

Communication

[Comunicação]

Digestibility of dry extruded food in adult dogs and puppies

[Comparação da digestibilidade de um alimento seco extrusado entre cães adultos e filhotes]

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The pet food market has expanded considerably over the last few years. However, this expansion has raised some doubts regarding the quality of the products offered in the market. Therefore, knowing the digestibility of dog food is essential to supply these animals with adequate nutrients to provide their requirements in every physiological stage, particularly in terms of energy.

The aging process in cats and dogs is mainly influenced by genetics, nutrition, and the environment to which the animals are submitted, among other factors. Animal development is associated to changes in the physiological and metabolic systems; however, such changes are not completely elucidated in companion animals (Hayek and Davenport, 1998). As animal's age, the intestinal microbiota and morphology, as well as the production of digestive enzymes and hormones are modified, influencing digestibility (Fahey *et al.*, 2008). According to Meyer *et al.* (1940), amylase, trypsin, and lipase activities in the duodenal juice are reduced with age. However, Gilham *et al.* (1993), in a study with Labrador Retriever puppies with twelve or twenty weeks of age, did not find any statistically significant influence of age on nutrient digestibility. Taylor *et al.* (1995) also postulated that the reduction of enzyme production as a consequence of age does not affect nutrient digestion and absorption because the mammalian gastrointestinal tract (GIT) has a

large reserve capacity, allowing sufficient time for the action of digestive juices on the food, thereby compensating the lower enzymatic activity in older animals.

In order to contribute to the understanding of the effect of aging on food digestibility in dogs, the objective of the present study was to compare apparent digestibility coefficients of dry extruded dog food between adult dogs and puppies.

Twelve Beagles, distributed in six adults (5 years of age) and six puppies (5-6 months of age) and three males and three females per age group, were used. Adults and puppies weighed, in average, 13.4±1.7kg and 6.5±0.6kg, respectively. Dogs were housed in metabolic cages (0.7m long x 0.6m wide x 0.5m high), and fed a dry extruded food, with nutritional content exceeding the minimum recommendations from AAFCO (Association ..., 2003) for growing dogs (Table 1). A 5-d period of adaptation to the diet and to the metabolic cages was applied, followed by five days of total feces collection, as indicated by AAFCO (Association ..., 2003).

No differences were detected between adult dogs and puppies regarding organic matter (OM), dry matter (DM), crude protein (CP), or non-nitrogen extract (NNE) apparent digestibility coefficients (ADC), or energy metabolizability ($P>0.05$). However, puppies presented higher acid hydrolysis ether extract ADC ($P<0.05$) (Table 2) when compared to adults.

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Table 1. Ingredients and analyzed chemical composition of the experimental diet for adult dogs and puppies

Ingredient	(% fresh matter)
Corn	59.08
Poultry offal meal	26.14
Corn gluten 60	5.71
Poultry fat	5.00
Poultry liver hydrolysate	1.86
Mineral-vitamin supplement	1.30
Salt	0.71
Calcium propionate	0.17
Potassium sorbate	0.03
Total	100.00
Chemical composition	(% in dry matter)
Dry matter (DM)	90.97
Crude protein (CP)	24.62
Acid hydrolysis ether extract (AEE)	11.01
Crude fiber (CF)	1.35
Mineral matter (MM)	7.00
Non-nitrogen extract (NNE) ¹	56.00
Ca	1.43
P	1.02
Metabolizable energy (kcal/kg) ²	4,020.2

¹NNE% = 100 – (MM% + CP% + AEE% + CF%), on dry matter basis.

²Estimated according to the NRC (Nutrient..., 2006).

Table 2. Apparent digestibility coefficients of dry extruded food of adult dogs and puppies

Variable	Adult	Puppy	SEM	P
Dry matter (%)	82.9	83.6	0.292	0.261
Organic matter (%)	86.7	86.7	0.242	0.974
Crude protein (%)	85.3	83.2	0.372	0.061
Acid hydrolysis ether extract (%)	89.5 ^b	95.3 ^a	0.927	<0.001
Non-nitrogen extract (%)	94.4	95.3	0.244	0.065
Metabolizable energy (kcal/kg) (%)	4,106	4,100	11.467	0.798

Means followed by different letters in the same row are different through the Student's t-test (P<0.05).

SEM: standard error of the mean.

Puppies have lingual lipase that, together with gastric lipase, aids in the breakdown of milk lipids, making these available for use. During suckling (about four weeks after birth), milk is usually the sole nutrition source for puppies (Iverson *et al.*, 1991). This may explain the higher ether extract digestibility detected in puppies as compared to adults in the present study. Nevertheless, further studies are required to determine for how long lingual lipase remains present and significantly functional in dogs.

In literature, no studies evaluating the same ages used at the present study were found. However, Weber *et al.* (2003), studying dogs of different

breeds and ages (three, five, and nine months, and one year and three months of age), observed higher fat digestibility in dogs older than five months of age as compared to 3-month-old puppies. On the other hand, Swanson *et al.* (2004) did not find any differences in nutrient digestibility and feces characteristics between 10- and 3-month-old dogs, but observed that 11-year-old dogs presented higher dry matter, organic matter, and fat digestibility when compared to 5-month-old puppies. In the Gilham *et al.* (1993) study, 20-week-old dogs showed higher protein digestibility when compared to 12- and 16-week-old dogs. According to Fahey *et al.* (2008), both puppies and kittens have lower

protein digestibility than adults because these present higher pepsin secretion. However, no differences in protein digestibility were found in the present study, consistent with the findings of Taylor *et al.* (1995).

Gilham *et al.* (1993), Swanson *et al.* (2004) and Fahey *et al.* (2008) suggested that nutrient digestibility improves as the animal ages due to GIT maturation. It is possible that the

fermentation of indigestible dietary compounds by the microbiota of puppies may allow them to achieve similar nutrient digestibility as adult dogs. Although ileal digestibility has not been determined, this hypothesis is based in the lower pH (as measured in dry feces) and the higher ammonia content in the feces of puppies ($P < 0.05$) (Table 3), which indicate higher fermentation in their intestines.

Table 3. Fecal characteristics of adult dogs and puppies

Parameter	Adult	Puppy	SEM	P
Dry matter (%)	40.68b	36.63a	0.481	0.001
Ammonia (%)	0.43a	0.54b	0.008	<0.001
Fecal score	3.86b	3.40a	0.051	<0.001
g fecFM/kg body weight/day ¹	0.44	0.43	0.011	0.890
g fecDM/kg body weight/day ²	0.17	0.16	0.002	0.832
pH fresh feces	6.37	6.29	0.032	0.962
pH dry feces	6.05a	5.86b	0.021	<0.001

Means followed by different letters in the same row are different through the Student's t-test ($P < 0.05$). SEM: standard error of the mean.

¹Feces production on fresh matter (FM) basis (g)/body weight/day.

²Feces production on dry matter (DM) basis (g)/body weight/day.

Regarding feces consistency, feces of puppies contained lower dry matter content, and consequently worse fecal score when compared to adult dogs ($P < 0.05$) (Table 3). The production of wetter feces by puppies may be explained by their higher intestinal transit rate relative to adult dogs, resulting in lower water absorption in the large intestine, as reported by Weber *et al.* (2003).

Swanson *et al.* (2004) noted that intestinal microbiota changes as the animal ages, which may influence diet digestibility, and consequently feces characteristics. However, Benno *et al.* (1992) comparing the microbiota of the stomach, duodenum, jejunum, or ileum of dogs younger than one year of age and older than eleven, did not find any difference, except for a lower concentration of *Clostridium perfringens*

in the GIT of puppies as compared to elderly dogs. Although in the present experiment no differences were detected in most of the analyzed digestibility parameters, the shorter intestinal transit time associated to a possibly developing intestinal microbiota may explain the different fecal characteristics of puppies, which presented higher moisture and ammonia contents, making their stools softer and with a stronger odor as compared to adult dogs.

Five to six-month-old dogs have higher fat digestibility as compared to five-year-old adult dogs, as well as softer feces with higher ammonia content.

Keywords: Beagle, adult dog, puppy, digestibility

RESUMO

Os diversos alimentos completos para cães existentes no mercado objetivam atender as necessidades nutricionais do animal quanto ao estágio fisiológico, conforme as alterações que possam ocorrer no aproveitamento dos nutrientes. Com a finalidade de comparar os coeficientes de digestibilidade aparente (CDA) e as características das fezes de um alimento seco extrusado de cães adultos e filhotes, foram utilizados 12 cães da raça Beagle, sendo seis adultos, cinco anos, e seis filhotes, cinco-seis meses, mantidos em gaiolas metabólicas e distribuídos em delineamento inteiramente ao acaso. Os animais

foram alimentados duas vezes ao dia com um alimento completo seco extrusado para filhotes, por um período de adaptação de cinco dias seguidos por cinco dias de coleta total de fezes. Houve diferença apenas para o CDA do extrato etéreo em hidrólise ácida, sendo maior para os filhotes – 95,3 vs 89,5%. Em relação às características das fezes, os filhotes apresentaram pior escore fecal, devido às fezes terem se mostrado mais úmidas, além de maior pH em fezes secas e maior teor de amônia, culminando em pior qualidade. Conclui-se que filhotes de 5-6 meses de idade apresentam maior digestibilidade da gordura quando comparado a cães adultos, porém defecam fezes com pior escore fecal.

Palavras-chave: Beagle, cão adulto, cão filhote, digestibilidade

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