Consumption of diets based on native forages, pumpkin and corn by collared peccary (*Pecari tajacu*)

ABSTRACT

Aims: To evaluate the effect of the consumption of corn-based diets with *Brosimum alicastrum* or pumpkin (*Cucurbita sp*) forage on live weight, number of erythrocytes and leukocytes and serum urea nitrogen of collared peccaries (*Pecari tajacu*) in captivity the study was carried out.
Study design: A comparative longitudinal experiment of four treatments with repeated measures design was applied.
Place and Duration of Study: Xmatkuil Wildlife Conservation Management Unit, in Mérida, Yucatán, Mexico, for three months.
Methodology: Nine adult female collared peccaries (*Pecari tajacu*) were subjected to voluntary consumption of the following diets: T1: Diet with 60% corn meal and 40% dry *B. alicastrum* forage, T2: Diet with 40% corn and 60% dry *B. alicastrum*, T3: Diet with 60% corn and 40% fresh pumpkin on dry matter basis, T4: Diet with 40% corn and 60% fresh pumpkin, for 14 days for each treatment. The dry matter intake of each treatment, live weight, number of leukocytes, erythrocytes and serum urea nitrogen in each of the specimens were measured. Response variables in each treatment were compared with repeated measures ANOVA or Friedman's test if parametric analysis requirements were not met.
Results: There was no significant difference between live weights in each treatment (P=05) but there was a significant difference in dry matter intake between treatments. There was no significant difference in erythrocyte levels between treatments. There was no difference in leukocyte levels between treatments (P=0.05), but there was a difference in the means of urea nitrogen between treatments.
Conclusion: Pumpkin diets with corn show higher levels of dry matter intake, higher levels of urea Nitrogen and a greater number of erythrocytes than diets with corn and dry *B: alicastrum*, so it is suggested that diets with pumpkin and corn are more suitable than with corn and dry *B. alicastrum*.

Keywords: Collared peccary, diets, blood variables, native forage consumption, Pecari tajacu

1. INTRODUCTION

Mexico is one of the countries with high biodiversity, and wildlife is part of this valuable natural capital, since pre-Hispanic times it has provided benefits to native American, because it is an alternative source of protein for rural populations today, for this reason, it should be considered as a resource on which some rural communities in Mexico and also Latin America depend [1].

Collared peccary (*Pecari tajacu*) is an important wild mammal in American continent. This species has been bred in Mexico through intensive Management Units for Wildlife Conservation (UMA) or in Farms and Facilities for Wildlife Management (PIMVS) [2]

There are several objectives that breeders of *P. tajacu* have in intensive UMA, that is, animals in captivity, among which are the generation of breeding stock, meat and skin production [1].

Populations of *P. tajacu* reared in captivity require adequate feeding programs to generate satisfactory productive and reproductive indicators, and also to reduce feeding costs, which represent around 77% of total costs [3]. Therefore, it is necessary to plan diets based on native feeds in combination with corn. In this way the use of local vegetables resources is optimized, of which free populations have been maintained, especially since this species has been considered pseudo-ruminant [4] and therefore it is convenient to test different mixtures of forage substrates.

The variety of feed sources offered by the vegetation of the sub-humid tropical forest of Yucatan is ample. One example is the foliage of the ramón tree (*Brosimum alicastrum*) of the Moraceae family, which is slow growing, but reaches up to 30 meters in height, its trunk is straight, generally with well-formed branches, these are ascending, from which its fruits hang, the cup has a pyramidal shape and is very thick [5].

The foliage of this tree is used for feeding herbivorous mainly ruminants [6]. Another very common feedstuff in the region is the pumpkin (*Cucurbita sp*), the fruit of this plant is well accepted as feed for the collared peccary [7].

The objective of this research was to evaluate the effect of four treatments formulated with a combination of ground corn with dry *Brosimum alicastrum* forage or fresh pumpkin (*Cucurbita sp*) on live weight changes, number of erythrocytes, leukocytes and serum urea nitrogen in nine adult specimens of *Pecari tajacu* kept in captivity.

2. MATERIAL AND METHODS

2.1 Study site

The work was carried out in the Xmatkuil Wildlife Conservation Management Unit, in Yucatan, Mexico. The climate is tropical warm subhumid with rains in summer and intermittent in winter [8].

2.2 Experimental animals

Nine adult females of *Pecari tajacu* were tested in four diets. The average live weight of the animals was 21 + 2.5 Kg, with ages from 2 to 3 years.

2.3 Experimental phase

The preliminary phase was carried out with animals under voluntary consumption of ground corn for 14 days, to measure the average consumption per day and per animal. Subsequently, four diets were tested for 14 days each, according to table 1. Throughout all the treatments, the animals had free access to fresh water inside the pen.

Table 1. Content of each diets to which nine adult female Collared Pecari (*Pecari tajacu*) were subjected in captivity, during 14 days of each treatment

Diets	Ingredients

T1	60% corn (*Zea mays*) and 40% dry fodder of *Brosimum aliscatrum*
T2	40% corn and 60% dry fodder of *Brosimum alicastrum*
T3	60% corn and 40% pumpkin fruit (*Cucurbita sp*)
T4	40% corn and 60% pumpkin fruit (*Cucurbita sp*)

At the end of each treatment, blood samples were collected and the weights of each animal were measured. For blood sampling, sedation was applied by intramuscular injection of Ketamine 10% at a dose of 20 mg per kilogram of live weight. The blood collection of 1 ml was by puncture of the external saphenous vein. Each blood sample was fractionated to measure the amount of leukocytes, erythrocytes and serum urea nitrogen.

2.4 Statistics analysis

The effect of the diets on the response variables: dry matter intake of each treatment or diet, live weight, number of erythrocytes, leukocytes and serum urea nitrogen, were evaluated with the repeated measures Analysis of Variance (ANOVA) method, if the data present normal distribution and homocedasticity, otherwise Friedman analysis was applied for related samples with the SPSS 11.5 statistical package [9]. Paired comparisons based on the medians were made according to [10].

3. RESULTS AND DISCUSSION

The mean ranks and arithmetic means of live weights in the four diets are shown in Table 2. The Friedman analysis was applied since the normality requirement was not met, there are no significant differences between the diets.

Table 2. Mean ranks and arithmetic means of live weights between the 14-day diets of each one, in nine *Pecari tajacu*

Diets	Mean Rank of Live Weight	Arithmetic Mean of Live Weight in Kg
T1	2.83 a	20.61
T2	1.83 a	20.06
T3	3.11 a	20.67
T4	2.22 a	20.28

Same literal indicates that there is no significant difference (P=0.05)

Table 3 shows the consumption in dry matter of each diet in peccaries. The Friedman test was applied because the normality requirement was not met.

Table 3. Mean ranks and arithmetic means of consumption in dry matter between the diets of 14 days of duration of each one, in nine *Pecari tajacu*

Diets	Mean rank of consumption in dry matter	Arithmetic mean of consumption in dry matter in kg
T1	1.00 a	0.023
T2	2.00 a	0.111
T3	3.44 b	0.238
T4	3.56 b	0.235

Same literal indicates that there is no significant difference (P=0.05)

Table 4 shows the means and standard deviations of the amounts of erythrocytes in the blood and the result of the contrast between treatments, by repeated measures ANOVA because the requirements of the statistical model were met.

Table 4. Mean numbers of erythrocytes in blood of collared peccary (*P. tajacu*), fed with diets of Maize (*Zea mays*) in combinations with *B. alicastrum* and *Cucurbita sp*

Diets	Mean number of erythrocytes (millions/mm^3)	Standard deviation (millions/mm^3)
T1	7.19 a,b	1.63
T2	5.90 a	1.02
T3	6.00 a	1.48
T4	8.52 b	1.64

Same literal indicates that there is no significant difference (P=0.05)

Table 5 shows the amounts of leukocytes in the blood of peccaries in each treatment. The Friedman test was applied because the normality requirement was not met.

Table 5. Mean ranks and arithmetic means of the number of leukocytes in the blood of collared peccary (*Pecari tajacu*), fed with diets of Maize (*Z. mays*) in combinations with Brosimum alicastrum and *Cucurbita sp*

Diets	Mean rank of the number of leukocytes/mm^3	Arithmetic mean of the number of leukocytes/mm^3
T1	3.17 a	12483.33
T2	3.00 a	12816.67
T3	1.58 a	10233.33
T4	2.25 a	11650.00

Same literal indicates that there is no significant difference (P=0.05)

Table 6 shows the results of the serum urea nitrogen level of peccaries in each diet group. Repeated measures ANOVA was applied because the model requirements were met.

Table 6. Means of serum urea nitrogen in collared peccary (*Pecari tajacu*), fed with diets of Corn (*Z. mays*) in combinations with *B. alicastrum* or *Cucurbita sp*.

Diets	Mean Serum Ureic Nitrogen Levels (mg/dl)	Standard deviation (mg/dl)
T1	8.67 a	3.02
T2	7.09 a	3.49
T3	13.91 b	3.87
T4	11.00 b	1.85

Same literal indicates that there is no significant difference (P=0.05)

The live weights of the specimens throughout the days that each treatment lasted, presented slight variations, which were not significant, so the diets used provide the amount of crude protein (CP) for maintenance; the minimum CP requirement in peccary is 5.4% [11]. The pumpkin provides 9.3% CP in the shell, 32.7% in the seed and 3.8% in the pulp [12], the foliage of *B. alicastrum* provides 13.27% CP [13].

The dry matter intakes of diets T1 and T2 were lower than T3 and T4, the latter containing fresh pumpkin, in combination with 60 and 40% corn inclusion, respectively. Possibly the preference is due to the digestibility of the forage feed, [14] reports that in collared peccary there is an inverse relationship between apparent total digestibility of the digestive tract with the content of dry matter and organic matter in diets with high forage content fibrous, in this aspect the pumpkin has higher digestibility, 80% for crude fiber in sheep [15] and *B. alicastrum* of 45.4% of neutral detergent fiber in rabbits [6]. This comparison is valid because *P. tajacu* is considered pseudo-ruminant [4] and has crude fiber digestibility intermediate between cattle and pigs [16], because it has a forestomach and generates volatile fatty acids throughout the digestive system, but it does not ruminate, it can also use urea as a source of non-protein nitrogen in the diet [17].

The variations in the concentrations of erythrocytes were not significant between T1, T2, T3 nor with T1 vs T4, but is significant between T4 vs T2 and T3. T1 and T4 contain different combinations including corn with *B. alicastrum* and pumpkin, respectively. It would be expected that the highest values of erythrocytes would be with T3 and T4, but this did not happen, only T4 presented what was expected, according to the consumption and apparent digestibility of each ingredient reported in the literature, which appear in table 2. However, the arithmetic means are similar and even higher than those reported by [18], which range from 5.4 ± 0.2 to $6.7 \pm 0.2 \times 10^6$ erythrocytes/mm^3 in the summer season. [19] report that peccaries subjected to diets with high crude protein (CP) and digestible energy (DE) contents (15.2% CP and 3300 kcal ED/kg) presented erythrocyte concentrations of 7.37 and $7.5 \pm 0.21 \times 10^6$ cells/mm^3, respectively, compared to peccaries fed a low quality diet (6.3% CP and 1921 kcal DE/kg) with values of 6.19 ± 0.19 and $5.99 \pm 0.30 \times 10^6$ cells/mm^3, however [20] report that in winter the values change from 7.0 ± 0.2 to $7.4 \pm 0.2 \times 10^6$ cells/mm^3, therefore the season of the year and the amount of PC and ED in the diets can modify the hematological values in the southern United States of North America, so apparently there is no affectation of the treatments T1, T2, T3, but there is an increase in erythrocytes with T4 during the study period, probably because T4 has a high protein value provided by the pumpkin in the shell and seed and with high digestibility according to the literature.

The amounts of leukocytes between the treatments did not show a significant difference; however, T3 shows a tendency to present the lowest mean values, although the rest of the treatments are similar to that reported for peccaries by [18], mentioning concentrations of 13.1 to 15.7×10^3 cells/mm3. [20] report a mean of $13.1 \pm 1.2 \times 10^3$ to $10.7 \pm 0.9 \times 10^3$ cells/mm^3 for females in captivity in the summer season, which are values similar to those obtained in this study but in warm sub-humid climate conditions.

It is notable that blood urea nitrogen levels are higher for T3 and T4 containing pumpkin rather than *B. alicastrum*. Blood urea nitrogen is an indicator that is used to evaluate the supply of protein in the diet [21], the values quantified in peccaries fed with T3 and T4 are higher than that reported by [22] with peccaries fed diets high in CP (16%) and digestible energy (3300 kcal/kg), which showed values of 8.2 ± 1.2 to 10.2 ± 1.9 mg/dl. Even the diets T1 and T2 showed higher values than those reported by these same authors, with diets containing a moderate amount of CP (8.4%) and digestible energy (2300 kcal/kg), the values reported for blood urea nitrogen by these authors varied from 3.0 ± 0.6 to 5.5 ± 0.3 mg/dl. These results suggest that all the treatments offered provide the necessary nutrients for the maintenance of collared peccaries in captivity in sub-humid tropical conditions, according to what was reported by [1] who evaluated the ovarian cyclicity of peccaries during 35 days in animals subjected to diet consumption with *B. alicastrum* silage, pumpkin and corn or diet with corn and pumpkin only, found no significant difference in blood progesterone levels nor in the number of ovarian cycles in collared peccaries.

4. CONCLUSION

The diets that contain maize in combinations with *B. alicastrum* and pumpkin in proportions of 60 and 40% of each one, do not show affectation in the live weight, nor number of leukocytes, but those that contain pumpkin in different proportions exceed in number of erythrocytes and blood urea nitrogen to those containing *B. alicastrum*. It is suggested that diets containing maize and pumpkin are more suitable than maize and *B. alicastrum* for feeding *P. tajacu* in captivity.

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