld, 2008). Besides its nutritional value, it represents an economic alternative due to short reproductive cycles, low costs of production, fast growth and easy management (Miégoué et al., 2016). These characteristics have increased the demand for guinea pigs (Chávez-Tapia & Avilés-Esquivel, 2022; Torres Salazar & Bardales Escalante, 2023). In Ecuador, guinea pig breeding is part of family farming and contributes to food security and family economic support (Chicaiza Sánchez et al., 2024). This productive system has adapted to the country's agroecological conditions, integrating animal production with crops and promoting a more efficient use of available resources (Reyes-Silva et al., 2021; Damián Quito et al., 2022).

Feeding is the main component of production costs in guinea pig breeding, representing approximately 60% of the total (Aliaga et al., 2009). Their diet is mainly based on green forage, especially alfalfa, due to its high protein content and digestibility (Reyes-Silva et al., 2021). A balanced diet ensures good growth, feed conversion and animal health (Castro-García & Nava, 2021). However, the use of commercial balanced feed increases production costs, which has promoted the search for local, artisanal, and low-cost alternatives elaborated with available supplies in the area (Hermitaño-Osorio et al., 2024).

In this context, there is a rising global tendency towards the assessment and usage of non-conventional ingredients in animal feed due to the need to reduce costs, the sustainable enhancement of productive systems, and the variability in traditional forage availability. These ingredients should be viable and nutritionally adequate to partially or totally substitute conventional forage, especially during periods of scarcity or when quality is low (Apráez-Guerrero et al., 2013). Many studies have reported the potential of different alternative ingredients. Hidalgo and Valerio (2020) showed that corn germ presented higher digestibility for dry matter (79%), while *hominy feed* registered the highest values of digestible and metabolizable energy (4,372 and 4,351 kcal kg<sup>-1</sup> of dry matter, respectively). Likewise, Sotelo et al. (2020) reported

digestibility coefficients superior to 60% in dry forage from *Mucuna pruriens*, while Castro Bedriñana et al. (2018) found high digestibility of soluble carbohydrates in maca stubble (*Lepidium peruvianum*). Hurtado et al. (2012) highlighted Arboloco (*Montanoa quadrangularis*) with almost 90% of crude fiber and dry matter.

Within the line of alternative ingredients search, paprika (*Capsicum annuum*) is presented as a promising option. This crop, used mainly in the food, medical, and cosmetic industries (González-Pérez et al., 2025), is produced in high volumes on the Peruvian coast. Globally, *Capsicum annuum* is one of the most economically important vegetables, with approximate 1.7 million cultivated hectares (Food and Agriculture Organization of the United Nations [FAO], 2023). Their fruits contain high levels of vitamins A and C, carotenoids, flavonoids, and antioxidant compounds (Choi et al., 2023), plus relevant pharmacological properties (Zhang et al., 2023). Chili genotypes have higher levels of protein, fiber, fats, carbohydrates and are rich sources of secondary metabolites (Mis-Valdez et al., 2022). At the Yucatan Peninsula, this crop stands out because of its genetic diversity and economic relevance (Castillo-Aguilar et al., 2021).

In Peru, the most widespread crops include sweet pepper, native pepper, Ancho San Luis (broad chili pepper), paprika, rocoto, and piquillo, with a national production estimated at 27,749.69 t year<sup>-1</sup> (FAO, 2023). One of the main strategies to improve commercial quality and productivity is the use of hybrids with strong yield performance, fruit uniformity and better adaptation to specific environmental conditions (Krishna et al., 2021; Naves et al., 2022). However, farmers face significant losses in commercial quality due to scald and sunscald, which cause excedents that most of the time cannot be inserted in formal markets. The discarded volumes represent an opportunity to be revalued for other uses, like animal feed, where their nutritional and energetic inputs could be utilized.

However, their use in animal feed has been less explored. In rabbits, García et al. (1977) reported 63.1% of protein digestibility and crude fiber, and 1747.6 kcal kg<sup>-1</sup> MS of digestible energy. Given that information about paprika's nutritional value in guinea pigs is practically nonexistent, it becomes necessary to evaluate its potential as an alternative ingredient through digestibility studies.

The present study aimed to determine the apparent digestibility coefficients and estimate the digestible energy of paprika (*Capsicum annuum*) through *in vivo* assays in male guinea pigs to evaluate its potential as an alternative ingredient in the formulation of balanced diets. The results contribute relevant information

for the diversification of food sources in guinea pig breeding, promoting the exploitation of agricultural excedents and reducing production costs. Thus, strengthening the sustainability of family productive and commercial systems in high-Andean zones.

## 2. Materials and Methods

### 2.1. Study area

The experiment was carried out in the Laboratory of Biological Evaluation of Food at the Faculty of Animal Science of the National Agrarian University of La Molina [UNALM], Lima, Peru. Proximal chemical analyses were done in the Laboratory of Nutritional Evaluation of Food [LNEF] at the Faculty of Animal Science of the UNALM.

### 2.2. Set and equipments

Guinea pigs were placed individually in 10 metabolic cages with an area of 0.11 m<sup>2</sup>. The cages had metallic mesh floors, metal dining rooms, and glass drinkers with a pacifier type and a capacity of 250 mL. The cages also had a funnel-shaped tray to collect feces and urine separately.

### 2.3. Animals and experimental diets

Ten three-month-old male guinea pigs from an enhanced lineage type I, with an average weight of 825.5 g, were used. They were obtained from the Research and Social Projection Program [RSPP] of Meat from UNALM.

The animals were divided into two groups of five and fed the experimental diets exclusively, with no additional forage, to strictly control the composition of ingested nutrients:

- Basal diet: 100% wheat by-product.
- Experimental diet: 40% grounded paprika (*Cap-sicum annum L. var. longum*) and 60% wheat by-product.

The ground paprika was initially dried in the shade, then further dried in a stove before being ground at the Laboratory of Drying and Grinding of the Faculty of Animal Science.

### 2.4. Experimental period

The experiment consisted of two periods. The first was a seven-day adaptation period, during which the level of wheat by-product was gradually reduced, and

the inclusion of ground paprika in the experimental diet was increased. Five animals of the control group were fed exclusively on wheat by-product during this period. The second was a five-day period and corresponded to feces collection. During this time, daily diet consumption was recorded, and feces were collected.

### 2.5. Consumption record and sample collection

Feeding was calculated every 24 hours through the difference between fresh food and the residual. Collected feces were stored in polyethylene bags, weighed daily, and kept refrigerated until processing. An aliquot of 5 g was dried on a stove at 105 °C for 5 hours to determine the initial humidity. The rest was homogenized, dried, and ground to a particle size of 2 mm for proximate analyses.

### 2.6. Chemical analyses and digestibility

Chemical analyses of diets and feces were carried out according to the official methods from the Association of Official Agricultural Chemists (AOAC, 2016). The apparent digestibility coefficients of diets were calculated through the direct method. In the case of paprika, the apparent digestibility of diets was determined by the indirect method described by Crampton and Harris (1974). This procedure compared the digestibility of the basal diet with that of the experimental diet that has the ingredient of evaluation, allowing the estimation of the ingredient digestibility.

### 2.7. Digestible energy estimation

Diets, feces and paprika gross energies were estimated using the formula proposed by the Alimentation Équilibrée de Commeny [A.E.C.] (1978), using caloric factors of 5.70 for raw protein, 9.30 for ether extract and 4.10 for raw fiber plus nitrogen-free extract. From these values, the digestible energy of ground paprika was calculated following the recommendations of Crampton and Harris (1974).

## 3. Results and Discussion

### 3.1. Proximal chemical composition of ground paprika and feces

The ground paprika used in this article showed a high nitrogen-free extract (36.91%) and raw fiber (25.91%) contents in its proximate chemical composition, while ether extract was the least abundant component

(6.98%) (Table 2). These values correspond solely to the paprika batch used in this experiment and reflect its specific chemical composition, which could vary in function of the origin, maturity stage, dry conditions and storage.

Previous studies, such as that of Bravo-Delgado et al. (2024), have shown that the composition of dried huacle chili varies according to fruit color, highlighting the yellow type due to its high humidity levels ( $15.15 \pm 1.49\%$ ) and ether extract ( $14.67 \pm 1.16\%$ ) associated with the presence of carotenoids and phenolic compounds. The black type, however, showed the lowest ash content ( $6.51 \pm 0.13\%$ ) and protein ( $10.21 \pm 0.67\%$ ). These results are consistent with other vegetable by-products used in monogastric feeding, which are characterized by an important fraction of nitrogen-free extract (Castro Bedriñana et al., 2018; Sotelo et al., 2020).

According to the chemical composition of feces, differences were observed between animals fed the basal diet and those fed the experimental diet supplemented with ground paprika (Table 3). The feces of the experimental group showed a marked increase in raw fiber content (31.30% from 15.39%) with a reduction in raw protein levels (16.32% from 19.38%) and nitrogen-free extract (36.25% from 51.06%).

These changes are attributed to the lower digestibility of the experimental diet, which is consistent with its higher crude fiber content from paprika. Likewise, a decrease in nitrogen-free extract in the feces suggests higher excretion of structural non-digestible carbohydrates, possibly associated with the presence of lignified cellular walls and phenolic compounds.

### 3.2. Apparent digestibility of paprika

Apparent digestibility coefficients are presented in Table 4. The ether extract showed the highest value, reaching a digestibility of 89.32%, which demonstrates efficient utilization of the lipid fraction. This result was higher than the one observed in forages, such as *Mucuna pruriens*, whose digestibility was 60.18%, or maca stubble with 75.27% (Castro Bedriñana et al., 2018; Sotelo et al., 2020). In contrast, raw fiber showed the lowest digestibility (40.85%), a value considerably lower than those reported for tree species such as mulberry, which reached approximately 80%, and arboloco with nearly 89%. (Hurtado et al., 2012). This low fiber availability can be influenced by the presence of lignin and tannins in paprika, compounds that limit the degradation of structural polysaccharides (Rubio y Molina, 2016).

**Table 1.** Official methods used for proximate chemical analysis of diets and feces in the study.

Components	Method AOAC (2005)
Humidity	AOAC (2005), 950.46
Dry matter	By difference
Organic matter	By difference
Raw protein	AOAC (2005), 984.13
Raw fiber	AOAC (2005), 962.09
Ether extract	AOAC (2005), 2003.05
Ashes	AOAC (2005), 942.05
Nitrogen-free extract	By difference: 100 minus the determined analytes

**Table 2.** Proximate chemical analysis of ground paprika (% dry basis).

Components	Partially dry	Dry base
Humidity, %	6.45	0.00
Dry matter, %	93.55	100.00
Organic matter, %	83.92	89.71
Raw protein, %	18.62	19.90
Raw fiber, %	24.24	25.91
Ether extract, %	6.53	6.98
Ashes, %	9.63	10.29
Nitrogen-free extract, %	34.53	36.91

Apparent digestibility of dry matter obtained during this study was 69.77%, which is higher than the values reported for wheat by-product (65.3%) (Hidalgo & Valerio, 2020), matarraton (49.9%), and India grass (45.5%) (Hurtado et al., 2012). However, it was smaller than the value for corn gluten, which reached around 79%, and arboloco, with around 86.8%. The observed differences among ingredients could be attributed to the variation in fiber and lignin content, factors that limit the nutrient accessibility and degradation (Figueiredo et al., 2019).

Raw protein digestibility (86.76%) was high in comparison to that from *Mucuna pruriens* forage (74.02%) (Sotelo et al., 2020), maca stubble (68%) (Castro et al., 2018) and mulberry (74.9%) (Hurtado et al., 2012). However, it was slightly smaller than the values for matarraton (91.6%) and arboloco (87.7%). These results confirm that paprika offers protein with high digestibility. However, the presence of anti-nu-

tritious compounds, such as tannins, could limit its full utilization (Rubio y Molina, 2016). Regarding nitrogen-free extract, the digestibility (80.70%) was higher than that reported for maca stubble (77.8%) and for legumes such as *Pueraria phaseoloides* (48.21%) and *Stylosanthes guianensis* (55.15%) (Castro et al., 2018; Sotelo et al., 2016). These values confirm the potential of paprika as a source of soluble carbohydrates and rapidly available energy.

Digestibility of raw fiber (40.85%) was higher than the value found in legumes, such as *Pueraria phaseoloides* (17.84%) and *Stylosanthes guianensis* (18.5%) (Sotelo et al., 2016). However, the 40.85% value was smaller than that of mulberry (80%) and arboloco (89%) (Hurtado et al., 2012). The dry and ground processes could have influenced the enhancement of fiber accessibility, though its lignin and pectin insoluble content limit their exploitation (Benítez & Poveda, 2011).

**Table 3.** Chemical composition of guinea pig feces from animals fed the basal and experimental diets.

Components (%)	Feces – Basal diet	Feces – Experimental diet
Dry matter	100.00	100.00
Organic matter	91.55	89.71
Raw protein	19.38	16.32
Raw fiber	15.39	31.30
Ether extract	5.71	5.84
Ashes	8.45	10.29
Nitrogen-free extract	51.06	36.25

**Table 4.** Apparent digestibility coefficients of ground paprika (% dry basis).

Components	Digestibility coefficient	Variability coefficient
Dry matter	69.77	4.88
Organic matter	70.36	4.91
Raw protein	86.76	7.02
Ether extract	89.32	11.89
Raw fiber	40.85	12.53
Ashes	69.56	8.44
Nitrogen-free extract	80.70	3.48

**Table 5.** Estimated digestible energy of ground paprika (kcal kg<sup>-1</sup> DM).

Animal N°	Basal diet (kcal kg <sup>-1</sup> )	Experimental diet (kcal kg <sup>-1</sup> )	Ground paprika (kcal kg <sup>-1</sup> )
1	3,336.3	3,406.0	3,290.6
2	3,590.5	3,422.0	3,469.3
3	3,425.2	3,387.8	3,381.7
4	3,395.4	3,463.0	3,564.3
5	3,412.5	3,462.4	3,537.2
Average	3,431.9	3,428.2	3,448.6

Nitrogen-free extract showed a digestibility of 80.70%, which is a higher value to that observed on maca stubble (77.8%) (Castro Bedriñana et al., 2018) and other tropical legumes (Sotelo et al., 2016). This result shows that paprika contributes with an important fraction of nutrients potentially used by animals, which contributes to its energetic value in the diet.

### 3.3. Digestible Energy

In terms of digestible energy, ground paprika reached a value of 3,448.6 kcal kg<sup>-1</sup> MS (Table 5), which far surpasses that of wheat by-product (2,801 kcal kg<sup>-1</sup> MS) (Hidalgo y Valerio, 2020) and dry forage of *Mucuna pruriens* (2,610 kcal kg<sup>-1</sup> MS) (Sotelo et al., 2020). This high energetic value is related to its elevated digestibility capacity in protein and ether extract, as well as with the effect of processing on nutrient availability (García et al., 1997).

## 4. Conclusions

Estimated digestibility coefficients for ground paprika, obtained by the indirect method applied in the experimental diet, showed a high availability of raw protein (86.76%) and ether extract (89.32%), as well as an energetic value of 3,448.6 kcal kg<sup>-1</sup> MS. These results showed that paprika has a potentially significant contribution of energy and protein when used as an ingredient in guinea pig diets. However, low digestibility of raw fiber (40.85%) and the possible presence of non-nutritious compounds showed the need to evaluate optimal inclusion levels in balanced diets and their impact on productive performance under practical feeding conditions.

### Contributor roles

- Gustavo Guerrero Torres: validation, writing – review & editing.
- Mary Flor Cesare Coral: investigation, writing – original draft.
- Ana Zela Apaza: validation, writing – review & editing.
- Edgar Norabuena Meza: validation, writing – review & editing.
- Marilyn Aurora Buendía Molina: writing – review & editing.
- Alejandrina Sotelo-Méndez: conceptualization, investigation, methodology, resources.

### Data availability

Data will be made available on request.

### Use of Artificial Intelligence

The authors declare that no artificial intelligence has been used in the preparation of the manuscript.

### Ethical Implications

The authors declare that the study was conducted in compliance with national and international animal welfare standards. The guinea pigs were managed under controlled conditions in metabolic cages, ensuring adequate supply of food and water, continuous health monitoring, and stress reduction during the experimental period.

The research was developed in accordance with Law No. 30407 – Peruvian Animal Protection and Welfare Law and its regulations (Supreme Decree No. 006-2017-MINAGRI), as well as following the principles of good livestock practices and international guidelines for the ethical use of animals in scientific research. The procedures applied were non-invasive and did not compromise the welfare or physiological integrity of the animals.

### Conflicts of Interest

The authors declare that they have no affiliation with any organization with a direct or indirect financial interest that could have appeared to influence the work reported.

### References

- Aliaga, L., Moncayo, R., Elizabeth, E., & Caicedo, A. (2009). *Producción de cuyes*. Fondo editorial UCSS. Lima, Perú. <https://www.ucss.edu.pe/publicaciones/produccion-de-cuyes>
- Alimentation Equilibree de Commentry [A.E.C.]. (1978). *Alimentación animal. Energía, aminoácidos, vitaminas y minerales* (Documento N° 4). Francia.
- Apráez-Guerrero, J. E., Gómez-Gómez, T. C., & Calpa-Tello, J. S. (2013). Comportamiento productivo de (*Cavia porcellus*) bajo sistemas silvopastoriles con gramíneas en clima templado del departamento de Nariño, Colombia. *Revista Investigación Pecuaria*, 2(2), 41–48. <https://revistas.ude-nar.edu.co/index.php/revip/article/view/990>
- Association of Official Agricultural Chemists [AOAC]. (2016). *Official Methods of Analysis of AOAC INTERNATIONAL* (13<sup>th</sup> ed.). AOAC. <https://www.aoac.org/official-methods-of-analysis/>
- Association of Official Analytical Chemists [AOAC]. (2005). *The Official Methods of Analysis* (18<sup>th</sup> ed.). AOAC. <https://www.aoac.org/official-methods-of-analysis/>
- Benítez, S. Y., & Poveda, C. A. (2011). Evaluación nutricional de ensilaje con diferentes niveles de inclusión de cáscara de naranja (*Citrus sinensis*) y digestibilidad *in vivo*, como alternativa energética para la alimentación de cerdos. *Revista Colombiana de Ciencia Animal*, 4(1), 20–28. <https://revistas.ut.edu.co/index.php/ciencianimal/article/view/139>
- Bravo-Delgado, C. H., Cejudo-Valentin, R., Díaz Orejón, E. T., Jaimes Rodríguez, A., & Bravo-Delgado, H. R. (2025). Características morfológicas, fisicoquímicas y químicas

- proximales de tres variedades de chile huacle (*Capsicum annum* sp), en estado fresco y seco de San Juan Bautista Cuicatlán, Oaxaca. *Ciencia Latina Revista Científica Multidisciplinar*, 8(6), 10350–10369. [https://doi.org/10.37811/cl\\_rcm.v8i6.15710](https://doi.org/10.37811/cl_rcm.v8i6.15710)
- Castillo-Aguilar, C. C., López Castilla, L. C., Pacheco, N., Cuevas-Bernardino, J. C., Garruña, R., & Andueza-Noh, R. H. (2021). Phenotypic diversity and capsaicinoid content of chilli pepper landraces (*Capsicum* spp.) from the Yucatan Peninsula. *Plant Genetic Resources: Characterization and Utilization*, 19(2), 159–166. <https://doi.org/10.1017/S1479262121000204>
- Castro Bedriñana, J., Chirinos Peinado, D., & Calderón Inga, J. (2018). Calidad nutricional del rastrojo de maca (*Lepidium peruvianum* Chacón) en cuyes. *Revista de Investigaciones Veterinarias Del Perú*, 29(2), 410–418. <https://doi.org/10.15381/rivep.v29i2.13405>
- Castro-García, A., & Nava, J. C. (2021). Uso de harina de gandum en la alimentación de cuyes de engorde en Milagro, Ecuador. *Revista Científica de La Facultad de Veterinaria*, 31(4), 141-146. <https://doi.org/10.52973/rcfcv-luz314.art3>
- Chávez-Tapia, I., & Avilés-Esquivel, D. (2022). Caracterización del sistema de producción de cuyes del cantón Mocha, Ecuador. *Revista de Investigaciones Veterinarias del Perú*, 33(2), 22576. <https://doi.org/10.15381/RIVEP.V33I2.22576>
- Chicaiza Sánchez, L. A., Gualavisi Pulamarin, S. P., Andrade Aulestia, P. M., Chacón Marcheco, E., & Garzón Jarrín, R. A. (2024). Caracterización de parámetros fenotípicos, morfométricos y evaluación productiva de *Cavia porcellus* procedentes de diferentes zonas del Ecuador. *Revista Científica y Tecnológica UPSE*, 11(1), 1–8. <https://doi.org/10.26423/rctu.v11i1.762>
- Choi, M.-H., Kim, M.-H., & Han, Y.-S. (2023). Physicochemical properties and antioxidant activity of colored peppers (*Capsicum annum* L.). *Food Science and Biotechnology*, 32(2), 209–219. <https://doi.org/10.1007/s10068-022-01177-x>
- Crampton, E., & Harris, L. (1974). *Nutrición animal aplicada*. Editorial Acribia. Zaragoza, España.
- Damián Quito, L. F., Martínez Alcívar, F. R., Zurita Vargas, S. J., & Mancero-Castillo, D. (2022). Evaluación del crecimiento de pastos Brachiaria en combinación con desechos verdes para la producción de cuyes (*Cavia porcellus*) en Milagro-Ecuador. *Pro Sciences: Revista de Producción, Ciencias e Investigación*, 6(46), 35–41. <https://doi.org/10.29018/issn.2588-1000vol6iss46.2022pp35-41>
- Figueiredo, R., Araújo, P., Llerena, J. P. P., & Mazzafera, P. (2019). Suberin and hemicellulose in sugarcane cell wall architecture and crop digestibility: A biotechnological perspective. *Food and Energy Security*, 8(3). <https://doi.org/10.1002/fes3.163>
- Food and Agriculture Organization of the United Nations [FAO] (2023). *FAOSTAT: Crops and livestock products*. FAO. <https://www.fao.org/faostat/en/#data/QCL>
- García J., Villamide M. J., & De Blas J. C. (2010). Energy, protein and fibre digestibility of paprika meal for rabbits. *World Rabbit Science*, 5(4), 139–141. <https://doi.org/10.4995/wrs.1997.333>
- González-Pérez, E., Villalobos-Reyes, S., Núñez-Colin, C., & Canul-Ku, J. (2025). Caracterización morfológica de líneas avanzadas de chile (*Capsicum annum* L.) del centro de México. *Agronomía Mesoamericana*, 36. <https://doi.org/10.15517/am.2025.61651>
- Hermitaño-Osorio, F., Meza-Rojas, E., Rodríguez-Vargas, A., Aquino-Tacza, A., & García-Olarte, E. (2024). Evaluación comparativa de un suplemento alimenticio artesanal y cuatro balanceados comerciales sobre la eficiencia productiva de cuyes parrilleros. *Revista de Investigaciones Veterinarias del Perú*, 35(4), e28780. <https://doi.org/10.15381/rivep.v35i4.28780>
- Hidalgo L., V., & Valerio C., H. (2020). Digestibilidad y energía digestible y metabolizable del gluten de maíz, hominy feed y subproducto de trigo en cuyes (*Cavia porcellus*). *Revista de Investigaciones Veterinarias del Perú*, 31(2), e17816. <https://doi.org/10.15381/rivep.v31i2.17816>
- Hurtado, D., Nocua, S., Narváez, W., & Vargas, J. (2012). Valor nutricional de morera (*Morus* sp.), matarratón (*Gliricidia sepium*), pasto indio (*Panicum maximum*) y arboloco (*Montanoa quadrangularis*) en la alimentación de cuyes (*Cavia porcellus*). *Veterinaria y Zootecnia*, 6(1), 56–65. <https://revistasoj.s.ucaldas.edu.co/index.php/vetzootec/article/view/4426>
- Kimura, B. K., LeFebvre, M. J., deFrance, S. D., Knodel, H. I., Turner, M. S., Fitzsimmons, N. S., Fitzpatrick, S. M., & Mulligan, C. J. (2016). Origin of pre-Columbian guinea pigs from Caribbean archeological sites revealed through genetic analysis. *Journal of Archaeological Science: Reports*, 5, 442–452. <https://doi.org/10.1016/j.jas-rep.2015.12.012>
- Krishna, M. M., Topno, S. E., & Bahadur, V. (2021). Estudios de variabilidad genética en chile (*Capsicum annum* L.). *International Journal of Chemical Studies*, 9(1), 2412–2415. <https://doi.org/10.22271/chemi.2021.v9.i1ah.11588>
- Miégoúé, E., Tendonkeng, F., Lemoufouet, J., Noubissi, M., Mweugang, N., & Zougou, T. (2016). Croissance pré-sevrage des cobayes nourris au *Panicum maximé* suplementado con una ración que contenga *Arachis glabrata*, *Calliandra calothyrsus* o *Desmodium intortum*. *International Journal of Biological and Chemical Sciences*, 10(1), 313–325. <https://www.ajol.info/index.php/ijbcs/article/view/141600>
- Mis-Valdez, Y. A., Pinto, M. J., Hernández, M., Garruña, R., Medina, K. B., & Andueza-Noh, R. H. (2022). Características fenotípicas, nutricionales y nutracéuticas de frutos de chile x'catik, dulce y su híbrido F1 (*Capsicum annum* L.). *Polibotánica*, (53), 183–195. <https://doi.org/10.18387/polibotanica.53.12>
- Naves, E. R., Scossa, F., Araújo, W. L., Nunes-Nesi, A., Fernie, A. R., & Zsögön, A. (2022). Heterosis and reciprocal effects for agronomic and fruit traits in *Capsicum* pepper hybrids. *Scientia Horticulturae*, 295, 110821. <https://doi.org/10.1016/j.scienta.2021.110821>
- Pigière, F., van Neer, W., Ansieau, C., & Denis, M. (2012). New archaeozoological evidence for the introduction of the guinea pig to Europe. *Journal of Archaeological Science*, 39(4), 1020–1024. <https://doi.org/10.1016/j.jas.2011.11.021>
- Reyes-Silva, F., Aguiar-Novillo, S., & Enríquez-Estrella, M. A. (2021). Análisis del manejo, producción y comercialización del cuy (*Cavia porcellus* L.) en Ecuador. *Dominio de las Ciencias*, 7(6), 1004-1018. <http://dx.doi.org/10.23857/dc.v7i6.2377>
- Rosenfeld, S.A., 2008. Delicious guinea pigs: Seasonality studies and the use of fat in the pre-Columbian Andean diet. *Quaternary International* 180, 127–134. <https://doi.org/10.1016/j.quaint.2007.08.011>
- Rubio, L. A., & Molina, E. (2016). Las leguminosas en ali-

- mentación animal. *Arbor*, 192(779), a315. <https://doi.org/10.3989/arbor.2016.779n3005>
- Sotelo, A., Contreras, C., Norabuena, E., Castañeda, R., Van Heurck, M., & Bullón, L. (2016). Digestibilidad y energía digestible de cinco leguminosas arbóreas forrajeras tropicales. *Revista de la Sociedad Química del Perú*, 82(3), 306–314. <https://doi.org/10.37761/rsqp.v82i3.84>
- Sotelo, A., Valenzuela, R., Césare, M., Alegría, C., Norabuena, E., Gonzáles, T., Paitán, E., Valderrama, M., & Echevarría, M. (2020). Determinación de la digestibilidad y energía digestible del forraje seco de terciopelo (*Mucuna pruriens*) en cuyes. *Revista de Investigaciones Veterinarias del Perú*, 31(1), e17537. <https://doi.org/10.15381/ri-vep.v31i1.17537>
- Torres Salazar, R., & Bardales Escalante, W. (2023). Eficiencia de las jaulas con cámara bioclimática en la crianza de cuyes (*Cavia porcellus*) en traspatio a nivel familiar. *Revista Científica Dékamu Agropec*, 4(1), 34-42. <http://portal.amelica.org/ameli/journal/744/7444325003/>
- Zhang, X., Chen, X., Dong, Y., Wang, S., Hu, Y., Ding, X., & Jia, D. (2023). Study on the agronomic traits and quality characteristics of new varieties of pod peppers hybridized with three lines. *Science and Technology of Food Industry*, 44(7), 311–319. <http://dx.doi.org/10.13386/j.issn1002-0306.2022060123>