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Apparent digestibility of dry matter and apparent digestible energy of native fruits consumed by tepezcuintles (*Cuniculus paca*) in captivity

Abstract

Eight adult male tepezcuintles (*Cuniculus paca*) were subjected to consumption tests of orange fruit (*Cítrus sinensis*), corn (*Zea mays*), papaya (*Carica papaya*) and Huaya (*Talisia olivaeformis*), to measure the apparent digestibility of dry matter (ADDM) and digestible apparent energy (ADE). The tepezcuintles were fed for periods of seven days with each food. Food consumption and feces production were measured during each period. The results showed that the tepezcuintles presented ADDM values from 81.1 to 97.5% with significant differences ($P < 0.05$) and the ADE was from 74.6 to 92.7%. A simple linear regression model was fitted between ADDM and ADE of the four foods ($P < 0.05$, $R^2 = 90.76$). It is concluded that specimens of *C. paca* in captivity show high ADDM and ADE through a direct and significant relationship between both, with fruits of the four native plant species.

Keywords: *Agouti paca*, *Cuniculus paca*, digestibility of dry matter, digestibility of energy, fruits, food, Tepezcuintle

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Introduction

The tepezcuintle (*Cuniculus paca*) is a large rodent that is found from Mexico to northern Argentina.[1] Due to the high quality of its meat, it has been intensively hunted, reaching amountsup to 1115 kg of meat, equivalent to 206 specimens sold in the market of a single town in Peru.[2] *Cuniculus paca* (*C. paca*) is a rodent with diverse eating habits (frugivore, granivore and folivore). Smythe et al.,[3] reported that the tepezcuintles consume forage of *Brosimum alicastrum*, *Cajanuscajan*, *Desmodium ovalifolium*, *Ficus* sp., *Faramea* sp., *Ipomea* sp., *Guazuma sp*., and *Bursera simaruba* bark, they even consume cooked or raw meat and fish, therefore this species is omnivorous. Martínez-Ceceñas et al.,[4] reported that the diet of wild tepezcuintles in the Lacandon jungle is made up of 20 plant species, which vary in consumption, depending on the time of year, being the mamey (*Pouteria sapota*), custard apple (*Annona reticulata*), avocado (*Persea americana*) and majunche banana (*Musa paradisiaca*) the most consumed fruits, which were also reported by Matamoros.[5–7]

Since they have the ability to take advantage of native food, even fibrous ones, such as the leaves of *B. alicastrum, Ficus* sp, *Faramea* sp, *Ipomea* sp, it led us to believe that the use of diets with native food could be a strategy to plan the feeding of tepezcuintles bred in captivity (3; 6), especially when one of the limitations shown by the tepezcuintle hatcheries in Costa Rica is its low profitability, the main factors causing this result are: high maintenance costs per feeding, infrastructure and breeding stock.[8] The aim of this work is to measure the apparent digestibility of dry matter and apparent digestible energy of four native fruits that are consumed by the tepezcuintles, corn (*Zea mays*), orange (*Cítrus sinensis*), huaya (*Talisia olivaeformis*) and papaya (*Carica papaya*).

Material and methods

Eight adult male tepezcuintles (*C. paca*) with live weight of 5.7 ± 0.8 kg were subjected to consumption tests at the Xmatkuil Wildlife Management and Conservation Unit, located in Mérida, Yucatán, México. These animals were housed in individual cages of 9 m^2, each enclosure containing a burrow, feeder, drinker and container for excreta. Food and water were offered daily, food residues and excreta were cleaned daily.

Four fresh fruits of corn on the cob (*Zea mays*), orange (*Cítrus sinensis*), huaya fructification (*Talisia olivaeformis*) and papaya (*Carica papaya*) were offered. The orange and papaya fruits were cut into small pieces and given to the animals for seven days, in 3 kg portions per animal, so that there was a rejection amount to measure the consumption by difference between what was offered and rejected. From the fourth day of treatment, feces were collected at the beginning of the day to measure their dry matter. Once the seven-day period was over, the food offer was changed for the next treatment, the same procedure was repeated. The samples of foodoffered and the collected feces were immediately kept frozen (-20 °C), until the total material collected in each treatment was collected. The samples collected daily were mixed to amount one portion per treatment, and dehydrated in an oven for 72 hours at 60 °C. An aliquot of dry matter (DM) from feces and foodwere subjected to gross energy analysis, by means of an adiabatic calorimeter (Parr Instruments, Illinois, USA).

The apparent digestibility of dry matter (ADDM) and apparent digestibility of energy (ADE) were calculated using the equations of 9:

$$ADDM = \frac{CDM - EDM}{CDM}(100) \qquad ADE = \frac{CGE - EGE}{CGE}(100)$$

CDM is consumed dry matter, EDM is excreted dry matter. CGE is consumed gross energy, EGE is excreted gross energy.

Statistical analysis

ADDM was compared between the four foods consumed by tepezcuintles, using one-way analysis of variance, and Tukey's method to contrast means. A linear regression model was fitted between ADDM and ADE, with the four foods tested.[10]

Results and discussion

Table 1 shows the values of voluntary consumption in dry matter (CDM), excreted dry matter (EDM), and apparent digestibility of dry matter (ADDM). Papaya and orange are the substrates with the largest CDM, followed by corn and huaya. The highest ADDM were with papaya and orange, showing significant differences between papaya vs huaya, papaya vs corn, and orange vs huaya (P<0.05).

Table 1 Consumed dry matter (CDM), excreted dry matter (EDM) and apparent digestibility of dry matter (ADDM) of four foods fed to tepezcuintle (*Cuniculus paca*) in captivity

Food	CDM (g/day)	EDM (g/day)	ADDM (%)
Citrus sinensis (orange) a	107.7 ± 16.5	9.2 ± 3.0	91.3 ± 6.9 (a, b, d)
Zea mays (corn) b	86.7 ± 10.5	10.9 ± 4.9	86.6 ± 6.9 (a, b, c)
Carica papaya (papaya) c	107.4 ± 10.3	3.7 ± 1.6	97.5 ± 1.0 (d)
Talisia olivaeformis (huaya) *d*	89.9 ± 26.1	16.7 ± 5.4	81.1 ± 10.2 (c)

Different literal in the same column indicates significant difference (P<0.05)

Table 2 shows the digestible energy coefficient corresponding to each food consumed by *C. paca*. ADE was high in papaya and orange. The fitted linear regression model is ADE = -8.69163 + 1.04787*ADDM is significant (P<0.05), with Coefficient of Determination of 0.9076, indicates that there is a significant relationship between ADDM and ADE (Figure 1).

Table 2 Apparent digestibility of energy (ADE) of four foods consumed by Tepezcuintles (*Cuniculus paca*) in captivity

Food	Consumed gross energy (kcal)	Excreted gross energy (kcal)	Apparent digestibility of energy (%)
Citrus sinensis (orange)	93.4	12.3	86.8
Zea mays (corn)	93.5	14.3	84.7
Carica papaya (papaya)	61.4	4.5	92.7
Talisia olivaeformis (huaya)	133.5	33.9	74.6

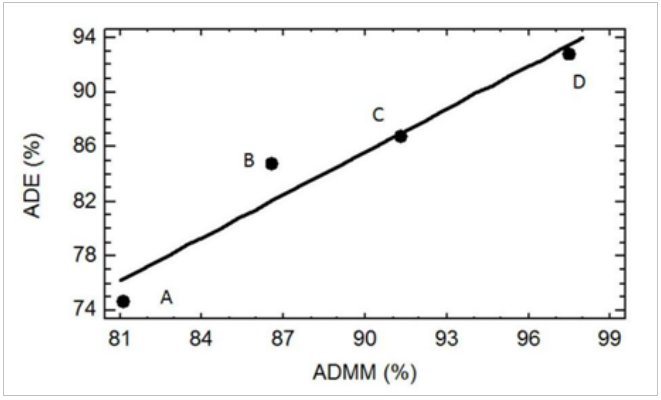

Figure 1 Linear Regression model ADE = -8.69163 + 1.04787*ADDM. (P<0.05, R^2 = 0.9076), in orange fruits C (*Citrus sinensis*), corn B (*Zea mays*), papaya D (*Carica papaya*) and huaya A (*Talisia olivaeformis*).

Orange, papaya and huaya show the highest levels of CDM, all exceeding 80 g/day. It is also noted that ADDM for orange, corn and papaya have values above 85% being lower for huaya, which can be considered highly digestible for monogastrics.[11] However, 3 indicates that tepezcuintles also consume foliage of *B. alicastrum*, *D. ovalifolium*, *Ficus, Faramea* sp, this suggests that tepezcuintles may have the ability to digest and absorb food material and water at the cecum and colon level, like non-ruminant herbivores.[12] The ADE values of native fruits showed that tepezcuintles are efficient at assimilating these foods, which are the most frequently grown in rural areas even in the backyard. It is known that tepezcuintles prefer to consume food when energy is high, regardless of the amount of carbohydrates, proteins or lipids,[13] therefore they will prefer food in which they may have greater efficiency in energy absorption, such as that obtained in orange, corn and papaya. Although ADE of a food does not indicate the total use of energy by the animalthat ingests it, but provides an idea of the possible use of the energy that the food may have when it is ingested by tepezcuintles.[14]

ADE shows that the largest are for papaya, orange and corn, the smallest for huaya, this trend is similar to ADDM, therefore the linear regression model presented a positive and also significant linear relationship with high coefficient of determination. Corn, orange and papaya have the highest values in starches and sugars, between 48.4 and 78.6% respectively[15] but huaya contains 20.49% (16), this largely explains why tepezcuintle more efficiently take advantage of sugar-rich food (orange, corn and papaya) in the same way as other species of frigovorous or non-ruminant folk animals such as spider monkeys *Ateles geoffroyi*.[16]

Conclusion

Cuniculus paca tepezcuintles in captivity show high apparent digestibility values of dry matter and apparent digestibility of energy, which are directly and significantly related, when consuming orange fruits (*Citrus sinensis*), corn(*Zea mays*), papaya(*Carica papaya*) and huaya (*Talisia olivaeformis*).

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Conflicts of interest

Authors declare that there are no conflicts of interest.

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