

Food and nutritional requirements for dogs



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INTRODUCTION

Domestic dogs (*Canis familiaris*) are the most popular pet species in Britain, excluding fish (PFMA, 2014), and as such there are a wide variety of stakeholders in dog welfare, ranging from the owner and veterinarian to insurance companies and animal welfare charities (Buckland *et al.* , 2013). The pet food business is a multi-million pound industry which aims to produce adequate foodstuffs for pets in terms of nutritional content, but also aims to turn a profit as in any other trade (Thompson, 2008; FEDIAF, 2012). As such, the nutritional quality of pet food varies between brands and the usage of non-meat sources of protein has been questioned (Hilton, 1987). This paper aims to highlight the carnivorous origins of domestic dogs, review their major protein, vitamin and mineral requirements including some of the issues pertaining to inadequate pet food nutrition and develop a conclusion to the hypothesis: dogs can survive on a ' vegetarian' diet.

TAXONOMY AND EVOLUTION

All dogs, Family Canidae, are members of the Order Carnivora and possess the enlarged carnassial teeth associated with the carnivorous diet characteristic of this taxon (Wang *et al.* , 2004). Carnivora is split into two suborders: Feliformia, which includes felids, and Caniformia which includes canids. The Suborder Caniformia is then further divided into two sister subfamilies: Cynoidea, which includes Canidae, and Arctoidea which includes the Mustelidae, Procyonidae, Ursidae and Pinnepedia.

Canidae is reported to be the earliest diverging family of the Caniformia, approximately nine million years ago (Wayne & O'Brien, 1987) and currently

hosts 34 extant species of wolf, dog and fox. Domestication of dogs has been traced back approximately 15, 000 years, with the earliest known *C. familiaris* fossil dating back 14, 000 years (Sablin & Khlopachev, 2002). The grey wolf (*Canis lupus*) was almost certainly the precursor species of the domestic dog, based on mitochondrial DNA sequencing (Garcia-Moreno *et al.* , 1996). Studies on grey wolf diet have shown it to be a primary carnivore which is highly adaptable to variations in prey, whereas domestic dogs have a much wider tolerance of different food types, facilitated by the adaptation of three genes involved in starch metabolism (Axelsson *et al.* , 2013).

Distinctive breeds appear to have diverged approximately 3000-4000 years ago (Harcourt, 1974; Clutton-Brock, 1984), with the greyhound being one of the most ancient breeds, however modern domestic dogs are known to exhibit similar foraging behaviours to their wild ancestors (Bradshaw, 2006). The variation in size and therefore energy requirements of breeds within dogs is the largest of any mammalian species (Lauten, 2006). Therefore pet food must accommodate not only differences in breed and size, but also other factors such as age, activity, reproductive status, environment and health (FEDIAF, 2013).

PHYSIOLOGY

Cats are described as obligate carnivores because protein is metabolised for energy as well as functioning in structural and synthetic processes (Zoran, 2002). In contrast, dogs can survive on an omnivorous diet by adjusting the catabolism of protein within the body when fed a low-protein diet, and can metabolise glucose from higher concentrations of carbohydrate thereby reducing the need for proteinaceous energy (Zoran, 2002). Dogs are unable

to synthesise ten essential amino acids which are required for the synthesis of protein within the body for structural and metabolic processes (Lotspeich, 1949). Therefore protein is an essential component of the diet, providing a vital source of essential amino acids.

NUTRITIONAL REQUIREMENTS

For adult dogs, the minimum recommended level of protein within dry matter food is 18g/100gDM. For pregnancy and early growth stages, i. e. puppies under 14 weeks old, this requirement is increased to 25g/100gDM. Above 14 weeks old, but still before adulthood, a minimum of 20g/100gDM is recommended (FEDIAF, 2013). With every 1%DM increase in protein, an extra 0.01g of arginine is recommended (NRC, 2006). Pet food manufacturers are required to meet these minimum recommended amounts of dietary nutrition for the target consumer animal they are producing for (FEDIAF, 2013); this means that owners have peace of mind when choosing a diet for their dog, knowing that it is nutritionally balanced. However, constituents of pet food must meet optimal criteria for nutrition, palatability, digestibility and be economical (Thompson, 2008). If a food is too expensive, owners are likely to resort to a lower cost food or feed their dog upon scraps which increases the risk of an unbalanced diet and improper nutrition (Coffee *et al.*, 1980).

Table 1: Popular and premium dog food constituent comparisons. Prices with ^a sourced from Tesco (2015) or ^b from Petplanet (2015), dashes indicate no data.

Dog Food Brand	Dry/	Crude	Fat	Crude	Fibre	Moisture	Cost	Source
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	Wet	Protein (%)	(%)	Ash (%)	(%)	(%)	(£/kg)	
Bakers Complete Tasty Beef	Dry	21.0	10.0	8.0	2.5	-	2.66	^a Bakers
Ceser Can with Chicken and Turkey	Wet	9.0	5.0	-	0.3	83.0	3.73	^a Tesco
Hi Life Feed Me with Turkey and Chicken	Dry	21.0	7.0	-	3.0	21.0	2.50	^a Tesco
Iams ProActive Health Adult Small & Medium Breed	Dry	26.0	15.0	7.4	3.0	8.0	2.50	^a Iams (
James Wellbeloved Adult Fish and Rice	Dry	21.5	10.5	7.3	3.1	-	2.79	James Wellbe (2015)
James Wellbeloved Adult Turkey and Rice	Wet	6.5	4.0	1.5	0.5	81.0	4.66	b
Pedigree Complete Adult with Chicken	Dry	21.0	13.0	-	3.0	12.0	2.50	^a Pedigr (2015)

Pedigree Complete Puppy Nutrition Chicken Dry and Rice		28.0	16.0	-	2.5	12.0	2.33 ^a	
Pedigree with Beef In Gravy	Wet	7.0	5.5	-	0.5	81.0	1.50 ^a	
Royal Canin Giant Adult	Dry	28.0	20.0	5.2	1.8	8.0	2.93 ^b	Royal (2014)
Royal Canin Medium Adult	Dry	25.0	14.0	5.9	1.2	9.5	2.93 ^b	
Royal Canin X-Small Adult	Dry	24.0	18.0	5.7	1.7	9.5	5.66 ^b	
Tesco Everyday Value Beef Chunks in Gravy	Wet	6.5	4.0	2.0	0.5	81.5	0.81 ^a	Tesco
Tesco Everyday Value Complete Dog Food	Dry	21.0	8.5	-	3.0	-	0.59 ^a	
Wafcol Vegetarian Dog Food	Dry	20.0	5.0	7.0	6.0	-	1.73 ^b	Petpla (2015)

DOG FOOD CONSTITUENTS

Complete dog foods are those which are nutritionally balanced and suitable to be fed daily (FEDIAF, 2013). They meet the minimum FEDIAF standards

and do not exceed maximal recommendations where stated (e. g. lysine during growth), although differences in protein, fat and carbohydrate ratios are seen among brands with cost typically increasing with protein content (Thompson, 2008), as described in table 1.

Traditional dog foods use meat protein sourced from cuts of meat, viscera or meat meal and may be packaged in cans or within cereal based dry kibble which is treated with meat flavours to improve palatability (McGrane, 2006). Extrusion is a technique used in the production of about 95% of dry pet foods in order to improve the palatability and utilisation of protein through heat treatment (Bednar *et al.* , 2000; Tran *et al.* , 2008). Processing of soybeans is carried out to remove toxins such as lectin and protease inhibitors but also destroys the naturally high concentrations of B vitamins such a thiamine (Gregory, 1985; Hilton, 1987; LebieziÅ,, ska & Szefer, 2006).

Dietary protein may come from either animal or vegetable sources (NRC, 2006), with a huge increase in the usage of soybean products (ground soybeans, soy flour, soy hulls, soybean oil and concentrate) reducing production costs of pet food and facilitating the anthropomorphic ‘vegetarian’ diet which some owners are feeding their pets (McGrane, 2006). However, Kienzle & Engelhard (2001) found that only two of the twelve commercially available foods investigated in their European study provided adequate nutrition according to recommendations set out by AAFCO, mainly on the basis of protein concentration. As shown in table 1, the vegetarian food had the lowest percentage of protein, and it has been suggested that the vegetable products those diets are made up of may not contain the correct balance of amino acids necessary for a healthy dog (Coffee *et al.* , <https://assignbuster.com/food-and-nutritional-requirements-for-dogs/>

1980; Hilton, 1987). For example, arginine, which is required for optimal growth in young dogs and plays an intermediate role in the urea cycle (Burns *et al.*, 1981; FEDIAF, 2013), cystine and methionine, both implemental in coat condition, are all naturally abundant in animal tissue (Wu & Morris, 1998).

The levels and source of dietary protein and the form it is delivered in can have significant effects on the health of a dog. For example, diets low in protein can cause hypoproteinemia (a low concentration of albumin and total protein in the blood) leading to edema (Weech *et al.*, 1935) or pancreatitis in high-fat, low-protein diets (Lindsay *et al.*, 1948). Zhao *et al.* (1997) demonstrated that assimilation of protein into the gut is limited by digestibility, which in turn is affected by the form of protein with a food. If the source of protein available within the food is intact, around 40% remains undigested but available within the ileum four hours after a meal. In comparison, hydrolysed proteins (those which have been broken down into constituent amino acids) have an absorption rate of over 70% within an hour in humans (Chung *et al.*, 1979).

EFFECTS OF A VEGETARIAN DIET

Diets reduced in meat and fish are most often fed to dogs due to owner preference as opposed to health reasons; in studies recruiting pets fed vegetarian diets all owners report being vegetarian themselves (Kienzle & Engelhard, 2001; Michel, 2006; Rothgerber, 2014). The reported effects of a vegetable-based diet for dogs are variable due to the low incidence of vegetarian dogs in the population and the lack of long term studies (Kienzle & Engelhard, 2001). Some diets are strictly vegan and supplemented with

vitamins and minerals, whereas others are more lenient and treated with meat-based products in order to increase palatability (Michel, 2006).

In a study carried out across Germany, Switzerland and Belgium (Kienzle & Engelhard, 2001), nutrient intake of 86 dogs fed a vegetarian diet was investigated through owner interviews and blood samples. The study found that protein intake was not sufficient in over half of those dogs tested, 62% showed sub-optimal calcium levels, 73% showed insufficient sodium intake and deficiencies in zinc, iron and vitamin D were also common. In a separate study, zinc deficiency caused by phytate, a zinc-binding molecule present in soybean meal, led to the development of skin conditions in puppies fed on a soy based diet (Sanecki *et al.* , 1982).

The high fibre content associated with vegetable and cereal foods can cause bowel irritation by affecting gastrointestinal motility and absorption of nutrients (Bueno *et al.* , 1981; Earle *et al.* , 1998).

Proteins play a vital role in the condition of a dog's coat, particularly those high in methionine and cystine amino acids because they synthesise keratin (Dethioux, 2008). Complete dog food diets contain these amino acids in suitable concentrations through meat protein, however vegetarian diets show a marked deficiency in these amino acids, and soy protein has a proven negative effect on serum lipids (Anderson *et al.* , 1995); therefore the dog may suffer from alopecia and depleted coat condition when on a plant-protein diet (Dethioux, 2008). Thiamine is a vital part of carbohydrate metabolism and deficiency can severely affect parts of the body which have high energy requirements, such as the brain (Markovich *et al.* , 2013).

Clinical signs of thiamine deficiency may take weeks to develop, but will be characterised by a progressive loss of normal motor function such as a head tilt, falling and lack of coordination, ultimately ending in seizures and death if untreated (Markovich *et al.* , 2013).

Furthermore, soy has been identified in controlled studies as an important allergen, although incidences of soy allergies were significantly lower than those relating to beef and dairy (4. 7% and 34. 2% respectively) (Wills & Harvey, 1994).

Treatment for amino acid, vitamin and mineral deficiencies involve feeding a balanced nutritional diet appropriate for the dog's size, age, activity level and health, which in a vegetarian diet is possible through the addition of supplements (Michel, 2006).

CONCLUSION

Proteins from non-meat sources are harder for dogs to digest and therefore are of less nutritional value than meat. While dogs can survive on this diet, the lack of sufficient protein and other dietary constituents such as vitamins and minerals will lead to improper nutritional value which can ultimately affect the health of the animal. From a manufacturer's perspective, it is possible to create a vegetarian pet food which complies to AAFCO standards of nutritional content, however the economic savings of not using meat are offset by the need to add supplements and highly refined components to improve palatability and digestibility. For the owner, although they may feel less guilt by feeding their pet a vegetarian diet, they must feed a greater quantity to achieve similar levels of protein and nutrients within the animal

(Rothberger, 2014) and the general healthy appearance of their pet is often diminished (Dethioux, 2008). Although dogs can survive on a diet of vegetarian-based protein, the natural instincts of a hunting animal still exist from the ancestral wolf and given the opportunity a dog will forage for alternative sources of food (Bradshaw, 2006). The general literary consensus remains that dogs are opportunistic feeders within the Carnivora, and their physiology shows a preference for ingesting and digesting meat protein (Hilton, 1987).