

## Levels of nutrients and aflatoxins in dry and extruded food to cats

### Níveis de nutrientes e aflatoxinas em alimentos secos e extrudados para gatos

DOI:10.34117/bjdv7n1-220

Recebimento dos originais: 05/12/2020

Aceitação para publicação: 10/01/2021

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## ABSTRACT

The present study aimed to compare the composition on the label of dry complete food for adult cats with the nutritional composition determined by chemical analysis, to determine the occurrence of aflatoxins, and to list the most used ingredients. The determined parameters were: crude protein (CP), ether extract in acid hydrolysis (EEA), mineral matter (MM), moisture (MO), crude fiber (CF), calcium (Ca), phosphorus (P), sodium (Na), calculated metabolizable energy (ME) and aflatoxins. In assessing the levels guaranteed on the label, MO, CP, CF, MM and P remained within the range, but with a variation on the limits. The metabolizable energy varied from 3,712 to 4,136 kcal/kg. There was a divergence in the levels of two diets, with Ca above and EE below the values declared on the label in relation to composition obtained by chemical analysis, and both non-compliant in 20% foods tested. Regarding sodium, the diets showed levels 130 - 384% higher than stated on the label. Aflatoxin was found in 90% samples from zero to 4.37 ppb. The wide variation observed in the composition within the same super premium segment can cause losses due to the lack or excess of essential nutrients for the animal.

**Keywords:** chemical analysis, mycotoxin, guarantee levels, sodium.

## RESUMO

O objetivo do trabalho foi comparar a composição declarada no rótulo de alimentos completos secos para gatos adultos com a composição nutricional determinada por análises bromatológicas, bem como determinar a ocorrência de aflatoxinas e elencar os ingredientes mais utilizados. Os parâmetros determinados foram: proteína bruta (PB), extrato etéreo em hidrólise ácida (EEHA), matéria mineral (MM), umidade (UM), fibra bruta (FB), cálcio (Ca), fósforo (P), sódio (Na), energia metabolizável calculada (EM) e aflatoxinas. Na avaliação dos níveis de garantia do rótulo, a UM, PB, FB, MM e P ficaram dentro do estabelecido, porém com uma variação sobre os limites. A energia metabolizável variou de 3712 até 4136 kcal/kg. Verificou-se divergência nos níveis de duas dietas, sendo do Ca acima e EE abaixo do declarado no rótulo em relação composição obtida por meio de análise bromatológica, e ambos não conformes em 20% dos alimentos. Sobre os níveis de sódio, as dietas apresentaram teores de 130 a 384% a mais do declarado no rótulo. Foi verificada a presença de aflatoxina em 90% das amostras de zero a 4,37 ppb. A ampla variação observada na composição dentro do mesmo segmento super premium pode trazer prejuízos pela falta ou excesso dos nutrientes essenciais do animal.

**Palavras-chave:** análise bromatológica, micotoxina, níveis de garantia, sódio.

## 1 INTRODUCTION

The domestication of cats is a long and continuous process, in which one of the main changes refers to eating habits. In nature, cats fed only on the hunt, and with domestication began to consume food produced by man. Cats are exclusively carnivorous animals, which makes them depend on animal protein in their diet or on its combination with highly digestible ingredients for an efficient use (Lei et al., 2015). Cat guardians are responsible for providing quality food to their animals to promote longevity and well-being.

The guardians' concern is growing regarding the type of food provided, and the quality of the ingredients in commercial pet food. This is due to the proximity between humans and animals. A relevant topic that divides the opinion of cat guardians are the sodium levels that make up commercial foods, as they seek levels considered safe that do not harm the health of the animal. With the insertion of products of plant origin in the nutrition of cats, another problem arises: the possibility of contamination with mycotoxins, such as aflatoxins, causing damage mainly to the liver of animals that are directly related to the level of intake (Wouters et al., 2013).

There are several national and international companies with a variety of brands of food for pets with different levels of ingredients in products that compete with each other to meet customer requirements. The standards of Quality and Identity of Complete Food and Special Food for dogs and cats comply with specific Normative Instruction IN 30, of August 5, 2009 (BRASIL, 2009). However, the specific classifications in Brazil for pet foods denominated as: Economic, Standard, Premium and Super Premium are assigned according to what the industry establishes, according to the characteristics of the food, such as quality and concentration of ingredients, prices, etc. This classification aims to guide the products of the same company, as well as competition between companies

Although the pet food market is expanding, there is little research developed in the area on the composition of food in relation to quality related to the nutritional requirements of the species of interest. Thus, the goal of this study was to determine the nutritional composition, and compare with the composition on the label, to analyze the occurrence of aflatoxins, and list the most used ingredients in Super premium dry foods for adult cats.

## **2 MATERIAL AND METHODS**

This study tested 10 Super Premium complete commercial foods for adult cats sold in Brazil. The food was purchased in shops in the city of Florianópolis, State of Santa Catarina, and was identified by number, to hide the information from the manufacturers. At the Animal Nutrition Laboratory, Center for Agricultural Sciences/DZDR (UFSC), the samples were previously ground (1 mm), and packed in sealed plastic bags to maintain the nutritional characteristics of the food. Each sample was stored individually with the appropriate identifications (1 to 10), and sent for analysis to a commercial laboratory certified by National Institute of Metrology, Quality and Technology (Inmetro).

Samples were analyzed for crude protein (CP), ether extract in acid hydrolysis (EEA), mineral matter (MM), dry matter (DM), crude fiber (CF), calcium (Ca), phosphorus (P), sodium (Na) and aflatoxins, according to the methods described in the Brazilian Compendium of Animal Feed (Analytical Methods, 2013).

After obtaining the results of the laboratory analyses, the contents of metabolizable energy (ME) of the food were calculated according to the equations of NRC (2006).

The analyzed nutrients (AN) were compared with the nutrients on the label (NL) declared by the manufacturers, qualified as in or out of the declared standard. The coefficient of variation was set at 5%, which is an acceptable and safe level at the laboratory level, which follows the recommendation of the Brazilian Compendium of Animal Feed 2013 (Analytical Methods, 2013).

Data obtained were subjected to descriptive analysis, and the results presented as a percentage of compliant and non-compliant samples, according to values declared by the manufacturers.

### **3 RESULTS AND DISCUSSION**

Regarding the evaluated parameters, it was observed that there is a wide variation in the composition between the commercial foods of the Super Premium line for adult cats. This variation in the composition of foods can cause losses if they have excess or lack of nutrients.

All samples had lower moisture and crude fiber compared to the declared values, and 50% samples had higher levels for crude protein compared to those declared on the label (Table 1). Regarding the CP levels of foods, compliance with minimum values of 31.45% and maximum of 37.1% was found. For cats, CP levels above the established minimum bring benefits as long as they are high quality proteins, since this animal category has a high requirement for protein in the diet, as they are constantly catabolizing amino acids in the liver to obtain energy (Wortinger, 2009). Another relevant factor regarding the protein content is related to the source and method of obtaining this nutrient, especially the processing of meals of animal origin that require high temperatures, pressure and correct time for their production, which can compromise the quality of the protein by burning organic matter, as well as reflecting on the protein quality of the ingredients by decreasing digestibility or making amino acids unavailable (Melo et al., 2014).

With respect to the ether extract, two foods (2 and 7) showed a reduction of about 12% compared to the value described on the label. The rest of the samples were above the minimum levels on the label, noting that for this fraction 20% samples were not in accordance with what was declared (Table 2). Diets deficient in essential fatty acids can damage the nutrition of cats because they are not able to synthesize arachidonic acid from linoleic acid (Trevizan; Kessler, 2009). On the other hand, the high amount of fat in the diet can also be a problem due to the caloric value of the food, and there may be cases of overweight and obesity in dogs and cats (Bauer, 2008) in addition to oxidation of the lipid fraction during storage because of the increase of EE in the food.

In two commercial foods (8 and 10), the Ca values were about 10% above that described on the label (Table 2). The industry has a broader margin to work with Ca levels, because according to IN 30 of 2009 (BRASIL, 2009), it must present the maximum and minimum levels.

The Ca: P ratio of foods 8 and 10 were adequate when compared to the label, with 1.0: 1 and 1.4: 1 on the label and 0.99: 1 and 1.4: 1 in samples analyzed in the laboratory. However, when the Ca: P ratio is examined separately from the label and the analyzed composition of these two foods (8 and 10), values lower than the recommended value from 1.1 to 2 Ca: 1 P were identified (AFFCO, 2015; FEDIAF 2018). Carciofi et al. (2006) investigated an inverse relationship in some commercial foods when evaluated the Ca: P ratio in adult dog food of 1.3: 1 (economic, standard and premium) and puppies of 1.3: 1 for and super premium.

The imbalance between calcium and phosphorus can cause losses because of the competition between minerals, which can cause bone calcification and osteoporosis when the amount of phosphorus is higher than calcium (Melo et al. 2014; AAFCO, 2015; FEDIAF, 2018).

With respect to the metabolizable energy levels, it was found in foods that had high ME (4,136 to 4,256 kcal/kg high), the content of mineral matter (4.76 to 6.18%) remained low, and when MM (6.18 to 8.11%) was high, ME (3,712 to 3,941 kcal/kg) had lower levels (Figure 1). The high level of mineral matter in some diets may be the result of including ingredients of animal origin in the formulation. Animal origin protein presents a greater variation in the chemical composition, quality and digestibility, and consequent limitation in the inclusion in the formula because it contains excess levels of minerals (Wolfarth; Johann; Araldi, 2011). Poultry offal meal, often used in the formulation of commercial foods, varies in composition, affecting the average values of

mineral matter, crude protein and ether extract due to the predominance of certain parts of the birds used to prepare the ingredient. This variation in the composition of the offal meal interferes with the total mineral contents and average values of calcium and phosphorus (Nascimento, 2002).

The presentation of the sodium level on dog and cat food labels is not mandatory by Brazilian law. However, in the group of 10 foods analyzed, about 80% exceeded the minimum levels stated on the label (Table 3). The samples were considered non-compliant because they showed differences of 130 to 384% more than the minimum sodium stated on the packaging over the value analyzed in the laboratory.

Although the samples exceeded the sodium value, none exceeded the level recommended by the NRC (2006) of 1.5% sodium for adult cat diets. However, six samples remained below the recommended by NRC, which is 0.68g Na/kg. In contrast, the analyzed amounts of sodium from all samples are well above the recommended by FEDIAF (2018), 0.08% DM, for adult cats.

Studies carried out by Hawthorne and Marwell (2004) reported that sodium levels greater than 0.275 - 0.4 g Na/100 kcal for adult cats increased water intake and, consequently, resulted in a larger volume of urine, and a reduction in oxalate of calcium. Xu, Laflamme and Long (2009) found that, in diets for mature adult cats, the level of 11.1 g Na/kg DM did not cause effects on food intake, body composition, blood pressure, hydration, and renal function markers. The safe proportion of sodium without deficiency or excess in the diet for healthy adult cats or those prone to disease has not yet been set, and there is no consensus among researchers about the real needs of these animals.

Positive results for the presence of aflatoxins were found in 90% of the analyzed samples, remaining between 0 and 4.37ppb (Table 3). None exceeded the 50ppb and 20 ppb/kg limits established by Brazilian legislation and the Pet Food Brazil Manual of the Brazilian Association of the Pet Products Industry (ABINPET, 2017). Grandi et al. (2019) observed that a relatively high number of samples (five samples of premium feeds and three samples of standard feeds for adult cats) exceeded the limits established for some mycotoxins. The occurrence of aflatoxins in pet food is highly variable. Nevertheless, several aflatoxicosis outbreaks are reported in the literature (Dereszynski et al., 2008; Arnot et al., 2012). Aflatoxins directly affect the liver resulting in signs of the disease that vary according to the time of exposure, type of aflatoxin and concentration in the food, which can be chronic or acute (Gomes et al., 2014; Guterres et al., 2017).

The concentration of aflatoxins found in the analyzed samples is because they contain corn and gluten meal at different concentrations, quality, processing and storage of the ingredients included in the diets (Martins et al., 2003).

The ingredients most often found in commercial cat food were offal meal, present in 100% commercial food; followed by corn and broken rice, present in 90% food; corn gluten meal 60, beer yeast, chicken fat; occurring in 80%, 70% and 60% of complete cat foods evaluated in this study, respectively. The choice of raw materials used in the formulation and the impact of processing on cat food is extremely important, and the quality of the final product is attributed to the texture, uniformity, extrusion process, nutritional quality and economic viability of the product (Grandi et al ., 2019). Thus, the processing of the ingredients is essential to increase the digestibility of the ingredients in the feed.

#### **4 CONCLUSION**

The wide variation found in all nutritional levels in commercial foods for adult cats in the Super premium segment, demonstrate the importance of food quality standards;

Although present, the levels of aflatoxins found in complete foods did not exceed the limits set by the current legislation;

The most commonly ingredients declared on the labels of commercial cat food were offal meal, corn, broken rice, corn gluten meal 60%, beer yeast and chicken fat.



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## ANEXOS

Table 1 – Levels of nutrients on the labels (NL) and levels of the analyzed nutrients (AN) from ten complete commercial foods for adult cats in the Super Premium segment.

Feed	MO (%)		CP (%)		EE (%)		CF (%)	
	NL	AN	NL	AN	NL	AN	NL	AN
1	9.50	6.15	29.00	32.52	18.00	19.76	2.50	0.890
2	10.00	7.14	31.00	37.09	12.00*	10.91*	3.00	1.76
3	12.00	7.13	30.00	31.45	9.00	11.65	4.00	1.49
4	10.00	6.52	31.00	35.33	12.00	11.93	3.50	1.84
5	8.00	5.78	30.00	31.55	13.00	15.38	5.00	4.58
6	10.00	6.83	32.00	33.58	18.00	18.83	3.50	1.64
7	10.00	5.78	31.00	32.92	12.00*	10.53*	3.00	2.44
8	10.00	6.99	31.00	32.75	12.00	15.34	3.00	2.32
9	12.00	6.15	36.00	37.10	15.00	17.64	2.50	0.86
10	10.00	5.19	31.00	32.20	10.00	16.39	4.00	1.81

\*Coefficient of variation > 5%; Nutrients: MO - Moisture; CP – crude protein; EE – ether extract; CF – crude fiber.

Table 2 – Values of minerals on the food label and results of chemical analysis of foods for adult cats in the Super Premium segment.

Feed	MM (%)		Min and Max Ca (%)		P (%)		Ca:P ratio (%)	
	NL	AN	NL	AN	NL	AN	NL	AN
1	6.00	4.76	0.50 - 1.05	0.70	0.50	0.71	1.00	0.99
2	7.50	6.37	0.70 – 1.10	0.98	0.60	0.97	1.17	1.01
3	8.50	7.57	0.60 – 1.50	1.37	0.70	0.96	0.86	1.43
4	8.00	5.89	0.70 – 1.50	1.04	0.60	0.94	1.17	1.11
5	7.90	6.18	0.93 – 1.39	1.07	0.88	1.11	1.06	0.96
6	8.00	6.18	0.80 – 1.45	1.23	0.70	1.01	1.14	1.22
7	8.00	6.35	0.80 – 1.60	0.98	0.80	1.12	1.00	0.88
8	8.00	7.95	1.00 – 1.60*	1.85*	0.80	1.20	1.25	1.54
9	7.50	5.98	0.80 – 1.40	1.10	0.80	0.97	1.00	1.13
10	8.50	8.11	0.80 – 1.60*	1.75*	0.70	1.53	1.14	1.14

\*Coefficient of variation > 5%; Nutrient: MM - mineral matter; Ca - Calcium; P - Phosphorus. NL: Nutrient on the label; AN: Analyzed nutrient.

Table 3 – Levels of aflatoxin and sodium on the labels (NL) and analyzed (AN) in samples from ten complete commercial foods for adult cats in the Super Premium segment.

<sup>1</sup> aflatoxin level in ppb found in the analyzed samples.

Feed	Aflatoxin <sup>1</sup> (ppb)	NL sodium (%)	AN sodium (%)	% Exceeded sodium <sup>2</sup>
1	4.37	0.20	0.42	210.00
2	2.33	0.25	0.96	384.00
3	2.03	0.80	1.04	130.00
4	2.03	0.20	0.63	315.00
5	2.93	Not informed	0.65	-
6	2.07	0.35	0.59	168.57
7	2.41	0.25	0.68	272.00
8	0	Not informed	0.60	-
9	2.22	0.35	0.52	148.57
10	2.48	0.30	0.73	243.33

<sup>2</sup> percentage exceeded of the analyzed value from the value on the label.

Figure 1 – Relationship between metabolizable energy and mineral matter in feed

