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Evaluation of the consumption of two integral diets for psittacines in captivity in a wildlife rescue unit

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ABSTRACT

Objective: To evaluate the consumption of nutrients intake in a traditional and a proposed diet for parrots in captivity.

Design/methodology/approach: The study took place at Pachuca de Soto, Hidalgo, Mexico. Twelve parrots were assessed in captivity. The traditional diet (TD) provided to the birds was evaluated and a proposed diet (PD) was the alternative. The consumption and the amount of waste of each diet were recorded for five weeks. PD formula contained fruits, vegetables, and seeds. Data were analyzed with the Student's t-test at $p<0.5$ significance.

Results: TD lacked homogeneity in the ingredients offered during the five weeks evaluation. There were significant differences in the consumption between the two evaluated diets. The individual bird consumption was 349 g for TD and 314 g for PD. The TD was 41.87% fruits and 58.12% vegetables. The PD diet included seeds supplements. From the second to the fifth week of the evaluation PD had less waste.

Limitations of the study: The age, weight, sex and excreta collection from the parrots were not registered due to restriction rules in the conservation area.

Findings/conclusions: The PD offered the requirements that parrots need. It is necessary to train technical personnel on diet preparation. Feeding frequencies and food diversity stimulated consumption and waste decreased, improving the nutritional balance of the birds in captivity.

Keywords: Parrots, consumption, captivity, alternative diet.

INTRODUCTION

The Psittacidae (*Psittacidae*) are a family of birds of the order *Psitaciforme*. They include 86 genres with 353 species, most of which distribute in the tropics and are classified into three families: *Loriidae*, *Cacatuidae* and *Psittacidae* (Ravazzi and Conzo, 2008). These birds, commonly known as parrots and macaws, are characterized by their large hooked beaks and zygodactyl feet

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(fingers two and three forward and one and four back). *Psittacines* are a gregarious species, most of the time they are seen in pairs or large groups (Recalde and Vinueza, 2013). *Psittacines* are one of the taxonomic groups that have the greatest trafficking of species problem. These are generally extracted from their natural environments and if recovered, placed in rehabilitation centers or zoos, the management of these individuals in captivity are of vital importance.

Knowledge and implementation of adequate nutrition and feeding programs for *psittacines* is necessary to maintain or improve their well-being in captivity conditions (Jiménez, 2008). The amount of nutrients required by these birds depends on their metabolic demand for the maintenance of their body mass in relation to the physiological stage in which each individual is (Soto-Piñerido and Bert, 2011). Birds in free natural conditions, tend to expend excess energy, since they are constantly active, feeding and flying (O'Malley, 2007). In captivity, feeding is essential to maintain their usual body and physical processes according to their species. Supplying food, not containing or exceeding the amount of necessary nutrients, can predispose them to the appearance of nutritional disorders and diseases (Fowler and Miller, 2011). In Mexico, there are many *psittacines* under human care, for either research, rehabilitation, reproduction, conservation or exhibition (Engebretson, 2006). As an alternative response to their extinction threat, zoos and rescue centers must develop and implement conservation and feeding strategies in their available habitats (Collados, 1997). The objective of the present study was to evaluate the consumption of the nutrient intake in a traditional diet, compared to an alternative diet. The latter through the formulation and proper management of wild birds in captivity.

Figure 1. Alternative diet with fruits and vegetables in a plastic bucket.

MATERIAL AND METHODS

The study took place at the first "Unidad de Rescate, Rehabilitación y Reubicación de Fauna Silvestre, Endémica y Exótica de México" (Unit for the Rescue, Rehabilitation and Relocation of Wild, Endemic and Exotic Fauna in Mexico URRRFSM+), which shares public spaces with the "Parque Infantil Bioparque Convivencia" at Pachuca de Soto Hidalgo, Mexico. Located in the Central-Eastern part of Mexico, at an altitude of 2400 m (20° 06' 59.6'' N and 98° 44' 45.1'' W) and a mean annual temperature of 25.4 °C.

The URRRFSM contains 12 *psittacines* specimens of five species of undetermined sex. The *psittacines* enclosure is a closed place where all the specimens in the study are housed, its shape is rectangular measuring 4.30 m wide × 15 m long × 8 m high in its highest point and 6 m in its lowest.

Study design

The consumption and food waste of the traditional diet (TD) were evaluated for five weeks. After this period, a new ration, the alternative diet (AD) was formulated; the birds were adapted for a week to the new diet and from then on, the consumption and amount of waste were again recorded for another five weeks. The eating habits and routine during the TD offering period occurred daily. The birds were fed daily at 9:00 am in a feeder inside the unit. The AD was formulated with first quality fruits and vegetables, preserved in refrigeration. (Figure 1). Table 1 shows the content of both diets. The food was cut into homogeneous 2×2 cm pieces and placed in a plastic bucket.

Table 1. Diets provided to psittacine in captivity.

Traditional Diet (TD)*		Alternative Diet (AD)*	
Ingredient	g 100 g^{-1}	Ingredient	g 100 g^{-1}
Raw corn	33.10	Tabasco Banana	18.18
Banana	14.71	Papaya	13.64
Apple	13.57	Apple	13.64
Melon	13.57	Melon	13.64
Broccoli	10.13	Raw corn	22.72
Spinach	6.31	Beet	4.54
Celery	4.40	Spinach	4.54
Chard	4.21	Seed concentrate*	9.10

* .- wet base ** Seed concentrate (g kg^{-1}): oats 0.21, peanuts 0.08, sunflower 0.08, wheat 0.21, sorghum 0.21, millet 0.21.

During both diets preparation, all food was weighed with an Avery Berkel® DZ342 electronic scale with a 15 kg total capacity. The food supplied was weighed daily and during the morning of the next day, the excess food was collected, weighed and the daily consumption of the birds estimated. The leftover food was collected with a spare mesh placed on the cage floor, below the perches.

The nutritional value of the provided diets was determined with the UFFDA® software designed for formulation and estimation of nutritional requirements, specific for *psittacines*. Before the calculations, the dry matter content (AOAC, 1990) of the ingredients was determined, dehydrating it in an oven at 65 °C for 24 h. The obtained information was entered into the program to increase the precision of the nutritional requirements.

Figure 2. Alternative diet of seed concentrate offered at 1:00 p.m.

The AD included a complement with concentrated oat seeds in grain, peeled peanuts, sunflower seeds, wheat, sorghum and white millet. This mix was kept stored at the Nutrition Center, where the required daily portion was taken from. (Figure 2). The distribution of the AD was as follows: at 9:00 a.m. a portion of chopped fruits and vegetables and at 1:00 p.m. the portion of seeds. The percentage of the content of the ingredients in the AD was made up of 59.09% fruits, 31.81% vegetables and 9.09% seeds.

Statistical analysis

The data were grouped in a spreadsheet in the Excel software. The data analyzed with a T-Student test in the IBM-SPSS statistical software (V. 21). The means comparison was made between the TD *vs*. AD group of the same week or time with a 0.5 significance.

RESULTS AND DISCUSSION

The nutritional value of the diets is shown in Table 2. The *psittacines* requirements are limited. Jiménez (2008) mentions that the amounts of protein for maintenance, growth and reproduction ranges between 15, 19 and 20%, and the amounts of fat and fiber should not be greater than 5%. Regard mineral contribution, the phosphorus (P) in both diets is greater than calcium (Ca); however, it is important to mention that these birds are also fed a compact solid biscuit, which contains a high amount of calcium and some vitamins. The birds freely consume them and with it, balance the Ca: P ratio in a 2:1 ratio.

During the study, the TD lacked homogeneity of the ingredients offered during the day. Variations were recorded regarding the size and portion of the ingredients, due to the lack of technical-operational knowledge of the personnel who prepared the rations. These inappropriate practices are common when there is either ignorance or lack of training (Cisneros, 2006), providing quantities greater than that of daily needs. Table 3 shows the daily consumption recorded for the n=12 bird specimens kept in the enclosure. There were significant differences in consumption during the five weeks of study (P<0.01). The individual consumption of each bird was on average 349 g for TD and 314 g for AD as wet consumption.

The higher TD consumption was possibly due to its lower nutritional contribution compared to AD. Additionally, on some occasions one ingredient was increased instead of another, the justification been the lack of some ingredient. Likewise, a common criterion of

Table 2. Nutritional balances estimated using the UFFDA® software in two diets provided to psittacines in captivity.

Nutritional Requirements	Traditional diet	Alternative diet	Concentrated seeds	Unit
Balance	Amount			
E Metabolizable	4.6776	6.8960	4.2529	Mcal/g
Protein	18.53	16.76	15.0025	%
Fat	3.24	4.43	10.6530	%
Calcium (Ca)	0.25	0.26	0.0758	%
Phosphor (P)	0.36	0.61	0.4860	%
Vitamin A	1397691	5208520	0.5300	UI/Kg
Vitamin E	2556496	559100	0.0094	mg/Kg

The proposed diet analysis includes the added percentage of the seed concentrate.

Table 3. Registered behavior of the food consumed for two evaluated diets in captive *psittacines*.

Period (Weeks)	Traditional Diet (TD)		Alternative Diet (AD)		P
	Mean	SD	Mean	SD	
I	4.102	0.128	3.366	0.082	<0.01
II	4.306	0.059	3.770	0.166	<0.01
III	4.176	0.046	3.882	0.039	<0.01
IV	4.214	0.044	3.910	0.056	<0.01
V	4.144	0.046	3.898	0.030	<0.01

SD: standard deviation.

the caretakers included that if some ingredient was not palatable, was not included in the ration.

During the development of the study, the TD contained 41.87% fruits and 58.12% of vegetables. However, sometimes rations were modified due to each operational technician criteria; This attitude generated an imbalance in the nutritional content and increased food waste (Table 4). During the study, development vegetables were the ingredients most left by the birds. Most of these ingredients had problems in their reception and preservation, therefore, it was common that they are rejected during the offering and consumption. Lawton (1988) recommended the use of fresh ingredients, Noriega and Lozano (2008) suggest feeding the birds more than twice a day, to stimulate consumption and reduce confinement depression.

The AD included supplementation of a seed concentrate necessary for these species (Noriega and Lozano, 2008). The AD offered a feeding alternative, consisting of two times, in the morning fruits and vegetables chopped in pieces, and in the afternoon the seed concentrate. When the size of the ingredients is homogeneous, the birds tend to show a greater taste for certain foods. Therefore, taking care of the size of the feed avoids selectivity (Sciabarrasit, 2016). The birds had good acceptance and better welfare, as well as the good acceptance for the consumption of the offered portions, as mentioned by Noriega and Lozano (2008). During the week of adaptation to the AD, rejections were immediately registered; however, the gradual change led to the immediate adaptation of the animals (Recalde, 2013). It should be noted that *psittacines* are sensitive to diet changes and this should be gradually done. Most *psittacines* spend 50% of their time searching for food (Jiménez, 2008), which causes considerable energy expenditure. It is reported that they can spend from four to six hours a day foraging, traveling several kilometers looking for places to feed on different sources (Meehan *et al*., 2003). The practices of offering the same diet or different diets can affect or improve the provided food consumption, it is important to encourage the bird's well-being when these are in confinement (Dierenfeld and Graffam, 1996).

Table 4 shows the registered food surpluses. During the first week, there was higher wastage in AD (P<0.01), attributed to the sequelae of the adaptation to the new diet. However, from weeks two on, there was less waste, this behaviour is attributed to a greater adaptation to the food and palatability of their ingredients.

The factors involved in the consumption and food refusal are diverse, mainly due to stress, the environment, and the freshness and variability of the food. Studies of *psittacines* in free life, indicate the ability of these birds to discriminate differences in the nutrient's concentration, allowing them to choose between fruits from different plants (Matson and Koutsos, 2006). While, in captivity, they do not exhibit this ability to select the ingredients of their diets, showing a notable preference for food with high energy content (McDonald, 2006). The recorded surpluses in the AD indicate that it is the best way to offer the food. The birds were kept busy feeding for a longer time and the surpluses percentage decreased. The results in this research allow visualizing that the AD decreased ingredients selection and facilitated their intake. *Psittacines* in captivity are characterized for choosing what to eat based on individual preferences for a certain food, regardless of its nutritional value (Recalde, 2013).

Table 4. Recorded surpluses of two diets evaluated in twelve psittacines birds in captivity.

Period (Weeks)	Traditional Diet		Alternative Diet		P
	Mean	SD	Mean	SD	
I	0.455	0.144	0.524	0.082	<0.01
II	0.380	0.055	0.326	0.169	<0.01
III	0.428	0.049	0.271	0.039	<0.01
IV	0.441	0.053	0.264	0.044	<0.01
V	0.527	0.058	0.263	0.032	<0.01

SD = Standard deviation.

CONCLUSIONS

It is important to evaluate the diets offered in the places where birds are kept in captivity, considering that these provide the needed daily requirements. It is necessary to train operational technical personnel in the preparation of the diets and involve behavioural studies in the birds to avoid feeding-related problems. Feeding frequencies and the diversity of the food such as vegetables, fruits and seeds, stimulate the consumption, reduces waste and improve the nutritional balance of birds in captivity.

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