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Study of the chemical and nutritional characteristics of commercial dog foods used as elimination diet for the diagnosis of canine food allergy

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ABSTRACT - "Hypoallergenic" pet foods are commercial dietary products for dogs and cats used as elimination diets for the diagnosis of adverse food reactions. Aim of this study was to compare chemical and nutritional characteristics of this kind of dog foods with regular maintenance diets. Twenty-nine dry pet foods (pellets) were collected and divided into classes on the basis of the type (H: hypoallergenic; R: regular), source of fat (with or without fish oil) and source of protein (with or without fish protein) used in their composition. Labels of the H pet foods identified 8 products (44%) with one protein in their formula, suggesting that only few commercial manufacturers concern about the number of protein sources included in their products. Samples of the two groups showed different chemical profiles with lower levels of protein, gross energy, phosphorus and better fatty acid profile (expressed as % of total fatty acids) for H products in comparison to R foods: PUFA, 38.91 *vs* 24.03, $P<0.01$; ω3, 5.70 *vs* 2.58, $P<0.01$; ω6, 33.22 *vs* 21.63, $P<0.01$; DHA, 2.85 *vs* 0.16, $P<0.05$; CLA, 0.24 *vs* 0.08, $P<0.05$, for H and R respectively. This study suggests that the differences observed in the fatty acids composition may be attributed to fish proteins addition, but not to fish oil, in H pet foods production.

Key words: Food allergy, Dog, Hypoallergenic pet food, Chemical composition.

Introduction – The term "hypoallergenic" pet foods, although not properly used, is commonly addressed to those products for dogs and cats recommended as elimination diets for diagnosing canine food allergies and controlling the related symptoms. There are two kinds of commercial elimination diets: novel protein diets and hydrolysed protein diets. Aim of an elimination diet is to avoid exposition of animals to potential allergens, therefore a particular care must be addressed to the choice of an appropriate dietary product for each animal. In particular, novel protein diets should be composed by one source of protein and one source of carbohydrate to which the animal should have never come previously in contact (Jackson, 2001). Besides, all diets should be well balanced in order to guarantee a correct long-term nutritional intake (Hill, 1999) extending their use also for maintenance purposes. Objectives of this study were to evaluate the ingredients selected for the composition of each hypoallergenic pet food and to compare their chemical and nutritional traits to those of regular pet foods generally given as maintenance diet to healthy adult dogs.

Material and methods – Twenty-nine dry pet foods (pellets) have been collected from different manufacturers. As reported in Table 1 pet foods were distributed into 7 classes considering type (H: hypoallergenic, R: regular), source of fat (f0: no fish oil; f1: fish oil) and source of protein (p0: no fish protein; p1: fish protein). Samples were analyzed for chemical composition (AOAC, 2000), gross energy determination (AOAC, 2000) and fatty acids profile (Christie, 1982). All data were analyzed by ANOVA within PROC-GLM (SAS, 2003) considering the effect of the combination of the three factors (type, T; source of fat, f; source of protein, p) and main contrasts were carried out. Differences were considered significant at $P<0.05$.

Table 1. Distribution of pet foods into classes on the basis of type (H: hypoallergenic; R: regular), source of fat (f0: no fish oil; f1: fish oil) and source of protein (p0: no fish protein; p1: fish protein).

Classes	Hf0p0	Hf0p1	Hf1p0	Hf1p1	Rf0p0	Rf0p1	Rf1p0
Samples, n.	7	5	4	2	2	3	6

Table 2. Number of sources of protein and carbohydrates in novel protein H diets and R pet foods.

Number of sources	H (n)	H (%)	R (n)	R (%)
1 protein	4	28.6	2	18.1
2-3 proteins	10	71.4	5	45.5
>3 proteins	0	0	4	36.4
1 carbohydrate	11	78.6	7	63.6
2-3 carbohydrates	3	21.4	2	18.2
>3 carbohydrates	0	0	2	18.2

Results and conclusions – Information reported on the labels of the novel protein diets (14 out of 18 H products) showed that only few manufacturers respect the important recommendation of including one single source of both protein and carbohydrates in their feedstuff. Indeed, 3 H pet foods (21.4%) contain 2 to 3 carbohydrate sources and 10 products (71.4%) include 2 to 3 protein sources in their formula. This recommendation doesn't commonly concern R products and most of the R diets collected for the study (81.9%) contained ≥2 protein sources (Table 2).

Hydrolysed chicken products have been added in 5 out of 14 novel protein H diets and in 1 out of 4 hydrolysed protein H diets whose main source of protein was different from chicken. It has been hypothesized that hydrolysed proteins may trigger an adverse food reaction in subjects sensitized to the parent proteins (Cave, 2006). Therefore, a lack of clinical improvement may occur in subjects sensitized to chicken when they are fed these products during the diagnostic trial. A failure of the elimination diet during the dietary trial can also be caused by the ingestion of potential allergenic foods. Terms such as "meat and meat derivatives" or "vegetarian sub-products", as reported in 5 H products labels, are vague and do not indicate the specific ingredients included. Moreover, a particular attention should be taken to the term "animal fats" or "vegetal oils" reported in the majority of the H pet food labels (72.2%): the precise source should be specified, as in humans it has been demonstrated that residual proteins might be withheld in the fatty component during extraction causing an adverse reaction (Crevel *et al.*, 2000). Carbohydrates sources used in the selected H pet foods are usually limited in number (rice, corn, potato or tapioca) if compared to the wider variety of source of animal (duck, eggs, turkey, lamb, rabbit, venison, different kind of fish) and vegetal proteins (soy, corn gluten, rice gluten). However, as in humans, the more a protein is consumed by the animal the more the possibility for the animal to become sensitive to that protein (Prélaud, 2003). For this reason H pet foods containing new protein or carbohydrate sources are regularly proposed in the market. Even if fish protein is still the most utilised in H pet foods (39% of H selected diets) because some years ago it represented a real change in the modern diet for pets, currently it cannot be longer considered an effective novel protein for elimination diets. Fish proteins are now common ingredients of several maintenance dog foods and sensitization to fish proteins has been already reported (Tapp *et al.*, 2002). Fish is richer than other animals' meat in ω3 fatty acids (NRC, 2006) and these are known to stimulate anti-inflammatory responses which may cause a partial improvement of cutaneous pruritus in individuals fed ω3 enriched diets (Ahlstrøm *et al.*, 2004; Scott and Miller, 1993). Based on the chemical analysis, H products showed lower levels of protein (23.1 *vs* 26.4% DM, $P<0.05$), gross energy (20.6 *vs* 21.5 MJ/kg DM) and phosphorus (0.76 *vs* 0.89%DM, $P<0.05$) than R diets, whereas the content of lipids was similar (14.33 *vs* 15.97% DM, for H and R respectively). Fatty acid profile revealed that H have lower concentrations of SFA and MUFA and higher PUFA levels and UFA/SFA ratio than R (Table 3). In particular, the concentration of ω6, ω3 and DHA resulted more elevated. Besides, CLA concentration was richer in H pet foods but their effect on allergic diseases in dogs is still controversial (Noli *et al.*, 2007). When the

Table 3. Fatty acids profile of hypoallergenic (H) and regular (R) pet foods, with or without fish oil (f0: no fish oil; f1: fish oil) and with or without fish protein (p0: no fish protein; p1: fish protein).

Items		H	R	Hf0	Hf1	Rf0	Rf1	Hp0	Hp1	Rp0	Rp1
SFA,	% FA	25.54^{b}	32.78^{a}	26.44	24.65	33.74	30.87	24.89	26.19	32.10	34.15
MUFA	% FA	30.59^{B}	38.53^{A}	31.47	29.72	37.55	40.53	29.64	31.55	38.47	38.65
PUFA	% FA	38.91^{A}	24.03^{B}	37.45	40.36	24.04	24.03	41.20	36.62	25.49	21.12
UFA/SFA		2.81^{a}	1.89^{b}	2.78	2.83	1.78	2.13	2.88	2.73	1.99	1.70
ω6	% FA	33.22^{a}	21.63^{b}	31.75	34.69	21.62	21.66	36.60	29.84	20.03	18.83
ω3	% FA	5.70^{A}	2.58^{B}	5.72	5.69	2.63	2.47	4.80^{b}	6.61^{a}	2.61	2.52
ω6/ω3		6.32	8.66	6.11	6.54	8.57	8.84	7.92^{a}	4.73^{b}	8.85	8.28
EPA	% FA	0.94	0.36	0.80	1.08	0.23	0.60	0.44^{b}	1.44^{a}	0.37	0.34
DHA	% FA	2.85^{a}	0.16^{b}	1.02	1.08	0.32	0.37	0.38^{B}	1.73^{A}	0.22	0.57
CLA	% FA	0.24^{a}	0.08^{b}	0.22	0.26	0.05	0.15	0.11	0.37	0.09	0.07

$^{a, b}P<0.05$; $^{A, B}P<0.01$.

comparison between H and R was allowed within products using the same source of fat or the same source of protein, the better fatty acid profile with higher concentrations of PUFA and ω3 levels was preserved in H products. However, it is worth noting that when contrasts were carried out within H or R and different sources of fat or different sources of protein were compared, significant differences were detected only in Hp0 *vs* Hp1: in particular, higher levels of ω3, EPA, DHA, CLA and a lower ω6/ω3 ratio were identified in Hp1 (Table 3). These findings indicate the probable low quantity or the scarce quality of fish oil included in the diets which claim to be enriched with this source of fat.

In conclusion, more care should be taken by manufacturers to the respect of the inclusion of a unique source of proteins and carbohydrates in H pet foods and a clear identification of all specific ingredients used in the formula should be indicated in the label. A positive fatty acid profile, richer in ω3 fatty acids, was detected in H compared to R products and this difference can be related to fish proteins utilization (and not fish oil), included in H pet foods composition.

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