Progress in Nutrition 2021; Vol. 23, N. 4: e2021151 DOI 10.23751/pn.v23i4.9208

Original article

Investigation on Iodine Levels in Canine and Feline Canned Food Products in Italy

Debora Guidi[1], Natalia Russo[1], Diana Vergnano[1], Elena Pagani[1], Liviana Prola[1]
1 Department of Veterinary Science, University of Turin, Grugliasco, Italy

Abstract. Thyroid diseases, and in particular hyperthyroidism, have frequently been diagnosed in cats by both pathologists and clinicians over the last 20-30 years. Hyperthyroidism and hypothyroidism are common endocrine disorders in elderly pets. Although the causes are not yet fully understood, it appears that a proper intake of iodine in the diet can reduce the incidence of these diseases. In Italy, moist canned foods are currently used extensively for both dogs and cats. Although moist foods are used to cover just a small portion of the energy requirements of dogs, they cover a much larger portion of these requirements in cats. The aim of the present study has been to verify the iodine levels in different types of complete, moist cat and dog food sold in different distribution channels. The results have shown that 25% of the analyzed food did not respect the recommended range and that nutritional adequacy was not influenced by the distribution channel.

Key words: Iodine levels, thyroid gland, hyperthyroidism, hypothyroidism, pet food

Highlights

- Iodine content in pet food for dogs and cats frequently did not satisfy official nutritional recommendations.
- Fluctuating intake of dietary iodine levels could be possibly linked to the high incidence of feline hyperthyroidism in Italy.

Introduction

Iodine (I) is a major component of the thyroid hormones thyroxine (T4) and triiodothyronine (T3), and it represents 65% and 59% of their weights, respectively (1). Thyroid hormones (THs) are involved in metabolic processes that are essential for normal growth and development; moreover, they also regulate the metabolism of adult cats and dogs (2). It is well known that their levels may interfere with energy consumption and with the lean and fat body mass percentages; an imbalance in their synthesis, related to a hyper- or hypo-functioning of the thyroid gland, could be a consequence of an altered I intake (2). Hyperthyroidism represents the most common endocrinopathy of older cats, and it resembles the toxic nodular goiter observed in older humans (3). Interestingly, prevalence rates appear to vary substantially according to the geographic region. The prevalence of hyperthyroidism in cats in the Union Kingdom is 20.1%, while it is 16.4 % in Spain, 11.4% in Germany and 3.9% in Hong Kong (4). Pure breed cats, and Siamese and Himalayan cats, have a decreased risk of developing hyperthyroidism (4), unlike cats, suffer from hypothyroidism and not hyperthyroidism. The prevalence of hypothyroidism in dogs varies from 0.2 to 0.9% in different breeds. However, considerably higher prevalence has been reported for some breeds, e.g., 2.7% for a cohort of 8 years old Gordon setters, 13 % for Swedish Hovawarts, and as high as 16% for Giant Schnauzers and Beagles (5). The disease has rarely been diagnosed in dogs under the age of 2–4 years (5). Hyperthyroidism is characterized by an overproduction of THs from hyperfunctioning hyperplastic

or adenomatous thyroid tissue, which leads to a hypermetabolic state that in turn is responsible for increased resting energy expenditure, weight loss, increased lipolysis, and gluconeogenesis. The I concentrations of commercial cat foods can vary extensively. A review of historical I recommendations made by Edimboro et al (6) has revealed that the units of I supplementation were changed in the 1970s; unsurprisingly, the first case-series of cats diagnosed with feline hyperthyroidism was published in the USA in 1979 (7), and it became a watershed for worldwide epidemics of the disease. Given the above, the commercial foods that have been minimally supplemented from the late 70's onwards may have been I deficient for most cats, and likely represented a risk factor for the development of thyroid dysfunctions in such a population. Furthermore, cats fed canned food seem to be more prone to developing hyperthyroidism than felines fed dry commercial food products (8, 19) A prolonged I deficiency in dogs (8-12 months) was found to result in variable thyroid patterns but did not have a significant effect on the serum T_4 and T_3 levels (9) demonstrated that commercial diets with a high iodine content could cause hypothyroidism and changes in the bone metabolism of young dogs. However, in the aforementioned studies, the studied puppies were significantly overfed (approx. 75% more than the energy requirement), which resulted in a substantially increased intake of I. Furthermore, the food was deficient in a number of key nutrients, e.g., Calcium, Phosphorus and Potassium, and therefore inappropriate for puppies. Consequently, these results may be considered irrelevant for normal commercial nutritionally balanced pet food products, and the current legal maximum is safe for all types of dogs. Hhypothyroidism is in fact mainly caused by lymphocytic thyroiditis or idiopathic thyroid atrophy. Lymphocytic thyroiditis is considered an autoimmune disorder and there is a hereditary predisposition. It has also been suggested that the disease may be influenced by a major gene (5). The studies that have investigated the occurrence of hypothyroidism in I deficiency areas in humans are countless (10), but limited information is available for cats and dogs. Minimum recommended level of I for adult cats of 0.13 mg/100g dry matter basic (DMB), for adult dogs of 0.11 g/100g DMB with a maximum legal limit for both of 1.10 mg/ 100g (11)

In view of this and given the pivotal role of the I content in the development of thyroid disease in pets, the aim of the present work has been to measure I concentrations in commercial, complete, canned, pet food products sold through different distribution channels in Italy.

Materials and Methods

The I content was analyzed in 12 wet food products (6 for dogs and 6 for cats) produced by 9 different manufacturers, both Italian and foreign, which are distributed in different channels and belong to different commercial brands. Tins were collected in one day and they were stored closed until processing in a cool and dry place. All tins were on sale and the expiry were around 2 years. The considered sample was composed of 12 units divided as follows:

- 4 "1st price" types of pet food sold at Grocery Pet Food (GPF) 2 for dos and 2 for
- 4 types of pet food sold in Specialized Pet Food (SPF) 2 for dogs and 2 for cats
- 4 food Veterinary formula (VF) 2 for dogs and 2 for cats (on sale in Italy in pet shops and at Veterinary surgeries);

The samples were analyzed to establish the I levels through the determination of the absorbable and total I by means of ICP/MS (Inductively Coupled Plasma Mass Spectrometry). This method makes it possible to determine the level of water-soluble I and the total I.

To analyze soluble I, a sample was extracted with water, whereas the sample used for the analysis of the total I was subjected to mineralization. In both cases, the resulting solutions were appropriately diluted and analyzed by means of ICP-MS.

The limit of detection (LoD) was 0.01 mg/kg for the soluble I and total I.

The following performances of the methods were considered:

- the selectivity and the confirmation of identity of the method are guaranteed by the analytical system (ICP-MS);
- The Linearity and Analytical Measurement Range goes up to 4000 mg/kg for soluble I and up to 50 mg/kg for total I;

Statistical analysis

The accuracy was evaluated by means of duplicate analysis of the representative test samples normalized by the mean. The statistical analysis (Bartlett's test) on the normalized data did not show any differences for the total or soluble I. Furthermore, the analysis of the data showed that the Dynamic Range of the method extended over several orders of magnitude and the scatter plots of the grouped normalized data showed a random variability over the measurement range; a greater variability was observed for low concentration values. The accuracy of soluble and total I was up to 0.1 mg/kg (Coefficient of Variation = 11.4%) for higher values (CV = 4.0%). In order to estimate the measurement uncertainty, as well as the precision of the method, the components of uncertainty, linked to systematic effects of the mass and volume measurements and of the calibration curve, were assessed. This resulted in a combined relative uncertainty of 11.7% for the soluble and total iodine for up to 0.1 mg/kg, and 4.6% for higher values. As a result, we obtained an expanded relative uncertainty of 23.3% for the soluble and total I up to 0.1 mg/kg, and 9.3% for higher values.

The resulting I values were then compared with the parameters established by FEDIAF (13), which has established a minimum recommended level of I for adult cats of 0.13 mg/ 100g DMB, a maximum legal limit of 1.10 mg/ 100g for adult dogs and a minimum of 0.11 g /100g DMB, while the maximum legal limit is the same as that of cats.

Results and Discussion

As shown in Tables 1 and 2, two of the six dog products (≈ 33%) had unsuitable levels of I, compared to the levels recommended by FEDIAF (13), one of them had a lower level of I (0,07 mg/100g DMB) and one had a higher level (5,04 mg/100 g DMB) than the reference values. Among the analyzed cat food products, one (≈17%) did not respect the parameters (Tab.2) and presented extremely low levels of I (0,038 mg/100 g DMB), compared to the ones recommended by both FEDIAF (11) and Wedekind (1) (0.046 mg/100g DMB). All tints were completely, percentage of water were 79 to 81 %, protein percentage were 8,5 to 11 %, other parameters was very similar. They used "closed formula" (Meat and derivatives, vegetables, cereals, mineral and vitamins) so we can know only the meet prevalent (beef, lamb, chicken, pork minimum 4%) Two of tins who were with beef are I lower one of cat and one of dog (in total tins with beef were for), these tins were produced by the same manufactures and came from SPF. I content of red meat is variable 0,007-0,555 mg/kg, like poultry meat (0,010-0,627 mg/kg), also to Saltwater fish but higher than the others (0,300-6,926 mg/kg) (21). So, we can speculate that I is not integrated in both by the manufacture, and meat used were low I content. One tin was high I level, content lamb meet and came from GPF. We don't have another simple with the same manufacture, but we have another sample with the same meet with normal I level and came from also GPF. So, we can speculate that the problem was not dependent to the type of meet or the distribution line. According to our results, most of the assessed pet food products fell within the I parameters set by FEDIAF (11), 17% of the samples were in fact found to have low levels and only one was found to have an excess amount. A suitable diet is fundamental for the thyroid function and for the metabolism of its hormones, and the role of I is crucial for their synthesis. Moreover, it has also been demonstrated that an excess of I in the diets of dogs can cause alterations of the thyroid and its functions, with clear effects on the metabolic activity and its hormones 9). In recent years, an increase in diseases related to the thyroid has been observed in cats, and hyperthyroidism. The causes have not yet been fully elucidated, although inadequate levels of I seem to represent a risk factor (6, 19) Several studies have brought to the light the fact that cats fed with a high level of I have a fourfold risk of hyperthyroidism, compared to groups fed low levels (10). Other studies have shown that the concentration of iodine in pet food products was very variable: it ranged from high to low levels and showed amounts that on occasion were not even quantitatively determinable (6,21, 22). Moreover, a recent study conducted in Munich has shown that, among 180 assessed completely dry and wet foods for dogs and cats, the wet foods presented a higher variability of iodine content (13). The percentage of non-compliant products was similar to the our percentage that is, about 17-20 %. The aim

of the present study has been to verify the level of I in commercial products on sale in Italy. Our choice was to carry out the study on wet products, according to the ASSALCO – ZOOMARK (23) report on the feeding and care of pets as there is the tendency to consume more wet products in Italy than dry ones (48.1% wet vs. 43.2% dry), especially for cats (32.4% wet vs. 18.0% dry), and wet products have proved to have a much higher variability of the iodine content. The variation among the canned foods in fact resulted in the ingestion of a range of 49 to 9639 μg I/day (24) Furthermore, it has emerged in several works that hyperthyroidism seems to target cats fed with canned food more frequently than those fed with dry or mixed food products (8,16,17, 20,21) It is possible that dramatic fluctuations in the iodine in take may contribute to the current increase in feline thyrotoxicosis and may be It is possible to understand why it is more common in those cats that eat wet food products as the variability is higher. although there are conflicting reports in literature. In fact, another study showed that 25% of the assessed cats affected by hyperthyroidism had never been fed canned food (16). Our study has shown I levels that, in most cases, fall within the range of referral as well as unsuitable levels in both cats and dogs, as had already emerged in previous studies. With the data available to us so far, it is possible to consider I as a risk factor of hyperthyroidism in cats in Italy, and this data alone cannot justify this high incidence, in view of the fact that this pathology is not so common in dogs. It would probably be correct to consider it as a multi-factorial disease: genetic predisposition, pollution (goitrogenic substances, toxins) (18, 20, 21) nutritional factors (I and the variability of I, Selenium level) (6,10) and the packaging materials, for example Bisphenol A (8, 20) Further studies are necessary and desirable to clarify these aspects.

Acknowledgments: The authors wish to acknowledge the help provided by Dr Alessia Candellone.

Declaration of interest: The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of this manuscript.

References

1. Wedekind KJ, Blumer ME. The feline iodine requirement is lower than the 2006 NRC recomended allowance. J Animal Phisiol Anim Nutr (Berl) 2010 ; 94(4): 527–39.
2. Mullur M, Liu YY. Thyroid hormone regulation of metabolism. Physiol Rev. 2014; 94(2): 355-82.
3. Mooney CT. Pathogenesis of feline hyperthyroidism. J Feline Med Sur. 2002; 4(3): 167-9.
4. Mc Lean JL, Lobetti RG. Prevalence of and risk factors for feline hyperthyroidism in South Africa. J Feline Med Surg 2017; 19(10) 1103-1109.
5. Ahlgren J, Uimari P. Heritability of hypothyroidism in the Finnish Hovawart population. Acta Vet Scand. 2016; 7:58: 39
6. Edinboro CH, Scott-Moncrieff JC. Feline hyperthyroidism: potential relationship with iodine supplement requirements of commercial cat foods. J Feline Med Surg.2010; 12(9): 672-9.
7. Peterson ME. Animal models of disease: feline hyperthyroidism: an animal model for toxic nodular goiter. J Endocrinol. 2014; 223(2): T97-114.
8. Peterson ME. Hyperthyroidism in cats: what's causing this epidemic of thyroid disease and can we prevent it? J Feline Med Surg. 2012; 14(11):804-18.
9. Castillo VA, Pisarev MA. Commercial diet induced hypothyroidism due to high iodine. A histological and radiological analysis. Vet Q. 2001; 23(4):218-23.
10. Zimmermann MB, Boelaert K. Iodine deficiency and thyroid disorders. Lancet Diabetes Endocrinol. 2015; 3(4):286-95.
11. European Pet Food Industry Federation. 2019. Nutritional guidelines for complete and 24 complementary pet food for cats and dogs. Brussels, Belgium: FEDIAF.
12. Ranz D, Tetrick M, Opitz B, Kienzle E., Rambeck WA. 2002. Estimation of iodine status of cats. J Nutr 2002; 132 (6 suppl 2): 1751S- 1753S.
13. Alborough R,Espenica S,Gardner DS. Iodine analysis of complete dog and cat food in the UK in comparison to European feed recommendations 2018. 22nd Congress of the European Society of Veterinary and Comparative Nutrition September 6th-8th . 209
14. ASSALCO – ZOOMARK. 2019. Report on the feeding and care of pets http://www.assalco.it/index.php?action=showownews&id=1&nid=5702
15. Edinboro CH, Pierce EN, Pino S Braverman LE. 2013. Iodine concentration in commercial cat foods from three regions of the USA. J Feline Med Surg. 2008-2009; 15(8):717-24.
16. Stephens MJ, O'Neill DG, Church DB McGreevy PD, Thomson PC, Brodbelt DC. Feline hyperthyroidism reported in primary-care veterinary practices in England: prevalence, associated factors and spatial distribution. Veterinary Record 2014 ;1 75:458.
17. Wakeling J, Everard A, Brodbelt D, et al. Risk factors for feline hyperthyroidism in the UK. Journal of Small Animal Practice 2009; 50: 406-414.

18. Hites RA. Polibrominateddiphenyl ethers in the environment and in people: a meta-analysis of concentrations. Environmental science & technology 2005; 39;925-931.
19. Kohler I, Ballhausen BD, Stockhaus C, Hartmann K, Wehner A, Prevalence of and risk factors for feline hyperthyroidism among a clinic population in Southern Germany. T Praxis, 2016; 16;44(3):149-57
20. Bernt J, Norrgran J, Weiss J, Are persistent organic pollutants important in the etiology of feline hyperthyroidism? A review. Acta vet scand 2019; 61;45
21. Haldimann M, Alt A, et al Iodine content of food groups. JFood Composit Analy 2002;15:265-276

Correspondence
Dr Natalia Russo,
Dipartimento di Scienze Veterinarie,
14 Universita'di Torino,
Largo Braccini 2, 10095 Grugliasco, Italy
E-mail: natalia.russo@unito.it