Comparison of methods for determination of nutrient
digestibility of a dry kibble diet for ocelots

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ABSTRACT.- Carvalho A.L., Oliveira V., Moraes W., Cubas Z.S., Rinaldi A.R., Oliveira M.J., Almeida R.P. & Bordignon L.A.F. 2013. **Comparison of methods in the determination of nutrient digestibility of a dry kibble diet for ocelots.** Pesquisa Veterinária Brasileira 33(Supl.1):71-74. Hospital Veterinário, Universidade Federal do Paraná, Campus Palotina, Rua Pioneiro 2153, Palotina, PR 85950-000, Brazil. E-mail: andersoncarvalho.mv@gmail.com

In this experiment, methods of total fecal collection (TFC) and internal markers (acid-insoluble ash - AIA, crude fiber - CF, and acid-detergent fiber - ADF) were compared for determination of the coefficients of apparent digestibility (CAD) for dry matter (DM), crude protein (CP), ether extract (EE), nitrogen-free extracts (NFE), and gross energy (GE) of commercial feline dry kibble for ocelots (*Leopardus pardalis*). Six adult animals, weighing 12.45 ± 1.37 kg, gradually received experimental kibble in their usual diet until the beginning of the experiment and were submitted to an adaptation period ten days prior to the collection period. CAD obtained by TFC, AIA, CF, and ADF were, respectively, 73.7, 76.83, 62.01, and 46.03% for dry matter; 81.9, 84.8, 75.8, and 63.8% for crude protein; 85, 86.7, 78.5, and 69.1% for ether extract; 78.52, 79.55, 69.11, and 53.04% for nitrogen-free extracts; and 80.5, 82.2, 71.4, and 58.4% for gross energy. The AIA method showed to be efficient in determining coefficients of apparent digestibility and may contribute to investigations on the digestibility of diets for wild felines. In comparison to the items of ocelot’s usual diet, the kibble used in this paper provided an adequate nutritional supply with reduced daily costs per animal.

INDEX TERMS: *Leopardus pardalis*, acid insoluble ash, crude fiber, acid detergent fiber, total fecal collection.
INTRODUCTION

In the last decades, the wild population of ocelots (Leopardus pardalis Linnaeus, 1758) has drastically declined (Mur-ray & Gardner 1997), and one of the ways to conserve the species is keeping genetically viable ex situ populations in facilities such as wild life breeding centers and zoos (Swan-son 2003, Cuárón 2005).

In the wild, L. pardalis can consume a varied diet, mainly composed of birds, mammals, and reptiles of diverse kinds and sizes (Abreu et al. 2008, Pereira-Silva et al. 2011). However, in captivity, diets are normally elaborated empirically, according to the choices and habits observed in wild animals, by trial and error and taking into account the body condition of each animal. Nevertheless, such factors may not be sufficient to attend the individual nutritional demands (Saad et al. 2007, Clausss et al. 2010).

Among the few studies on digestibility of wild felines diets, the use of raw meat or whole preys was observed. The employment of dry kibble was only studied for two species of small wild cats, Felis margarita (Crissey et al. 1997) and Felis lybica (Vester et al. 2010). For ocelots, only Bennett et al. (2009) studied the digestibility of whole preys and one type of commercial moist diet. The lack of literature data may be related to the experimental limitations mentioned by Vester et al. (2009), which highlighted the difficulty in accomplishing the experiments due to the reduced quantity of animals, as well as limitations in their handling and restraining.

The classic methodology for determination of apparent digestibility, commonly employed in domestic animals, presents high costs and requires keeping the animals in metabolic cages, for individual control of the ingested food and the total quantity eliminated as feces and urine (Oetting 2002). On the other hand, the methods of partial fecal collection (indirect) do not need metabolic cages; instead, they make use of markers in nourishment, allowing the calculation of the estimated apparent digestibility through a proportion between the ingredient and marker ingested, and the nutrient and marker that were evacuated (Sibbald 1982, Carciofi 1998, Vasconcellos et al. 2007). Among the markers used in the evaluation of digestibility of domestic cats, oxidative balance (Cr2O3) is the most employed (Vasconcellos 2003, Cuárón 2005). Other markers used in the evaluation of digestibility of domestic cats, oxidative balance (Cr2O3) is the most employed (Vasconcellos 2003, Cuárón 2005). However, in captivity, diets are normally elaborated empirically, according to the choices and habits observed in wild animals, by trial and error and taking into account the body condition of each animal. Nevertheless, such factors may not be sufficient to attend the individual nutritional demands (Saad et al. 2007, Clausss et al. 2010).

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Table 1. Nutritional composition and ingredients of the dry kibble used in the experiment in ocelots

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>93.4 %</td>
<td>Fibrous matter</td>
<td>4.91 %</td>
</tr>
<tr>
<td>Crude protein</td>
<td>30.8 %</td>
<td>Mineral matter</td>
<td>7.4 %</td>
</tr>
<tr>
<td>Ether extract</td>
<td>23.8 %</td>
<td>Nitrogen-free extracts</td>
<td>26.49 %</td>
</tr>
<tr>
<td>Gross energy</td>
<td></td>
<td></td>
<td>5.028 Kcal/Kg</td>
</tr>
</tbody>
</table>

Ingredients: chicken meal flour, isolated swine protein, rice, corn, gluten maize, wheat gluten, animal fat, borago oil, vegetable oil, fish oil, Psyllium seeds, pea-pod meal, fructo-oligo-saccharides, mannan-oligo-saccharides, beet pulp, dehydrated egg, chondroitin, glucosamine, calcium, coline, polyphenols of grape and green tea extracts, marigold extract, methionine, L-cantline, zeolite, taurine, minerals, vitamins and mineral premix, palatabilizant.
RESULTS AND DISCUSSION

Effect of the analytical method on determination of the coefficients of digestibility

When comparing the indirect methods (CF, ADF, and AIA) to the standard method for determination of digestibility (TFC), AIA was noticed as the only one presenting data significantly similar to the TFC for all analyzed coefficients while the CF and ADF methods were not capable of determining them, once they underestimated such coefficients (Table 2). This information confirms Carciofi et al. (1998), Lôbo Jr. et al. (2001), and Vasconcellos et al. (2007), who verified AIA as an efficient method in this determination. Lôbo Jr. et al. (2001) reported that ADF underrated the CAD determined by total fecal collection, in contrast to Carciofi et al. (1998), who deem CF and ADF efficient in this determination, but suggest the need for new studies to confirm such conclusion. Under these conditions, the reports of Vester et al. (2008) and Clauss et al. (2010), about the likelihood of microbial fermentation in the final portion of the small intestine and in the large intestine of small felines may justify the reduced CAD estimated by CF and ADF in the present experiment.

Table 2. Coefficients of apparent digestibility (CAD) and standard deviation according to analysis method

<table>
<thead>
<tr>
<th>Method</th>
<th>CADDM%</th>
<th>CADCP%</th>
<th>CADEE%</th>
<th>CADNFE%</th>
<th>CADGE%</th>
</tr>
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<tbody>
<tr>
<td>TFC</td>
<td>73.7±7.52</td>
<td>81.9±6.41</td>
<td>85±4.33</td>
<td>78.52±6.44</td>
<td>80.5±5.95</td>
</tr>
<tr>
<td>AIA</td>
<td>76.83±3.22</td>
<td>84.8±1.92</td>
<td>86.7±2.2</td>
<td>79.55±5.47</td>
<td>82.2±2.63</td>
</tr>
<tr>
<td>CF</td>
<td>62.01±3.09</td>
<td>75.8±3.78</td>
<td>78.5±3.79</td>
<td>69.11±6.52</td>
<td>71.4±2.99</td>
</tr>
<tr>
<td>ADF</td>
<td>46.03±2.5</td>
<td>63.8±6.98</td>
<td>69.1±6.99</td>
<td>53.04±9.9</td>
<td>58.4±3.42</td>
</tr>
</tbody>
</table>

Different letters indicate statistical difference (p<0.05). CADDM = coefficient of apparent digestibility for dry matter, CADCP = coefficient of apparent digestibility for crude protein, CADEE = coefficient of apparent digestibility for ether extract, CADNFE = coefficient of apparent digestibility for nitrogen-free extracts, CADGE = coefficient of apparent digestibility for gross energy.

The concentration of AIA (0.729%) in the dry kibble of this experiment is, according to Thonney et al. (1985), subject to larger errors in the laboratory quantification; however, the CAD results were analogous to those of TFC, validating what had already been reported by Vasconcellos et al. (2007), who used diets containing 0.11 or 0.18% of that marker and still obtained adequate determinations of CAD for all nutrients. Despite similarities, the coefficients of digestibility were slightly higher when determined by the AIA method, ranging from 1.31 to 4.25% for CADNFE and CADDM, respectively (Fig.1).

Use of dry kibble as alternative diet for ocelots

The CADDM (73.7%) and CADCP (81.9%) obtained in this study resembled those observed in domestic cats (Carciofi et al. 1998, Vasconcellos et al. 2007) and dogs (Lôbo Jr. et al. 2001). When compared to researches in small wild felines, the CADDM was similar to that verified by Crissey et al. (1997) in Felis margarita, yet inferior to the value found by Vester et al. (2010) in Felis lybica. In relation to the CADCP, values obtained in this study were superior to Felis margarita (Crissey et al. 1997) and inferior to Felis lybica (Vester et al. 2010).

The 85% ether extract apparent digestibility was similar to Carciofi et al. (1998), Lôbo Jr. et al. (2001) and Vasconcellos et al. (2007); however, it was inferior to results obtained by Vester et al. (2010). The CADNFE observed in this study (78.52%) was similar to the findings of Carciofi et al. (1998) and Vasconcellos et al. (2007), but smaller than the results reported by Lôbo Jr. et al. (2001). The 80.5% CADGE was similar to Crissey et al. (1998), Lôbo Jr. et al. (2001) and Vasconcellos et al. (2007) data, but inferior to Vester et al. (2010).

In their research, Crissey et al. (1997) used specific commercial kibble for wild felines; however this diet showed to be less digestible for DM, GE, and CP when compared to raw meat. Vester et al. (2010) recommended the dry diet of their experiment, despite the fact that it presented a CADCP inferior to the standard diet. According to Crissey et al. (1997), the smaller values of nutrient digestibility found may be related to the remarkable amounts of vegetal ingredients in the experimental kibble. This was also noticed by Vester et al. (2010), who observed larger fecal volume in individuals that received dry diet, what, inclusively, demanded more time for cleaning the enclosures. In the same way, it is believed that the different species of wild felines vary in their capacity to assimilate nutrients, therefore showing the need for further evaluations concerning other types of kibbles.

In comparison to the items of ocelot’s usual diet, which demands more complex facilities and specialized labor (vivaria and food manipulation), the kibble used in this experiment presented lower daily costs per animal. Nevertheless, the choice for kibbles must consider factors such as dental health (Haberstroh et al. 1984), behavior, and welfare (Bond & Lindburg 1990), or the use of animals involved in rehabilitation programs.

CONCLUSION

Concerning dry kibble for ocelots, the use of AIA as marker was efficient for determination of the CAD for DM, CP, EE, and GE, and may be an option to the use of metabolic cages in investigations on the digestibility of diets for wild feli-
nes once it allows the accomplishment of the experiment at the usual individual enclosure of the animal. Furthermore, commercial dry kibble, proving to be an economically viable and suitable nutritional alternative for ocelots, was properly assimilated by the species.7

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REFERENCES


