PURINA REPORT ON THE IMPACT OF INCLUSION OF FROZEN CHICKEN IN DOG FOOD ON DIGESTIBILITY, BIOAVAILABILITY AND BODY WEIGHT MAINTENANCE

Bouthegourd J. C., Conboy-Schmidt L., Roos M. (2014)

This scientific report illustrate the effect the effects of the Purina proprietary technology on higher protein and fat digestibility, better absorption of essential fatty acid and higher bioavailability of some limiting amino acids such as lysine and arginine thanks to 14-25% of total protein content coming from chicken.

Dietary protein is required to provide essential amino acids and nitrogen for the synthesis of non-essential amino acids, endogenous proteins, other nitrogenous compounds, and also to provide energy. An adapted level of high quality protein is essential for canine health: strengthening muscles and helping to maintain lean body mass, for healthy skin and coat, to support the immune system, and all vital organ function. Typical protein sources used in pet food formulation include unprocessed fresh or frozen animal parts, animal protein meals, and vegetable protein sources. Previous literature has indicated that heat treatment can reduce the digestibility of chicken by-product meal compared to unprocessed chicken (Murray *et al.*, 1997). Heating can also reduce both the level and the bioavailability of essential amino acids (EAA), in particular the heat sensitive amino acids lysine (Batterham *et al.*, 1986; Pérez-Calvo *et al*, 2010). Amino acid levels vary according to the protein sources, the lowest bioavailable amino acid limits the overall anabolism of protein (i.e. protein synthesis), and thus it is important to ensure that combined protein sources provide the ideal balance of amino acids for optimum protein synthesis and growth. Thus, we investigated the optimal protein sources and levels for the production of a superior canine maintenance diet (under the PRO PLAN Brand).

Two studies were performed; Study 1 to determine if feeding adult dogs a diet formulated with frozen fresh chicken (chicken) compared to poultry meal (PM) was associated with differences in protein and amino acid digestibility and bioavailability. Study 2 to investigate the optimal level of chicken inclusion in an adult maintenance diet.

In study 1, 16 adult dogs of various breeds and genders of were fed, in a cross over design, diets containing 25% of the total protein fraction from chicken or 25% from PM, both as the sole animal protein source. Remaining protein sources were high quality corn grain and corn gluten meal. Diets were formulated to be nutritionally complete and to meet or exceed minimum requirements for adult dogs as established by FEDIAF (FEDIAF 2014). Total dietary protein was 18% on a dry matter basis, amino acid profile did not differ between the diets. All dogs were individually housed in indoor kennels with free access to outside yard. To determine nutrient digestibility, diets were fed for a 7 day adaption period followed by 6 days of faecal collection. Apparent

digestibility was calculated by comparing nutrient intake to nutrient output. EAA availability was evaluated from blood samples taken before (basal) and after feeding.

In study 2, we determined the level of chicken that would support optimal nutrient digestibility. Amino acids availability was also investigated. 12 dogs received diets contain 25% total dietary protein with varying levels of chicken: 0% chicken (sole animal protein from PM), 14% or 20% chicken. The protein content of the diets was identical (25%), and the protein contribution from chicken was replaced with the equivalent protein contribution from PM. A cross over design was again applied.

All studies were carried out with full Animal Care and Use Ethical Committee consideration at the Nestlé Purina PetCare, France.

In study 1, nutrient digestibility for both diets was excellent, with protein digestibility exceeding or equal to 85% which is indicative of high quality proteins. However, overall protein and fat digestibility was significantly higher in the chicken compared to the PM diet (Table 1). Dry matter (DM), organic matter (OM), Ash, and gross energy (GE) digestibility were high and equivalent.

Table 1: Digestibility values in Study 1

Protein and fat digestibility were significantly higher in the chicken diet compared to the PM diet.

	Mean±SEM		P value
Digestibility	**Chicken**	**PM**	***t*-test**
Dry Matter	84.96 ± 1.42	84.96 ± 1.6	0.999
Organic Material	89.00 ± 1.13	88.61 ± 1.28	0.532
Crude Protein	88.14 ± 1.68	86.10 ± 1.85	0.037
Fat	96.59 ± 0.97	94.35 ± 1.07	0.001
Ash	35.21 ± 5.44	37.97 ± 6.56	0.377
Gross Energy	89.25 ± 1.12	88.42 ± 1.23	0.182

There was a significant difference in blood lysine (Figure 1) and arginine (Figure 2) post-prandial enrichments ($p<0.05$).

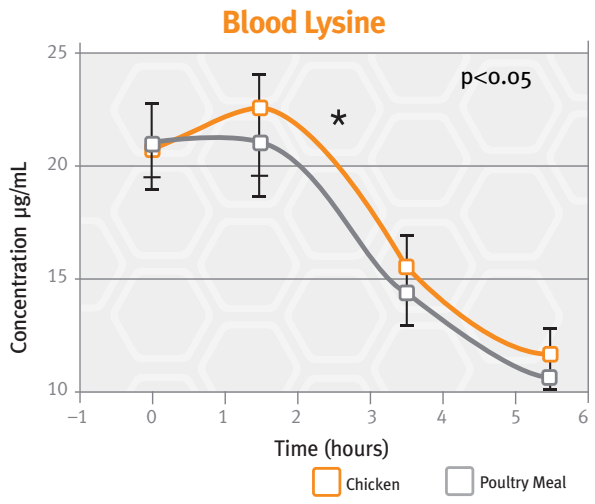

Figure 1: Blood lysine values of dogs fed either chicken or PM *(Study 1)*. Over time the area under the curve (AUC) was significantly higher with the chicken compared to PM diet ($p<0.05$).

Blood arginine levels were significant higher after feeding the chicken compared to PM diet, indicative of greater bioavailability of this essential amino acid in the chicken diet (Figure 2).

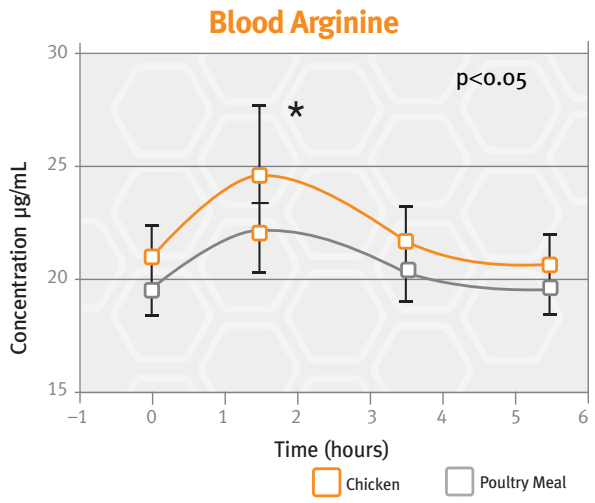

Figure 2: Blood arginine values of dogs fed chicken or PM diets (Study 1). Diet had a signicant effect on blood arginine level ($p<0.05$).

In study 2, when total dietary protein was 25% for both diets, no difference in nutrient digestibility was found, however protein digestibility tended to be reduced with a lower chicken inclusion (data not shown). In comparing a diet including chicken which provided a total of 18% dietary protein (study 1) to diet including chicken but which provided a total of 25% dietary protein (study 2), our results indicate that amino acids lysine and arginine are limiting on the 18% protein diet but fully available to sustain protein synthesis on a 25% protein diet.

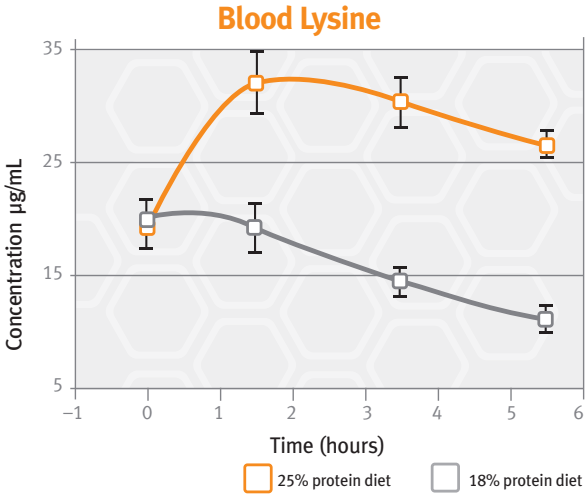

Figure 3: Blood lysine in dogs fed either 25% or 18% protein diets (including chicken).

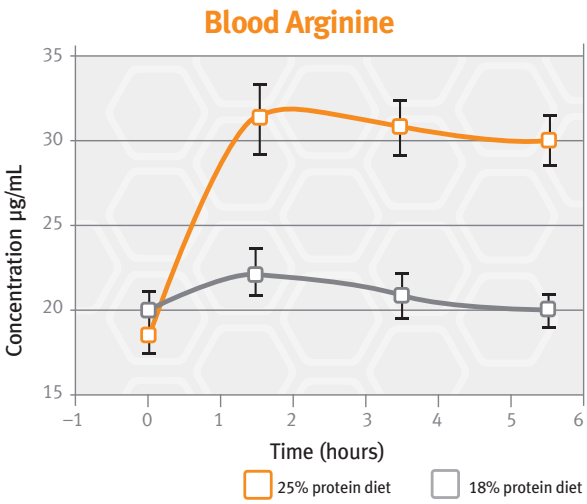

Figure 4: Blood arginine in dogs fed either 25% or 18% protein diet (including chicken).

In study 2, uptake of the essential fatty acid linoleic acid was significantly higher in the 14% and 20% chicken diets compared to the 0% chicken diet (Figure 5). This is due to a better fatty acid profile of chicken vs PM (higher linoleic acid content).

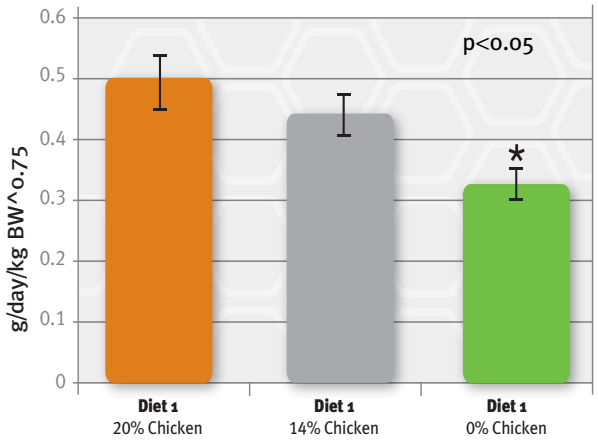

Figure 5: **Linoleic acid uptake (Study 2).** Net uptake of linoleic acid was significantly higher in the 20% chicken and 14% chicken diet compared to the 0% chicken diet.

The period in which study 2 was conducted coincided with a period of extreme cold weather in northern France. Due to these extreme weather conditions dogs had difficulty in maintaining body weight. A better body weight maintenance was observed in the dogs fed the 14% and 20% chicken compared to 0% chicken diet (Figure 6).

From our studies we could conclude that the use of high quality protein from chicken can significantly improve the nutritional quality of a canine diet. We showed that this ingredient promotes a higher protein and fat digestibility as well as a better absorption of essential fatty acid and higher bioavailability of limiting amino acids like lysine and arginine.

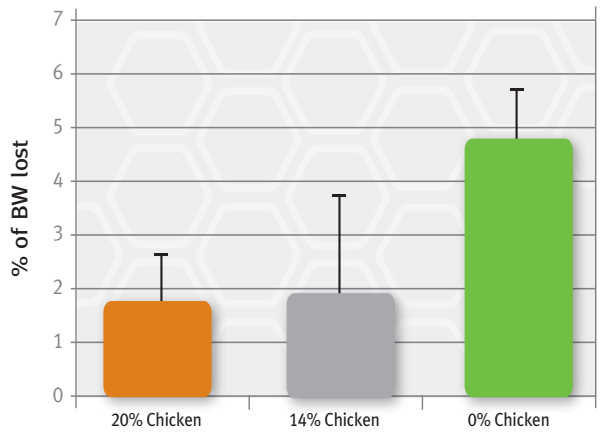

Figure 6: Spontaneous body weight loss of the dogs during a natural physiological challenge (cold external temperatures) according to the diet (study 2). There was a trend towards increased spontaneous weight lost in the 0% chicken diet compared to 14% and 20% chicken diets.

Also we demonstrated that a 25% protein diet compared to a 18% protein diet delivers higher amino acids bioavailability. When the 25% protein diet containing high quality protein from a minimum of 14% chicken was fed to dogs under natural conditions of physiological stress (such as cold temperatures), it helped dogs to better maintain body weight, compared to the same diet formulated with PM as its sole animal protein source. It shows the long term health benefit of providing highly bioavailable essential amino acids and fatty acid in the diet to canines.

Overall these studies indicate that superior nutrient absorption can be achieved by feeding a 25% protein diet containing 14% chicken as an animal protein source. These research outcomes have been implemented in the new PRO PLAN canine maintenance diet range.

REFERENCES:

Batterham ES, Andersen LM, Lowe RF, Darnell RE. (1986). Availability of lysine in meat meal. Meat and bone meal and blood meal as determined by the slope-ratio assay with growing pigs. Rats and chicks and by chemical techniques. Br. J. Nutr. 55. 427-440.

FEDIAF. Nutritional Guidelines for Complete and Complimentary Pet Food for Cats and Dogs. 2014. http://www.fediaf.org/self-regulation/nutrition/

Murray SM, Patil AR, Fahey GC Jr, Merchen NR, Hughes DM (1997). Raw and rendered animal by-products as ingredients in dog diets. J Anim Sci. 75(9). 2497-2505.

Pérez-Calvo E, Castrillo C, Baucells MD, Guada JA (2010). Effect of rendering on protein and fat quality of animal by-products. J Anim Physiol Anim Nutr (Berl). 94(5). e154-163.