[13](#_bookmark27)

[Nutrient Composition of](#_bookmark27) [Ingredients Used in Dog and](#_bookmark27) [Cat Foods](#_bookmark27)

# Data in [Tables 13-1](#_bookmark18) through [13-9](#_bookmark32) were compiled from commercial feed ingredient suppliers, published literature, and unpublished data provided by university researchers.[1](#_bookmark38) The tables include means and, when available, the standard deviation and number (*N*) of samples used to generate those statistics. Users should examine the standard deviation and *N* before using the mean value as an estimate of the nutritional content of a specific feed ingredient. Means derived from a large *N* will better reflect the total population. Means with a large standard deviation may represent the total population, but be a poor estimate for a specific sample. Common names are used to designate feed ingredients.

[T](#_bookmark19)[ABLE 13-1 Proximate Analysis of Selected Feed Ingredients (as fed)](#_bookmark19)[*a*](#_bookmark0)

*c*Dry matter.

# [TABLE 13-7 Vitamin Content of Selected Ingredients (mg/kg, as](#_bookmark26) [fed)](#_bookmark26)[*a*](#_bookmark30)

[TABLE 13-8 Composition of Selected Inorganic Macro-mineral Sources Used in Petfood](#_bookmark25)

*a*International Feed Number.

# [TABLE 13-9 Composition of Selected Inorganic Micro-mineral Sources Used in Petfood](#_bookmark24)

*a*International Feed Number.

[**REFERENCES**](#_bookmark23)

Bach-Knudsen, K. E. 1997. Carbohydrate and lignin contents of plant materials used in animal feeding. Anim. Feed Sci. Technol. 67:319-338.

Belch, J. J. F., and A. Hill. 2000. Evening primrose oil and borage oil in rheumatologic conditions. J. Clin. Nutr. 71:3525-3565.

Khan, M. A., and F. Shahidi. 2000. Tocopherols and phospholipids enhance the oxidative stability of borage and evening primrose triacylglycerols. J. Food Lipids 7:143-150.

National Research Council (NRC). Nutrient Requirements of Swine. 1998.

Washington, D.C.: National Academy Press.

Senanayake, S. P., and F. Shahidi. 1999. Enzyme-assisted acidolysis of borage and evening primrose oil. J. Agric. Food Chem. 47:3105-3112.

Spitze, A. R., D. L. Wong, Q. R. Rogers, and A. J. Fascetti. 2003. Taurine concentrations in animal feed ingredients; cooking influences taurine content. J. Anim. Physiol. Anim. Nutr. 87:251-262.

Spurvey, S. A., and F. Shahidi. 2000. Concentration of gamma linolenic acid (GLA) from borage oil by urea complexation: Optimization of reaction conditions. J. Food Lipids 7:163-174.

[1](#_bookmark16) An excellent source of information for feed ingredients not included here is contained in [Chapter 11](#_bookmark2) of the report Nutrient Requirements of Swine, available online at <http://www.nap.edu/catalog/6016.html> ([NRC, 1998](#_bookmark35)).

# case, the requirement relative to ME will be about 40 percent greater in a 6-kg cat than in a 2-kg cat and twice as large for a 100-kg dog as for a 2-kg dog (i.e., the diet would need to be more nutrient dense for a large than for a small animal).

[**Note on Bioavailability**](#_bookmark17)

# The proposed minimal concentrations and amounts of vitamins are the total bioavailable forms of the vitamins present in the diet (contributed by natural ingredients and vitamin premixes) at the point of consumption. Because the natural forms of some vitamins have low bioavailabilities, the proposed amount will generally be adequate when the majority of that vitamin is from a vitamin premix. However, when a vitamin is contributed mainly by food ingredients, the minimal concentration in the tables should be modified to account for bioavailability by using a suitable factor. For a discussion of the bioavailability of vitamins from various foods, refer to [Baker (1995)](#_bookmark20).

[TABLE 15-1 Change in Requirements Relative to ME (per 1,000 kcal) if Requirements Vary Directly with BW](#_bookmark3)

|  |  |  |
| --- | --- | --- |
| Species | BW (kg) | Change (%) |
| Dog | 2 | – 40 |
|  | 5 | – 24 |
|  | 10 | – 10 |
|  | 15 | No change |
|  | 20 | + 7 |
|  | 40 | + 28 |
|  | 60 | + 41 |
|  | 80 | + 52 |
|  | 100 | + 61 |
| Lean cat | 2 | – 20 |
|  | 3 | – 9 |
|  | 4 | No change |
|  | 5 | + 8 |
|  | 6 | + 14 |

[Table 15-1](#_bookmark39) is intended to illustrate the concept that, for nutrients whose requirements vary directly with BW, the value of those nutrient requirements expressed relative to ME will increase or decrease with differences in BW. The table should not be used to formulate diets. Rather, the reader is directed to the footnotes in each of the subsequent tables in [Chapter 15](#_bookmark2) that provide information on how to calculate requirements for cats and dogs of different sizes.

The reader should take note that this published report reflects a number of changes made to correct and update an unedited prepublication version of this report. Some values, particularly in [Chapter 15](#_bookmark2), have been revised or deleted based on the availability of new information or to correct errors in calculation. These changes were examined by four independent reviewers and have been approved by the authoring committee and the institution. This final published version of the report therefore supersedes the data contained in the prepublication.

# [TABLE 15-2 Daily Metabolizable Energy Requirements for Growth of Puppies After We](#_bookmark4)[aning](#_bookmark4)[*a*](#_bookmark43)[*,*](#_bookmark4)[*b*](#_bookmark44)

Where:

*Example:*

ME (kcal) = maintenance amount × 3.2 × [*e*(–0.87*p*) – 0.1] ME (kcal) = 130 × BW 0.75 × 3.2 × [*e*(–0.87*p*) – 0.1]

*p* = BWa /BWm

a

BWa = actual body weight at time of evaluation (kg) BWm = expected mature body weight (kg)

*e* = base of natural log ≈ 2.718

Labrador puppy 16 weeks of age, 17 kg actual body weight, expected mature weight 35 kg ME (kcal) = 130 × 170.75 × 3.2 × [*e*(–0.87 × 17/35) – 0.1] = 1,934 kcal

*[a](#_bookmark40)*This table refers to puppies after weaning. Newborn puppies need about 25 kcal per 100 g BW ([Kienzle et al., 1985](#_bookmark22)).

*[b](#_bookmark41)*Maintenance energy requirements of inactive puppies such as pet puppies without opportunity and/or stimulus to exercise may be lower by 10 to 20 percent, and maintenance energy requirements of very active puppies, such as Great Danes in kennels, may be higher.

# [TABLE 15-3 Nutrient Requirements for Growth of Puppies After Weaning](#_bookmark5)

*a*The values for Amt/kg DM have been calculated assuming a dietary energy density of 4,000 kcal ME/kg. (The term ≡ signifies equivalence.) If the energy density of the diet is not 4,000 kcal ME/kg, then to calculate the Amt/kg DM for each nutrient, multiply the value for the nutrient in the column labeled Amt/kg DM by the energy density of the pet food (in kcal ME/kg) and divide by 4,000.

*b*To calculate the amount to feed of each nutrient, multiply the value for Amt/1,000 kcal ME for each nutrient by the energy requirement for the puppy in kcal (calculated from [Table 15-2](#_bookmark42)) and divide by 1,000.

*c*The values for Amt/BW0.75 apply only to 5.5-kg puppies of expected mature body weight of 35 kg. To calculate the amount of a nutrient for puppies of different current or expected mature

body weights, calculate the energy requirement from [Table 15-2](#_bookmark42) and multiply this by the nutrient Amt/1,000 kcal and divide by 1,000.

*d*For 4 to 14 week-old puppies, 0.01 g arginine should be added for every g of crude protein above 180 g and 225 g, for the MR and RA, respectively, of arginine. For puppies over 14 weeks of age, 0.01 g arginine should be added for every g of crude protein above 140 g and 175 g for the MR and RA of arginine, respectively.

*e*The quantity of tyrosine required to maximize black hair color may be about 1.5-2.0 times this quantity.

*f*The requirement for α-linolenic acid varies depending upon linoleic acid content of the diet. The ratio of linoleic acid to α-linolenic acid should be between 2.6 and 16. Note that 0.8 g/kg DM value shown is the minimum RA of α-linolenic acid at 13 g linoleic acid per kg DM resulting in a ratio of linoleic acid to α-linolenic acid of approximately 16. *g*Eicosapentaenoic acid should not exceed 60% of the total amount.

*h*The RA for the calcium requirements of weaned puppies (of expected mature body weight

>25 kg) for up to 14 weeks of life should not be less than 0.54 g calcium/kg body weight.

*i*Some oxide forms of iron and copper should not be used because of low bioavailability.

*j*For vitamin A, requirements are expressed as RE (retinol equivalents). One RE is equal to 1 μg of all-*trans* retinol, and one IU of vitamin A is equal to 0.3 RE. Safe upper limit values are expressed as μg retinol.

*k*1 μg cholecalciferol = 40 IU vitamin D3.

*l*Higher concentrations of vitamin E are recommended for high PUFA diets. One international unit of vitamin E = 1 mg all-*rac*-α-tocopheryl acetate (see [Chapter 8](#_bookmark2)).

*m*Dogs have a metabolic requirement, but a dietary requirement has not been demonstrated when natural diets are fed. Adequate vitamin K is probably synthesized by intestinal microbes. The vitamin K allowance is expressed in terms of the commercially used precursor menadione that requires alkylation to the active vitamin K.

*n*For normal diets not containing raw egg white, adequate biotin is probably provided by microbial synthesis in the intestine. Diets containing antibiotics may need supplementation.

# [TABLE 15-4 Daily Metabolizable Energy Requirements for Adult Dogs at Maintenance](#_bookmark6)

Type

Kcal × kg BW0.75

# Average for laboratory kennel dogs or active pet dogs[*a*](#_bookmark49) 130

# Above average requirements:

# Young adult laboratory dogs or young adult active pet dogs 140

# Adult laboratory Great Danes or active pet Great Danes 200

# Adult laboratory terriers or active pet terriers 180

# Below average requirements:

# Inactive pet dogs[*b*](#_bookmark50) 95

# Type

Older laboratory dogs or older active pet dogs or laboratory Newfoundlands

Kcal × kg BW0.75 105

*[a](#_bookmark47)*Dogs kept in a domestic environment with strong stimulus and ample opportunity to exercise, such as dogs in multiple dog households in the country or in a house with a large yard.

*[b](#_bookmark48)*Dogs kept in a domestic environment with little stimulus and opportunity to exercise. Requirements of older or overweight dogs may still be overestimated.

# [TABLE 15-5 Nutrient Requirements of Adult Dogs for Maintenance](#_bookmark9)

*a*The values for Amt/kg DM have been calculated assuming a dietary energy density of 4,000 kcal ME/kg. (The term ≡ signifies equivalence.) If the energy density of the diet is not 4,000 kcal ME/kg, then to calculate the Amt/kg DM for each nutrient, multiply the value for the nutrient in the column labeled Amt/kg DM by the energy density of the pet food (in kcal ME/kg) and divide by 4,000.

*b*To calculate the amount to feed of each nutrient, multiply the value for Amt/1,000 kcal ME for each nutrient by the energy requirement for laboratory kennel dogs in kcal (calculated from [Table 15-4](#_bookmark46)) and divide by 1,000. For dogs with an unusually low energy intake (below the suggested requirement), the nutrient concentrations (Amt/1,000 kcal) may not be adequate.

These animals should be fed the nutrient amounts shown in the column Amt/kg BW0.75.

*c*0.01 g arginine should be added for every g of crude protein above 80 g and 100 g for the MR and RA, respectively.

*d*The quantity of tyrosine required to maximize black hair color may be about 1.5-2.0 times this quantity.

*e*The requirement for α-linolenic acid varies depending upon linoleic acid content of the diet. The ratio of linoleic acid to α-linolenic acid should be between 2.6 and 26. Note that 0.44 g/kg DM value shown is the minimum RA of α-linolenic acid at 11 g linoleic acid per kg DM, resulting in a ratio of linoleic acid to α-linolenic acid of approximately 25.

*f*50-60% of the total amount should be eicosapentaenoic acid, and 40-50% should be docosahexaenoic acid.

*g*Some oxides of iron and copper should not be used because of low bioavailability.

*h*Vitamin A requirements expressed as RE (retinol equivalents). One RE is equal to 1 μg of all- *trans* retinol, and one IU of vitamin A is equal to 0.3 RE. Safe upper limit values expressed as μg retinol.

*i*1 μg cholecalciferol = 40 IU vitamin D3.

*j*Higher concentrations of vitamin E are recommended for high PUFA diets. One international unit of vitamin E = 1 mg all-*rac*-α-tocopheryl acetate (see [Chapter 8](#_bookmark2)).

*k*Dogs have a metabolic requirement, but a dietary requirement has not been demonstrated when natural diets are fed. Adequate vitamin K is probably synthesized by intestinal microbes. The vitamin K allowance is expressed in terms of the commercially used precursor menadione that requires alkylation to the active vitamin K.

*l*For normal diets not containing raw egg white, adequate biotin is probably provided by microbial synthesis in the intestine. Diets containing antibiotics may need supplementation.

[TABLE 15-6 Daily Metabolizable Energy Requirements for Bitches in Late Gestation (4 Weeks After Mating Until](#_bookmark10) [Parturition)](#_bookmark10)[*a*](#_bookmark54)

ME (kcal) = maintenance + 26 kcal × kg BW

Average maintenance requirements 130 kcal × kg BW0.75 ME (kcal) = 130 kcal × kg BW0.75 + 26 kcal × kg BW

*Example:*

Body weight of bitch 22 kg

Maintenance requirements 220.75 × 130 kcal = 10.16 × 130 = 1,320 kcal Requirements for gestation 22 × 26 kcal = 572 kcal

Total requirements 1,320 kcal + 572 kcal = 1,892 kcal

*[a](#_bookmark52)*For variations in maintenance requirements, see [Table 15-4](#_bookmark46).

[TABLE 15-7 Daily Metabolizable Energy Requirements for Lactating Bitches Based on Number of Puppies and Weeks of Lactation](#_bookmark11)

Requirements for lactation:

ME (kcal) = maintenance + BW × (24*n* + 12*m*) × *L* Extrapolated maintenance energy requirements during lactation: 145 kcal × BW0.75

ME (kcal) = 145 kcal × BW0.75 + BW × (24*n* + 12*m*) × *L*

Where:

BW = body weight of bitch (kg)

*n* = number of puppies between 1 and 4

*m* = number of puppies between 5 and 8 (<5 puppies *m* = 0)

*L* = correction factor for stage of lactation: week 1, 0.75; week 2, 0.95; week 3, 1.1;

and week 4, 1.2 (see text)

*Example:*

Bitch 22 kg, 6 puppies, third week of lactation

Maintenance requirements = 220.75 × 145 kcal = 10.16 × 145 kcal = 1,473 kcal Number of puppies = 6: *n* = 4, *m* = 2,

Stage of lactation third week: *L* = 1.1

Requirements for lactation = 22 × (24 × 4 + 12 × 2) × 1.1 kcal = 2,904 kcal Total requirements = 1,473 kcal + 2,904 kcal = 4,377 kcal

[TABLE 15-8 Nutrient Requirements of Bitches for Late Gestation and Peak](#_bookmark12) [Lactation](#_bookmark12)[*a*](#_bookmark58)

*[a](#_bookmark56)*Few data could be found for the dietary concentrations for the minimal requirement for gestation for the bitch. The values for lactation relative to kg DM and 1,000 kcal ME may be taken as satisfactory for gestation.

*b*The values for Amt/kg DM have been calculated assuming a dietary energy density of 4,000 kcal ME/kg. (The term ≡ signifies equivalence.) If the energy density of the diet is not 4,000 kcal ME/kg, then to calculate the Amt/kg DM for each nutrient, multiply the value for the nutrient in the column labeled Amt/kg DM by the energy density of the pet food (in kcal ME/kg) and divide by 4,000.

*c*To calculate the amount to feed of each nutrient multiply the value for Amt/1 000 kcal ME for each nutrient by the energy requirement in kcal (calculated from [Tables 15-6](#_bookmark53) and [15-7](#_bookmark55)) and divide by 1 000.

*d*The values for Amt/BW0.75 apply only to a 22-kg bitch in peak lactation with 8 puppies and consuming 5,000 kcal/day. To calculate the amount for bitches of different body weights or litter sizes, calculate the energy requirement from [Table 15-7](#_bookmark55) and multiply this value by the nutrient Amt/1,000 kcal and divide by 1,000. To calculate the amount of a nutrient for gestating dogs, calculate the energy requirement from [Table 15-6](#_bookmark53) and multi l this value b the nutrient Amt/1 000 kcal and divide b 1 000

*e*0.01 g arginine should be added for every g of crude protein above 200.

*f*The quantity of tyrosine required to maximize black hair color may be about 1.5-2.0 times this quantity.

*g*The requirement for α-linolenic acid varies depending upon linoleic acid content of the diet. The ratio of linoleic acid to α-linolenic acid should be between 2.6 and 16. Note that 0.8 g/kg DM value shown is the minimum RA of α-linolenic acid at 13 g linoleic acid per kg DM, resulting in a ratio of linoleic acid to α-linolenic acid of approximately 16.

*h*50-60% of the total amount should be eicosapentaenoic, acid and 40-50% should be docosahexaenoic acid.

*i*Some oxides of iron and copper should not be used because of low bioavailability.

*j*Vitamin A requirements expressed as RE (retinol equivalents). One RE is equal to 1 μg of all- *trans* retinol, and one IU of vitamin A is equal to 0.3 RE. Safe upper limit values expressed as μg retinol.

*k*1 μg cholecalciferol = 40 IU vitamin D3.

*l*Higher concentrations of vitamin E are recommended for high PUFA diets. One international unit of vitamin E = 1 mg all-*rac*-α-tocopheryl acetate (see [Chapter 8](#_bookmark2)).

*m*Dogs have a metabolic requirement, but a dietary requirement has not been demonstrated when natural diets are fed. Adequate vitamin K is probably synthesized by intestinal microbes. The vitamin K allowance is expressed in terms of the commercially used precursor menadione that requires alkylation to the active vitamin K.

*n*For normal diets not containing raw egg white, adequate biotin is probably provided by microbial synthesis in the intestine. Diets containing antibiotics may need supplementation.

# [TABLE 15-9 Daily Metabolizable Energy Requirements for Growth of Kittens After Weaning](#_bookmark13)

ME (kcal) = maintenance amount × 6.7 × [*e*(–0.189*p*) – 0.66] ME (kcal) = 100 × BW 0.67 × 6.7 × [*e*(–0.189*p*) – 0.66]

# Where:

a

*p* = BWa/BWm

# BWa = actual body weight at time of evaluation (kg) BWm = expected mature body weight (kg)

*e* = base of natural log ≈ 2.718

*Example:* Kitten, 1 kg BWa, 4 kg BWm

ME (kcal) = 100 × 10.67 × 6.732 × [*e*(–0.189 × 1/4) – 0.66] = 198 kcal

# [TABLE 15-10 Nutrient Requirements for Growth of Kittens After Weaning](#_bookmark14)

[TABLE 13-1 Proximate Analysis of Selected Feed Ingredients (as fed)](#_bookmark18)[*a*](#_bookmark66)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feed  name/description IFN[*b*](#_bookmark67) | DM[*c*](#_bookmark68)(%) | CP[*d*](#_bookmark69)(%) | Fat (%) | TDF[*e*](#_bookmark70)(%) | CF[*f*](#_bookmark71)(%) | Ash (%) | kcal/g (dog) | kcal/g (cat) |
| *Ingredients of animal origin* |  |  |  |  |  |  |  |  |
| Bacon  Pork, cured | 68.40 | 8.70 | 57.50 | 0.00 |  | 2.10 |  |  |
| *N* | 251 | 321 | 202 | 1 |  | 50 |  |  |
| Beef  Meat, mechanically separated | 40.60 | 15.00 | 23.50 | 0.00 |  | 2.10 | 2.72 | 2.60 |
| *N* | 56 | 56 | 64 | 1 |  | 56 |  |  |
| Broth (or bouillon), dehydrated | 96.70 | 16.00 | 8.90 | 0.00 |  | 48.20 | 2.38 | 2.34 |
| *N* | 3 | 3 | 3 | 1 |  | 3 |  |  |
| Heart, raw | 24.40 | 17.10 | 3.80 | 0.00 |  | 1.00 | 1.13 | 1.11 |
| *N* | 15 | 4 | 4 | 1 |  | 10 |  |  |
| Kidney, raw | 23.00 | 16.60 | 3.10 | 0.00 |  | 1.10 | 1.03 | 1.01 |
| *N* | 28 | 5 | 9 | 1 |  | 11 |  |  |
| Liver, raw | 31.00 | 20.00 | 3.90 | 0.00 |  | 1.30 | 1.38 | 1.36 |
| *N* | 50 | 6 | 15 | 1 |  | 11 |  |  |
| Tripe, raw | 18.60 | 14.60 | 4.00 | 0.00 |  | 0.40 | 0.94 | 0.92 |
| *N* | 6 | 11 | 6 | 1 |  | 4 |  |  |
| Chicken  Meat and skin, raw | 38.20 | 17.60 | 20.30 | 0.00 |  | 1.00 | 2.53 | 2.43 |
| *N* | 1 | 1 | 1 | 1 |  | 1 |  |  |
| Broth (or bouillon), dehydrated | 97.70 | 16.70 | 13.90 | 0.00 |  | 49.20 |  |  |
| *N* | 4 | 4 | 4 | 1 |  | 4 |  |  |
| Gizzard | 23.80 | 18.20 | 4.20 | 0.00 |  | 0.90 | 1.13 | 1.11 |
| *N* | 13 | 15 | 14 | 1 |  | 12 |  |  |
| Liver | 26.40 | 18.00 | 3.90 | 0.00 |  | 1.20 | 1.20 | 1.18 |
| *N* | 18 | 13 | 54 | 1 |  | 12 |  |  |
| Egg  Dried, whole | 96.60 | 47.20 | 41.10 | 0.00 | 0.00 | 3.60 | 5.91 | 5.70 |

ME,[*g*](#_bookmark72)

ME,[*g*](#_bookmark72)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feed  name/description IFN[*b*](#_bookmark67) | DM[*c*](#_bookmark68)(%) | CP[*d*](#_bookmark69)(%) | Fat (%) | TDF[*e*](#_bookmark70)(%) | CF[*f*](#_bookmark71)(%) | Ash (%) | kcal/g (dog) | kcal/g (cat) |
| *N* | 3 | 3 | 3 | 1 | 1 | 3 |  |  |
| Fish  Meal, 5-  menhaden 02-  009 | 91.20 | 62.50 | 9.50 |  | 1.00 | 18.00 | 3.72 | 3.67 |
| *N* | 136 | 148 | 144 |  | 1 | 114 |  |  |
| Meal, tuna 5-  02-  023 | 93.00 | 53.00 | 11.00 |  | 5.00 | 25.00 | 3.35 | 3.30 |
| *N* | 1 | 1 | 1 |  | 1 | 1 |  |  |
| Meal, white 5-  02-  025 | 91.00 | 61.80 | 4.30 |  | 0.90 | 24.00 | 3.22 | 3.20 |
| *N* | 2 | 2 | 2 |  | 2 | 1 |  |  |
| Lamb  Ground | 40.50 | 16.60 | 23.40 | 0.00 |  | 0.90 | 2.77 | 2.65 |
| *N* | 1 | 1 | 1 | 1 |  | 1 |  |  |
| Liver | 28.60 | 20.40 | 5.00 | 0.00 |  | 1.40 | 1.34 | 1.31 |
| *N* | 17 | 1 | 1 | 1 |  | 1 |  |  |
| Meat, mechanically separated | 41.30 | 15.00 | 23.50 | 0.00 |  | 1.20 | 2.72 | 2.60 |
| *N* | 5 | 1 | 6 | 1 |  | 1 |  |  |
| Meat  Meal, 5-  rendered 09-  323 | 93.90 | 54.10 | 11.80 |  | 2.50 | 21.80 | 3.62 | 3.56 |
| *N* | 79 | 67 | 33 |  | 1 | 13 |  |  |
| Meal, with 5-  bone, 00-  rendered 388 | 94.00 | 50.90 | 9.80 |  | 2.80 | 19.20 | 3.61 | 3.56 |
| *N* | 63 | 63 | 55 |  | 1 | 13 |  |  |
| Poultry  By-product 5-  meal 03-  798 | 93.50 | 59.00 | 13.50 |  | 2.00 | 16.00 | 3.96 | 3.89 |
| *N* | 2 | 2 | 2 |  | 2 | 1 |  |  |

# Feed

name/description IFN[*b*](#_bookmark67)

DM[*c*](#_bookmark68)(%)

CP[*d*](#_bookmark69)(%)

# Fat (%)

TDF[*e*](#_bookmark70)(%)

CF[*f*](#_bookmark71)(%)

Ash (%)

kcal/g (dog)

kcal/g (cat)

Shrimp

Meat, mixed species

24.10 20.30 1.70 0.00

1.20 1.00 1.00

*N* 212 201 100 1 161

Milk

# Skimmed, dried

5-

01-

175

92.50 34.60 0.80 0.10 8.00 3.71 3.71

*N* 2 2 2 2 1

Turkey

Mechanically deboned

30.90 13.30 16.00 0.00

1.10 1.97 1.89

*N* 21 21 21 1 10

Whey

Dried 4-

01-

182

# 93.50 12.50 0.80 0.10 9.70 3.65 3.64

*N* 2 2 2 2 1

*Ingredients of plant origin*

Barley

Grain

4-

00-

549

90.20 12.30 2.20 17.30 5.30 2.30 3.81 3.80

*N* 9 14 8 1 2 15

Beet (sugar)

Pulp, dried 4-

00-

669

88.30 8.80 1.00 21.00 6.40 2.95 2.95

*N* 200 183 124 1 55

Carrots

Whole, raw

12.20 1.00 0.20 3.00 1.10

*N* 238 183 29 1 1

0.90

47

0.46 0.46

Cereal

# Cereal by- product

4-

00-

466

88.50 8.10 3.30 1.50 2.90 3.99 3.97

*N* 62 62 37 1 22

Feed

DM[*c*](#_bookmark68)

CP[*d*](#_bookmark69)

Fat

TDF[*e*](#_bookmark70)

CF[*f*](#_bookmark71)

Ash

kcal/g

kcal/g

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| name/description | IFN[*b*](#_bookmark67) | (%) | (%) | (%) | (%) | (%) | (%) | (dog) | (cat) |
| Chicory |  |  |  |  |  |  |  |  |  |
| Root |  | 20.00 | 1.40 | 0.20 |  |  | 0.90 |  |  |
|  | *N* | 1 1 | 1 |  |  | 1 |  |  |  |
| Corn, yellow |  |  |  |  |  |  |  |  |  |
| Bran, crude |  | 95.30 | 8.40 | 0.90 | 85.50 |  | 0.40 | 3.84 | 3.84 |
|  |  | *N* 6 | 6 | 6 | 1 |  | 6 |  |  |
| Distillers | 5- | 94.00 | 27.00 | 9.00 |  | 13.00 | 2.20 | 3.84 | 3.80 |
| grain, dried | 02- |  |  |  |  |  |  |  |  |
|  | 842 |  |  |  |  |  |  |  |  |
|  |  | *N* 1 | 1 | 1 |  | 1 | 1 |  |  |
| Distillers | 5- |  |  |  |  |  |  |  |  |
| grain w/ | 02- |  |  |  |  |  |  |  |  |
| solubles, | 843 |  |  |  |  |  |  |  |  |
| dried | and |  |  |  |  |  |  |  |  |
|  | 5- | 90.20 | 26.80 | 9.00 |  | 8.50 | 4.70 | 3.92 | 3.88 |
|  | 28- |  |  |  |  |  |  |  |  |
|  | 236 |  |  |  |  |  |  |  |  |
|  |  | *N* 893 | 880 | 465 |  | 1 | 135 |  |  |
| Gluten feed, | 5- |  |  |  |  |  |  |  |  |
| dried | 28- |  |  |  |  |  |  |  |  |
|  | 243 |  |  |  |  |  |  |  |  |
|  | and |  |  |  |  |  |  |  |  |
|  | 5- | 89.40 | 21.30 | 3.10 |  | 10.00 | 6.10 | 3.51 | 3.49 |
|  | 02- |  |  |  |  |  |  |  |  |
|  | 903 |  |  |  |  |  |  |  |  |
|  |  | *N* 132 | 187 | 69 |  | 1 | 26 |  |  |
| Gluten meal | 5- | 86.50 | 56.30 | 2.20 |  | 1.30 | 2.90 | 3.94 | 3.93 |
|  | 28- |  |  |  |  |  |  |  |  |
|  | 242 |  |  |  |  |  |  |  |  |
|  |  | *N* 67 | 58 | 43 |  | 1 | 20 |  |  |
| Grits |  | 90.00 | 8.80 | 1.20 | 1.60 |  | 0.40 | 3.64 | 3.64 |
|  |  | *N* 157 | 156 | 156 | 1 |  | 156 |  |  |
| Grain | 4- | 89.30 | 9.10 | 4.40 |  | 2.10 | 1.20 | 4.09 | 4.07 |
|  | 02- |  |  |  |  |  |  |  |  |
|  | 935 |  |  |  |  |  |  |  |  |
|  |  | *N* 12 | 9 | 6 |  | 2 | 5 |  |  |

Feed

name/description IFN[*b*](#_bookmark67)

DM[*c*](#_bookmark68)(%)

CP[*d*](#_bookmark69)(%)

# Fat (%)

TDF[*e*](#_bookmark70)(%)

CF[*f*](#_bookmark71)(%)

Ash (%)

kcal/g (dog)

kcal/g (cat)

Meal, degermed

Meal, whole kernel

88.40 8.50 1.70 7.40 0.60 3.59 3.59

*N* 513 127 128 1 127

89.70 8.10 3.60 7.30 1.10 3.72 3.71

[*N* 10 7 7 1 7](#_TOC_250000)

Starch 91.70 0.30 0.10 0.90 0.10 3.67 3.67

*N* 5 5 3 1 4

Syrup, dark 77.20 0.00 0.00 0.00 4.00 3.06 3.06

*N* 5 1 5 1 4

3

3

5.15

5.32

4.00

3

1

2

21.00 34.70 27.90 6.30

92.20

*N* 3

Flaxseed (linseed)

Whole

Molasses

Beet, sugar 4-

00-

668

78.00 6.70 0.10 0.00 9.00 3.64 3.64

*N* 22 13 4 1 10

Oats

Grain

4-

03-

309

90.00 11.90 4.60

10.80 3.00 3.68 3.66

Groats

4-

03-

331

*N* 177

92.00

309 146

16.00 6.00

1 104

2.60 2.20 4.11 4.08

*N* 1 1 1 1 1

Peas

Green, raw 21.10 5.40 0.40 5.10 0.90 0.83 0.83

# *N* 10 7 7 1 7

Potato

Flesh and skin, raw

8.00

2.00 0.00 2.40

0.80 0.29 0.29

*N* 9 9 9 9 9

Rice

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feed  name/description IFN[*b*](#_bookmark67) | DM[*c*](#_bookmark68)(%) | CP[*d*](#_bookmark69)(%) | Fat (%) | TDF[*e*](#_bookmark70)(%) | CF[*f*](#_bookmark71)(%) | Ash (%) | kcal/g (dog) | kcal/g (cat) |
| Bran 4-  03-  928 | 90.60 | 14.00 | 13.80 |  | 11.40 | 9.40 | 3.86 | 3.79 |
| *N* | 73 | 87 | 78 |  | 1 | 69 |  |  |
| Brewers 4-  (broken) 03-  932 | 89.00 | 8.70 | 0.70 |  | 9.80 |  |  |  |
| *N* | 1 | 1 | 1 |  | 1 |  |  |  |
| Brown, medium grain | 87.60 | 7.50 | 2.70 | 3.40 |  | 1.30 | 3.59 | 3.57 |
| *N* | 4 | 7 | 5 | 1 |  | 4 |  |  |
| Flour, brown | 88.00 | 7.20 | 2.80 | 4.60 |  | 1.50 | 3.60 | 3.58 |
| *N* | 3 | 3 | 3 | 1 |  | 3 |  |  |
| Flour, white | 88.10 | 6.00 | 1.40 | 2.40 |  | 0.60 | 3.57 | 3.56 |
| *N* | 2 | 2 | 2 | 1 |  | 2 |  |  |
| Hulls 1-  08-  075 | 92.00 | 3.00 | 0.50 |  | 44.00 | 20.00 | 1.47 | 1.46 |
| *N* | 1 | 1 | 1 |  | 1 | 1 |  |  |
| Sorghum  Grain 4-  20-  893 | 87.00 | 8.80 | 2.90 |  | 2.30 |  |  |  |
| *N* | 1 | 1 | 1 |  | 1 |  |  |  |
| Soybean  Flour, defatted | 92.80 | 51.50 | 1.20 | 17.50 |  | 6.20 | 3.70 | 3.70 |
| *N* | 6 | 6 | 6 | 1 |  | 2 |  |  |
| Flour, full fat, roasted | 96.20 | 38.10 | 21.90 |  |  | 5.90 | 4.84 | 4.73 |
| *N* | 58 | 52 | 31 |  |  | 16 |  |  |
| Hulls 1-  04-  560 | 90.90 | 12.60 | 2.40 |  | 36.50 | 4.40 | 2.49 | 2.48 |
| *N* | 131 | 139 | 78 |  | 1 | 46 |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Feed DM[*c*](#_bookmark68) | CP[*d*](#_bookmark69) | Fat | TDF[*e*](#_bookmark70) | CF[*f*](#_bookmark71) | Ash | kcal/g | kcal/g |
| name/description IFN[*b*](#_bookmark67)(%) | (%) | (%) | (%) | (%) | (%) | (dog) | (cat) |

Meal, solvent, (44% CP)

Meal, solvent,

without hulls (48% CP)

5-

20-

637

and 5-

04-

604

5-

20-

638

and

5-

04-

612

89.10 44.50 1.40 7.00 5.90 3.56 3.55

*N* 12 112 88 1 66

89.50 48.20 1.00 3.90 5.70 3.66 3.66

*N* 562 550 42 1 119

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sugar  Granulated |  | | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 4.00 | 4.00 |
|  | *N* | | 9 | 1 | 3 | 1 | 6 | |  |  |
| Brown |  | | 98.40 | 0.00 | 0.00 | 0.00 | 0.90 | | 3.89 | 3.89 |
|  | *N* | | 5 | 1 | 1 | 1 | 5 | |  |  |
| Wheat |  | |  |  |  |  |  | |  |  |
| Flour, whole grain |  |  | 89.70 | 13.70 | 1.90 | 12.20 |  | 1.60 | 3.62 | 3.61 |
|  |  | *N* | 15 | 16 | 10 | 1 |  | 14 |  |  |
| Germ |  |  | 88.90 | 23.20 | 9.70 | 13.20 |  | 4.20 | 3.87 | 3.82 |
|  |  | *N* | 10 | 7 | 8 | 1 |  | 9 |  |  |
| Germ meal | 5- |  | 89.00 | 25.00 | 7.00 |  | 3.50 | 5.30 | 4.00 | 3.96 |
|  | 05- |  |  |  |  |  |  |  |  |  |
|  | 218 |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 1 | 1 | 1 |  | 1.00 | 1 |  |  |
| Flour, white, unenriched |  |  | 88.10 | 10.30 | 1.00 | 2.70 |  | 0.50 | 3.55 | 3.55 |
|  |  | *N* | 72 | 61 | 29 | 1 |  | 61 |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feed  name/description IFN[*b*](#_bookmark67) | DM[*c*](#_bookmark68)(%) | CP[*d*](#_bookmark69)(%) | Fat (%) | TDF[*e*](#_bookmark70)(%) | CF[*f*](#_bookmark71)(%) | Ash (%) | kcal/g (dog) | kcal/g (cat) |
| Middlings 4-  05-  205 | 89.50 | 16.60 | 4.00 |  | 7.50 | 4.50 | 3.72 | 3.70 |
| *N* | 294 | 246 | 212 |  | 1 | 87 |  |  |
| Mill run | 90.00 | 15.50 | 4.10 |  | 8.30 | 5.30 | 3.66 | 3.64 |
| *N* | 1 | 1 | 1 |  | 1 | 1 |  |  |
| Yeast  Brewers, 7-  Torula, dried 05-  534 | 93.00 | 47.90 | 2.30 |  | 2.60 | 8.00 | 3.69 | 3.68 |
| *N* | 2 | 2 | 2 |  | 2 | 1 |  |  |

*[a](#_bookmark59)*For each ingredient two numbers are given: the first is the % composition of each respective dietary component in the ingredient; the second, the number (N) of observations on which the data are based.

*[b](#_bookmark65)*International Feed Number.

*[c](#_bookmark60)*Dry Matter.

*[d](#_bookmark61)*Crude Protein. *[e](#_bookmark62)*Total Dietary Fiber. *[f](#_bookmark63)*Crude Fiber.

*[g](#_bookmark64)*Metabolizable Energy.

[TABLE 13-3 Total Fat Concentration and Fatty Acid Composition of Selected Feed Ingredients](#_bookmark7)

Total Fat (% as

Percent of total fatty acids

16:1n-

18:1n-

Ingredient

is)

10:0 12:0 13:0 13:1 14:0 14:1 15:0 16:0

7 17:0 17:1 18:0 9

0.77 1.43

0.11

0.06

0.66

1.01

0.03

0.08

0.10

0.00

0.00

0.03

SD 1.67 0.01

0.21 0.08 23.88 6.50 0.16 0.12 7.58 36.41

0.60

12.90 0.00 0.04 0.00 0.00

Chicken Meal

*N* = 64

Lamb

Meal

13.80 0.07 0.17 0.01 0.01 2.71 0.17 0.63 21.05 1.72 1.56 0.54 22.00 30.49

*N* = 42 SD 1.63 0.05 0.10 0.04 0.03 0.69 0.10 0.15 1.02 0.41 0.22 0.33 3.22 1.35

1.96 4.26

0.30

0.39

0.20

1.82

0.29

0.14

0.49

0.00

0.00

0.02

SD 0.88 0.02

0.41 0.42 22.79 2.68 1.17 0.47 17.28 32.10

2.39

13.16 0.05 0.09 0.00 0.00

Beef Meal *N* = 8

Wheat

Bran

4.93 0.00 0.00 0.00 0.00 0.12 0.00 0.13 16.63 0.15 0.12 0.00 1.11 17.30

*N* = 4 SD 0.38 0.00 0.00 0.00 0.00 0.04 0.00 0.00 0.79 0.02 0.01 0.00 0.05 0.18

0.88 1.92

0.00

0.04

0.07

1.14

0.07

0.00

0.12

0.00

0.00

0.00

SD 0.58 0.00

0.00 0.14 17.26 0.09 0.12 0.00 1.73 14.10

0.16

3.41 0.00 0.00 0.00 0.00

Wheat Flour *N* = 6

Whole

Wheat

2.98 0.00 0.00 0.00 0.00 0.08 0.00 0.10 17.39 0.16 0.10 0.04 1.13 13.79

*N* = 4 SD 0.17 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.28 0.01 0.03 0.05 0.09 0.29

0.03 0.00 2.00 40.26

0.43 0.07 2.53 2.75

0.37

0.42

16.70 0.22

0.04

0.23

0.01

0.15

0.45

0.34

0.02 0.00 0.00

0.01 0.00 0.00

*N* = 8 SD 0.50 0.00

Rice Bran 4.15 0.00

Rice

Protein

6.73 0.00 0.00 0.00 0.00 0.70 0.01 0.03 23.79 0.15 0.06 0.02 2.23 29.31

*N* = 4 SD 0.15 0.00 0.00 0.00 0.00 0.23 0.02 0.00 3.00 0.02 0.00 0.02 0.05 2.51

0.06 0.16

0.00

0.00

0.03

0.62

0.00

0.00

0.02

0.00

0.00

0.00

SD 0.05 0.00

0.00 0.05 29.84 0.11 0.00 0.00 2.83 26.01

0.84

5.15 0.00 0.00 0.00 0.00

Rice Gluten *N* = 2

Rice

(Whole)

1.90 0.00 0.00 0.00 0.00 0.79 0.00 0.02 19.14 0.15 0.00 0.00 4.11 34.67

*N* = 8 SD 0.70 0.00 0.00 0.00 0.00 0.16 0.00 0.02 1.46 0.06 0.03 0.00 1.74 2.10

0.03 0.30

0.02

0.00

0.02

0.28

0.00

0.02

0.00

0.00

0.00

0.00

SD 1.31 0.00

0.02 0.03 11.48 0.16 0.08 0.02 2.24 25.09

0.05

5.97 0.00 0.00 0.00 0.00

Corn Gluten *N* = 6

Beet Pulp 1.70 0.00 0.00 0.00 0.00 0.35 0.00 0.40 20.16 0.45 0.07 0.06 1.46 14.66

*N* = 2 SD 0.10 0.00 0.00 0.00 0.00 0.05 0.00 0.06 0.03 0.07 0.07 0.06 0.48 0.57

0.31 0.19

0.00

0.00

0.06

0.39

0.03

0.00

0.39

0.00

0.00

0.01

SD 0.00 0.00

0.08 0.41 16.24 3.89 0.08 0.00 3.37 16.65

4.46

12.40 0.06 0.05 0.00 0.00

Herring Meal

*N* = 2

Ingredient

20:1n-

9

20:2n-

6

20:3n-

9

20:3n-6

(5,11,14)

20:3n-6

(8,11,14)

20:3n-

3

20:4n-

6

20:5n-

3 22:0

22:1n-

9

22:2n-

6 23:0

22:4n-

6

Chicken Meal

*N* = 64 SD

0.32 0.25 0.01 0.01

0.11 0.08 0.04 0.06

0.28

0.14

0.01 1.37 0.02 0.15 0.01 0.03 0.00 0.36

0.05 0.37 0.08 0.06 0.03 0.05 0.00 0.10

Lamb

Meal

0.30 0.10 0.00 0.00 0.07 0.00 0.62 0.21 0.23 0.06 0.04 0.02 0.11

*N* = 42 SD 0.23 0.20 0.00 0.00 0.14 0.00 0.25 0.13 0.12 0.14 0.09 0.07 0.09

0.00 0.07

0.14

0.23

0.03

0.05

0.23

0.30

0.24

0.00

0.00

0.26

0.21

SD

0.16 0.62 0.02 0.12 0.20 0.08 0.00 0.17

0.28

0.50 0.26 0.00 0.00

Beef Meal *N* = 8

Wheat

Bran

0.91 0.12 0.00 0.00 0.00 0.00 0.00 0.00 0.25 0.12 0.01 0.00 0.04

*N* = 4 SD 0.09 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.01 0.03 0.00 0.05

0.00 0.03

0.00

0.05

0.01

0.00

0.00

0.00

0.00

0.00

0.00

0.03

0.19

SD

0.00 0.00 0.00 0.26 0.18 0.00 0.00 0.02

0.00

0.82 0.12 0.00 0.00

Wheat Flour *N* = 6

Total

Percent of total fatty acids

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ingredient |  | Fat  (% as is) | 10:0 | 12:0 | 13:0 | 13:1 | 14:0 | 14:1 | 15:0 | 16:0 | 16:1n-  7 | 17:0 | 17:1 | 18:0 | 18:1n-  9 |
| Whole Wheat |  |  | 0.95 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.16 | 0.00 | 0.00 | 0.04 |
| *N* = 4 | SD |  | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.05 | 0.00 | 0.00 | 0.08 |
| Rice Bran |  |  | 0.44 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.82 | 0.00 | 0.17 | 0.00 | 0.14 |
| *N* = 8 | SD |  | 0.11 | 0.21 | 0.00 | 0.00 | 0.23 | 0.21 | 0.00 | 0.05 | 0.11 | 0.17 | 0.10 | 0.00 | 0.07 |
| Rice Protein |  |  | 0.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | 0.02 | 0.00 | 0.03 |
| *N* = 4 | SD |  | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.04 | 0.00 | 0.03 |
| Rice Gluten |  |  | 0.17 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| *N* = 2 | SD |  | 0.04 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rice (Whole) |  |  | 0.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.34 | 0.00 | 0.11 | 0.00 | 0.04 |
| *N* = 8 | SD |  | 0.04 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.07 | 0.00 | 0.03 |
| Corn Gluten |  |  | 0.27 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.40 | 0.00 | 0.00 | 0.00 | 0.09 |
| *N* = 6 | SD |  | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.01 |
| Beet Pulp |  |  | 0.48 | 1.19 | 0.37 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.77 | 0.20 | 0.08 | 0.00 | 1.65 |
| *N* = 2 | SD |  | 0.00 | 0.06 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.05 |
| Herring Meal |  |  | 6.50 | 0.22 | 0.00 | 0.00 | 0.04 | 0.00 | 0.67 | 5.49 | 0.14 | 10.36 | 0.18 | 0.00 | 0.19 |
| *N* = 2 | SD |  | 0.08 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.30 | 0.01 | 0.04 | 0.01 | 0.00 | 0.02 |

Selected Fatty Acids, % of Total Fatty Acids

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Lipid IFN[*b*](#_bookmark76) | <C10 | C12:0 | C14:0 | C16:0 | C1:1 | C18:0 | C18:1 | C18:2n- 6 | C18:3n- 3 | C18:4n- 3 | C20:1 | C20:4n- 6 | C20:5n- 3 | C2 |
| Animal fats  Beef 4-  tallow 08-  127 | 0 | 0.9 | 2.7 | 24.9 | 4.2 | 18.9 | 36.0 | 3.1 | 0.6 |  |  |  |  |  |
| Choice white grease | 0.2 | 0.2 | 1.9 | 21.5 | 5.7 | 14.9 | 41.1 | 11.6 | 0.4 |  |  |  |  |  |
| Lard 4-  04-  790 | 0.1 | 0.2 | 1.3 | 23.8 | 2.7 | 13.5 | 41.2 | 10.2 | 1.0 |  |  |  |  |  |
| Poultry fat 4-  09-  319 | 0.0 | 0.1 | 0.9 | 21.6 | 5.7 | 6.0 | 37.3 | 19.5 | 1.0 |  |  |  |  |  |
| Restaurant grease |  |  | 1.9 | 16.2 | 2.5 | 10.5 | 47.5 | 17.5 | 1.9 |  |  |  |  |  |
| Fish oils |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Anchovy |  |  | 7.4 | 17.4 | 10.5 | 4.0 | 11.6 | 1.2 | 0.8 | 3.0 | 1.6 | 0.1 | 17.0 | 1.2 |
| Herring 7-  08-  048 |  | 0.2 | 6.4 | 12.7 | 8.8 | 0.9 | 12.7 | 1.1 | 0.6 | 1.7 | 14.1 | 0.3 | 8.4 | 20 |
| Menhaden 7-  08-  049 |  |  | 7.3 | 19.0 | 9 | 4.2 | 13.2 | 1.3 | 0.3 | 2.8 | 2.0 | 0.2 | 11 | 0.6 |
| Capelin 7-  16-  709 |  |  | 7.9 | 11.1 | 11.1 | 1.0 | 17.0 | 1.7 | 0.4 | 2.1 | 18.9 | 0.1 | 4.6 | 14 |
| Cod liver 7-  01-  994 |  |  | 3.2 | 13.5 | 9.8 | 2.7 | 23.7 | 1.4 | 0.6 | 0.9 | 7.4 | 1.6 | 11.2 | 5.1 |
| Redfish |  |  | 4.9 | 13.2 | 13.2 | 2.2 | 13.3 | 0.9 | 0.5 | 1.1 | 17.2 | 0.3 | 8.0 | 18 |
| Salmon |  |  | 3.7 | 10.2 | 8.7 | 4.7 | 18.6 | 1.2 | 0.6 | 2.1 | 8.4 | 0.9 | 12.0 | 5.5 |

(sea caught) Vegetable oils

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Babassu |  | 11.1 | 42.4 | 16.8 | 9.3 |  | 3.5 | 14.2 | 2.4 |  |
| Borage |  | 0.0 | 0.0 | 0.0 | 11.5 |  | 4.9 | 19.5 | 40.3 |
| Canola | 4- | 0.0 | 0.0 | 0.0 | 4.0 | 0.2 | 1.8 | 56.1 | 20.3 | 9.3 |
| (rapeseed) | 06- |  |  |  |  |  |  |  |  |  |
|  | 144 |  |  |  |  |  |  |  |  |  |
| Coconut | 4- | 14.1 | 44.6 | 16.8 | 8.2 | 0.0 | 2.8 | 5.8 | 1.8 | 0.0 |
|  | 09- |  |  |  |  |  |  |  |  |  |
|  | 320 |  |  |  |  |  |  |  |  |  |
| Corn | 4- | 0.0 | 0.0 | 0.0 | 10.9 | 0.0 | 1.8 | 24.2 | 59.0 | 0.7 |
|  | 07- |  |  |  |  |  |  |  |  |  |
|  | 882 |  |  |  |  |  |  |  |  |  |
| Linseed | 4- | 0.0 | 0.0 | 0.0 | 5.3 | 0.0 | 4.1 | 20.2 | 12.7 | 53.3 |
|  | 14- |  |  |  |  |  |  |  |  |  |
|  | 502 |  |  |  |  |  |  |  |  |  |
| Cottonseed | 4- | 0.0 | 0.0 | 0.8 | 22.7 | 0.8 | 2.3 | 17 | 51.5 | 0.2 |
|  | 20- |  |  |  |  |  |  |  |  |  |
|  | 836 |  |  |  |  |  |  |  |  |  |
| Olive |  | 0.0 | 0.0 | 0.0 | 11.0 | 0.8 | 2.2 | 72.5 | 7.9 | 0.6 |
| Palm |  | 0.0 | 0.1 | 1.0 | 43.5 | 0.3 | 4.3 | 36.6 | 9.1 | 0.2 |
| Palm |  | 6.7 | 48.2 | 16.2 | 8.4 |  | 2.5 | 15.3 | 2.3 |  |

kernel

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Lipid | IFN[*b*](#_bookmark76) | <C10 | C12:0 | C14:0 | C16:0 | C1:1 | C18:0 | C18:1 | C18:2n- 6 | C18:3n- 3 | C18:4n- 3 | C20:4n- C20:1 6 | C20:5n- 3 | C2 |
| Peanut | 4- | 0.0 | 0.0 | 0.1 | 9.5 | 0.1 | 2.2 | 44.8 | 32.0 |  |  |  |  |  |
|  | 03- |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 658 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Safflower | 4- | 0.0 | 0.0 | 0.1 | 6.2 | 0.4 | 2.3 | 11.7 | 74.1 | 0.4 |  |  |  |  |
|  | 20- |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 526 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Safflower (high oleic) |  |  |  | 0.1 | 6.8 | 0.1 | 2.3 | 12.0 | 77.7 | 0.4 |  | 0.1 |  |  |
| Sesame |  | 0.0 | 0.0 | 0.0 | 8.9 | 0.2 | 4.8 | 39.3 | 41.3 | 0.3 |  |  |  |  |
| Soybean | 4- | 0.0 | 0.0 | 0.1 | 10.3 | 0.2 | 3.8 | 22.8 | 51.0 | 6.8 |  |  |  |  |
|  | 07- |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 983 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sunflower |  |  |  |  | 3.7 | 0.1 | 5.4 | 81.3 | 9.0 |  |  |  |  |  |

(high oleic) Sunflower 4-

20-

833

0.0 0.0 0.0 5.4 0.2 3.5 45.3 39.8 0.2

*[a](#_bookmark73)*Certain fats and oils have significant amounts of fatty acids other than those listed above. Examples include: Butter oil: C4:0, 3.65%; C6:0, 2.2%; C15:0, 2.1%; C14:1, 0.8%

Peanut oil: C24:0, 1.5%

Rapeseed (high erucic acid rape oil): C24:0, 1.0%; C22:1, 41.1%; C20:2, 0.7% Canola (low erucic acid rape) oil: C24:0 0.2%; C22:1, 0.7%; C20:2, 0.0%

Borage seed oil: C16:0, 11.5%; C18:0, 4.9%; C18:1n-9, 19.5%; C18:2n-6, 40.3%;C18:3n-6, 22.1%

Evening primrose oil: C16:0, 6.5%; C18:0, 1.8%; C18:1n-9, 8.6%; C18:2n-6, 73.5%; C18:3n-6, 8.7%

Black currant seed oil: C16:0, 6.7%; C18:0, 1.6%; C18:1n-9, 11.3%; C18:2n-6, 47.1%, C18:3n-6, 15.3%; C18:3n-3, 13.1%

*[b](#_bookmark74)*International Feed Number. *c*Saturated fatty acids. *d*Polyunsaturated fatty acids.

*e*Monosaturates are not included in this calculation.

SOURCE: [Belch and Hill, 2000](#_bookmark33); [Khan and Shahidi, 2000](#_bookmark34); [Senanayake and Shahidi, 1999](#_bookmark36); [Spurvey and Shahidi, 2000](#_bookmark37).

[TABLE 13-6 Mineral Content of Selected Ingredients (% or mg/kg, as fed)](#_bookmark15)[*a*](#_bookmark80)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | Bio- avail |  | | | | | | | | | |
|  |  | DM[*c*](#_bookmark82) | | Ca | P | P | Mg | K | Na | CI | S | Cu | Fe | Mn | Se | Z |
| Feed Name/Description | IFN[*b*](#_bookmark81) | (%) | | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | ( |
| *Ingredients of animal* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *origin* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bacon |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pork, cured |  |  | 68.40 | 0.01 | 0.14 |  | 0.01 | 0.15 | 0.73 |  |  | 0.64 | 6.00 | 0.00 | 0.25 | 1 |
|  |  | *N* | 251 | 2 | 20 |  | 0 | 15 | 20 |  |  | 18 | 20 | 18 | 14 | 1 |
| Beef |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Meat, |  |  | 40.60 | 0.49 | 0.32 |  | 0.02 | 0.28 | 0.06 |  |  | 0.56 | 57.00 | 0.00 | 0.21 | 3 |
| mechanically |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| separated |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 56 | 55 | 28 |  | 1 | 1 | 1 |  |  | 20 | 36 | 1 | 1 | 4 |
| Broth (or |  |  | 96.70 | 0.06 | 0.32 |  | 0.05 | 0.45 | 16.98 |  |  | 0.00 | 10.00 | 5.00 | 0.28 |  |
| bouillon), |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| dehydrated |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 3 | 1 | 2 |  | 2 | 2 | 3 |  |  | 1 | 1 | 3 | 1 | 1 |
| Heart, raw |  |  | 24.40 | 0.00 | 0.17 |  | 0.02 | 0.27 | 0.06 |  |  | 3.61 | 46.00 | 0.00 | 0.22 | 2 |
|  |  | *N* | 15 | 7 | 7 |  | 7 | 7 | 11 |  |  | 8 | 10 | 2 | 3 | 3 |
| Kidney, raw |  |  | 23.00 | 0.01 | 0.21 |  | 0.02 | 0.26 | 0.18 |  |  | 4.69 | 74.00 | 1.00 | 1.49 | 1 |
|  |  | *N* | 28 | 9 | 9 |  | 9 | 8 | 8 |  |  | 509 | 13 | 231 | 9 | 2 |
| Liver, raw |  |  | 31.00 | 0.01 | 0.32 |  | 0.02 | 0.32 | 0.07 |  |  | 33.39 | 68.00 | 3.00 | 0.41 | 3 |
|  |  | *N* | 50 | 1 | 10 |  | 13 | 10 | 9 |  |  | 311 | 33 | 232 | 6 | 2 |
| Tripe, raw |  |  | 18.60 | 0.01 | 0.08 |  | 0.01 | 0.27 | 0.05 |  |  | 0.90 | 20.00 | 0.00 | 0.46 | 2 |
|  |  | *N* | 6 | 1 | 1 |  | 1 | 1 | 1 |  |  | 1 | 4 | 1 | 1 | 1 |
| Chicken |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Meat and |  |  | 38.20 | 0.01 | 0.17 |  | 0.02 | 0.20 | 0.07 |  |  | 0.74 | 10.00 | 0.00 | 0.14 | 1 |
| skin, raw |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 1 | 1 | 1 |  | 1 | 1 | 1 |  |  | 1 | 1 | 1 | 1 | 1 |
| Broth (or |  |  | 97.70 | 0.19 | 0.17 |  | 0.06 | 0.31 | 18.59 |  |  | 0.00 | 10.00 | 2.00 | 0.28 | 1 |
| bouillon), |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| dehydrated |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 4 | 1 | 2 |  | 2 | 1 | 3 |  |  | 1 | 1 | 1 | 1 | 1 |
| Gizzard |  |  | 23.80 | 0.01 | 0.14 |  | 0.02 | 0.24 | 0.08 |  |  | 0.96 | 35.00 | 1.00 | 0.56 | 0 |
|  |  | *N* | 13 | 10 | 10 |  | 10 | 10 | 10 |  |  | 10 | 10 | 10 | 1 | 8 |
| Liver |  |  | 26.40 | 0.01 | 0.27 |  | 0.02 | 0.23 | 0.08 | 0.00 |  | 3.95 | 86.00 | 3.00 | 0.64 | 3 |
|  |  | *N* | 18 | 10 | 10 |  | 10 | 10 | 10 | 10 |  | 20 | 10 | 10 | 6 | 8 |
| Egg |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Dried, whole |  |  | 96.60 | 0.22 | 0.82 |  | 0.04 | 0.49 | 0.52 |  |  | 1.96 | 68.00 | 1.00 | 1.20 | 5 |
|  |  | *N* | 3 | 3 | 3 |  | 2 | 2 | 2 |  |  | 2 | 2 | 2 | 1 | 2 |
| Fish |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Meal, | 5- |  | 91.20 | 4.87 | 2.78 | 2.61 | 0.18 | 0.68 | 0.62 | 0.75 | 1.04 | 6.41 | 518.00 | 29.00 | 2.06 | 1 |
| menhaden | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 009 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 136 | 113 | 112 |  | 64 | 66 | 67 | 3 | 35 | 65 | 66 | 66 | 31 | 6 |
| Meal, tuna | 5- |  | 93.00 | 8.40 | 4.20 | 4.20 | 0.30 | 0.40 | 0.70 |  |  | 6.00 | 650.00 | 10.00 | 4.00 | 2 |
|  | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 023 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  | 1 | 1 | 1 | 1 | 1 |
| Meal, white | 5- |  | 91.00 | 7.16 | 3.66 | 3.50 | 0.20 | 0.97 | 0.88 | 0.50 | 0.48 | 7.00 | 131.00 | 11.00 | 1.56 | 8 |
|  | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 025 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| Lamb |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ground |  |  | 40.50 | 0.02 | 0.16 |  | 0.02 | 0.22 | 0.06 |  |  | 1.01 | 16.00 | 0.00 | 0.19 | 3 |

Feed Name/Description IFN[*b*](#_bookmark81)

DM[*c*](#_bookmark82)(%)

Ca (%)

P (%)

P (%)

Mg (%)

K (%)

Na (%)

CI (%)

S (%)

Cu (mg/kg)

Fe (mg/kg)

Mn (mg/kg)

Se Z

(mg/kg) (

*N* 5 5 1 1 1 1 1 1 1 1 1

1

4

8

3

1

0.82

13

0.20

1 1 1

69.79 74.00 2.00

520 1 13

0.58 59.00 0.00

0.02 0.29 0.06

0.16 0.34

Meat, mechanically separated

1

1

1

1

1

0.02 0.31 0.07

0.01 0.36

1 1 1

1

1

*N* 1

28.60

*N* 17

41.30

Liver

Meat

Meal, rendered

Meal, with bone, rendered

5-

09-

323

5-

00-

388

93.90 8.31 3.94 0.25 0.46 0.75 0.66 0.48 19.56 655.00 23.00 0.42 1

*N* 79 63 63 63 63 63 2 30 63 63 11 35 1

94.00 9.97 4.46 0.24 0.97 0.67 0.51 0.38 9.26 564.00 21.00 0.25 8

*N* 63 52 52 52 52 52 3 14 52 52 52 1 5

Poultry

By-product meal

5-

03-

798

93.50 3.50 2.05

0.21 0.58 0.35 0.55 0.51 14.00 470.00 11.00 0.78

1

*N* 2 2 2 2 2 2 2 2 2 2 2 2 2

Shrimp

Meat, mixed species

24.10 0.05 0.21 0.04 0.19 0.15 2.64 24.00 1.00 0.38 1

*N* 212 117 112 6 27 26 285 8 1 15 2

Milk

Skimmed, dried

5-

01-

175

92.50 1.27 1.01 1.00 0.12 0.84 0.52 0.90 0.32 11.75 29.00 2.00

0.12

3

*N* 2 2 2 1 2 2 2 1 2 2 2 2 2 1

Turkey

Mechanically deboned

30.90 0.15 0.12 0.01 0.17 0.05 0.93 16.00 0.00 0.27 2

*N* 21 6 1 1 1 1 1 6 1 1 6

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Whey  Dried 4- 93.50 0.92 0.78 0.79 0.13 1.13 1.30 1.50 1.04 44.55 145.00 7.00 0.07 3  01-  182 | | | | | | | | | | | | | | | | |
| *N* 2 | | | | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| *Ingredients of plant origin* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Barley |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Grain | 4- |  | 90.20 | 0.04 | 0.29 | 0.15 | 0.13 | 0.46 | 0.01 | 0.15 | 0.15 | 5.28 | 40.00 | 19.00 | 0.15 | 2 |
|  | 00- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 549 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 9 | 18 | 11 | 1 | 18 | 18 | 17 | 2 | 2 | 27 | 21 | 23 | 2 | 3 |
| Beet (sugar) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Pulp, dried | 4- |  | 88.30 | 0.80 | 0.08 |  | 0.20 | 0.84 | 0.27 | 0.15 | 0.26 | 9.74 | 564.00 | 55.00 | 0.12 | 1 |
|  | 00- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 669 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 200 | 172 | 154 |  | 154 | 154 | 154 | 18 | 57 | 154 | 154 | 154 | 11 | 1 |
| Carrots |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Whole, raw |  |  | 12.20 | 0.03 | 0.04 |  | 0.02 | 0.32 | 0.04 |  |  | 0.47 | 5.00 | 1.00 | 0.01 | 2 |
|  |  | *N* | 238 | 236 | 237 |  | 237 | 239 | 243 |  |  | 90 | 241 | 229 | 6 | 2 |

DM[*c*](#_bookmark82)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feed Name/Description | IFN[*b*](#_bookmark81) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | ( |
| Cereal |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cereal by- | 4- | 88.50 | 0.15 | 0.26 | 0.18 | 0.09 | 0.29 | 0.53 | 0.72 | 0.09 | 3.57 | 219.00 | 24.00 | 0.40 | 7 |
| product | 00- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 466 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 62 | 49 | 49 | 1 | 49 | 49 | 49 | 6 | 25 | 49 | 49 | 49 | 1 | 4 |
| Chicory |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Root |  | 20.00 | 0.04 | 0.06 |  | 0.02 | 0.29 | 0.05 |  |  | 0.77 | 0.00 | 2.00 | 0.01 | 3 |
|  | *N* | 1 | 1 | 1 |  | 1 | 1 | 1 |  |  | 1 | 1 | 1 | 1 | 1 |
| Corn, yellow |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bran, crude |  | 95.30 | 0.04 | 0.07 |  | 0.06 | 0.04 | 0.01 |  |  | 2.48 | 28.00 | 1.00 | 0.17 | 1 |
|  | *N* | 6 | 5 | 4 |  | 5 | 5 | 5 |  |  | 5 | 3 | 2 | 1 | 5 |
| Distillers | 5- | 94.00 | 0.09 | 0.41 | 0.17 | 0.20 | 0.16 | 0.47 | 0.07 | 0.43 | 30.00 | 300.00 | 23.00 | 0.35 | 5 |
| grain, dried | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 842 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Distillers | 5- | 90.20 | 0.20 | 0.75 | 0.40 | 0.30 | 0.99 | 0.27 | 0.23 | 0.40 | 7.28 | 161.00 | 24.00 | 0.35 | 5 |
| grain w/ | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| solubles, dried | 843  and 5- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 28- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 236 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 893 | 650 | 650 | 1 | 649 | 649 | 648 | 91 | 279 | 649 | 266 | 649 | 13 | 6 |
| Gluten feed, | 5- | 89.40 | 0.06 | 0.89 | 0.22 | 0.38 | 1.31 | 0.12 | 0.19 | 0.39 | 5.57 | 177.00 | 21.00 | 0.17 | 6 |
| dried | 28- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 243  and 5- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 903 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 132 | 145 | 145 | 1 | 145 | 145 | 84 | 3 | 66 | 145 | 145 | 145 | 13 | 1 |
| Gluten meal | 5- | 86.50 | 0.05 | 0.52 |  | 0.12 | 0.40 | 0.04 | 0.07 | 0.73 | 3.84 | 124.00 | 13.00 | 0.35 | 4 |
|  | 28- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 242 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 67 | 57 | 58 |  | 58 | 58 | 58 | 2 | 24 | 58 | 58 | 58 | 12 | 5 |
| Grits |  | 90.00 | 0.00 | 0.07 |  | 0.03 | 0.14 | 0.00 |  |  | 0.75 | 10.00 | 1.00 | 0.17 | 4 |
|  | *N* | 157 | 1 | 1 |  | 1 | 22 | 154 |  |  | 4 | 1 | 4 | 1 | 4 |
| Grain | 4- | 89.30 | 0.01 | 0.23 | 0.09 | 0.11 | 0.30 | 0.03 | 0.04 | 0.08 | 3.11 | 29.00 | 6.00 | 0.13 | 2 |
|  | 02- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 935 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 12 | 6 | 7 | 1 | 3 | 3 | 3 | 2 | 2 | 8 | 8 | 5 | 7 | 7 |
| Meal, degermed |  | 88.40 | 0.01 | 0.08 |  | 0.04 | 0.16 | 0.00 |  |  | 0.78 | 11.00 | 1.00 | 0.08 | 7 |
|  | *N* | 513 | 8 | 8 |  | 8 | 24 | 114 |  |  | 23 | 1 | 3 | 13 | 2 |
| Meal, whole kernel |  | 89.70 | 0.01 | 0.24 |  | 0.13 | 0.29 | 0.04 |  |  | 1.93 | 35.00 | 5.00 | 0.16 | 1 |
|  | *N* | 10 | 9 | 3 |  | 6 | 6 | 6 |  |  | 6 | 9 | 3 | 1 | 6 |
| Starch |  | 91.70 | 0.00 | 0.01 |  | 0.00 | 0.00 | 0.01 |  |  | 0.50 | 5.00 | 1.00 | 0.03 | 1 |
|  | *N* | 5 | 7 | 3 |  | 7 | 7 | 4 |  |  | 2 | 6 | 3 | 8 | 6 |
| Syrup, dark |  | 77.20 | 0.02 | 0.01 |  | 0.01 | 0.04 | 0.16 |  |  | 0.53 | 4.00 | 1.00 | 0.01 | 0 |
|  | *N* | 5 | 1 | 1 |  | 1 | 1 | 2 |  |  | 5 | 1 | 5 | 1 | 5 |
| Flaxseed (linseed) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Whole |  | 92.20 | 0.20 | 0.50 |  | 0.36 | 0.70 | 0.03 |  |  | 10.41 | 62.00 | 33.00 | 0.06 | 4 |
|  | *N* | 3 | 6 | 6 |  | 5 | 6 | 5 |  |  | 5 | 5 | 5 | 5 | 5 |
| Molasses |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Ca P P

Mg K Na

CI S Cu Fe

Mn Se Z

Feed Name/Description IFN[*b*](#_bookmark81)

DM[*c*](#_bookmark82)(%)

Ca (%)

P (%)

P (%)

Mg (%)

K (%)

Na (%)

CI (%)

S (%)

Cu (mg/kg)

Fe (mg/kg)

Mn (mg/kg)

Se Z

(mg/kg) (

Beet, sugar

4-

00-

668

78

0.12 0.02

0.23 4.73 1.15 1.30 0.47 17.20 71.00 46.00

1

*N* 22 14 12 11 11 9 1 10 8 9 8 5

Oats

Grain 4-

03-

309

Groats 4-

03-

331

90.00 0.10 0.36 0.14 0.47 0.03 0.11 0.17 7.20 95.00 39.00 0.43 3

*N* 177 222 229 206 205 102 1 31 184 185 194 69 1

92.00 0.07 0.45 0.17 0.09 0.34 0.05 0.20 6.40 35.00 29.00

*N* 1 1 1 1 1 1 1 1 1 1 1

Peas

Green, raw

21.10 0.03 0.11

0.03 0.24 0.01

*N* 10 8 8 8 10 7

1.76

7

15.00 4.00

8 7

0.02

1

1

7

Potato

Flesh and skin, raw

8.00 0.01 0.06 0.02 0.44 0.01 1.08 10.00 2.00 0.00 3

*N* 9 9 9 9 9 9 9 9 9 299 9

Flour, white

1

2

3

3

3

3

3

0.11 0.29 0.01

0.01 0.34

Flour, brown

1 4 1

3

1

*N* 4

88.00

*N* 3

88.10

*N* 2

92.00

*N* 1 1 1 1 1 1 1

0.01 0.10

0.04 0.08 0.00

2

2

2

2

2

1

2.30

2

1.30

2

5 1

20.00 40.00

2 3

4.00 12.00 0.15

2 2 2

1

2

3

8

2

Hulls

1-

08-

075

0.04 0.10

0.40 0.08

0.07 0.08

0.11 0.13 0.07

Rice

Bran

4-

03-

928

90.60 0.06 1.61

0.74 1.43 0.03 0.08 0.17 9.13

216.00 172.00 0.18

6

*N* 73

89.00

70

70

62 67 55 3 27 58

58

Brewers (broken)

4-

03-

932

0.08 0.08

1

0.08 0.06

24 9

18.00 0.27

5

1

*N* 1

87.60

1

1

1 1 1

1 1

Brown, medium grain

0.03 0.26

0.14 0.27 0.00

2.77

18.00

1

37.00

Sorghum

Grain 4-

20-

893

87.00 0.04 0.30 0.15 0.35 0.01 0.09 0.08 10.00 45.00 15.00 0.20 1

*N* 1 1 1 1 1 1 1 1 1 1 1 1 1

*N* 58 1 1 1 1 1 1 1 1 1 1

1

3

14 13 13 1

22.21 58.00 21.00 0.08

0.37 2.04 0.01

0.19 0.48

13 13 13

17 11

*N* 6

96.20

Flour, full fat, roasted

40.65 92.00 30.00 17.00 2

0.29 2.38 0.02

92.80 0.24 0.67

Flour, defatted

Soybean

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DM[*c*](#_bookmark82) | | | | | Ca | P | P | Mg | K | Na | CI | S | Cu | Fe | Mn | Se | Z |
| Feed Name/Description IFN[*b*](#_bookmark81)(%) | | | | | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | ( |
| Hulls 1- 90.90  04-  560 | | | | | 0.57 | 0.15 |  | 0.23 | 1.37 | 0.01 | 0.05 | 0.11 | 9.09 | 549.00 | 24.00 | 0.19 | 3 |
| *N* 131 | | | | | 82 | 80 |  | 73 | 72 | 75 | 5 | 37 | 72 | 73 | 74 | 4 | 7 |
| Meal, 5- 89.10 | | | | | 0.35 | 0.63 |  | 0.28 | 1.98 | 0.03 | 0.08 | 0.41 | 19.75 | 162.00 | 31.00 | 0.19 | 5 |
|  | solvent, | 20- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | (44% CP) | 637 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | and |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 5- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 04- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 604 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 12 | 27 | 30 |  | 20 | 22 | 13 | 2 | 7 | 16 | 16 | 16 | 43 | 1 |
|  | Meal, | 5- |  | 89.50 | 0.31 | 0.63 |  | 0.26 | 2.16 | 0.03 | 0.12 | 0.35 | 14.32 | 184.00 | 36.00 | 0.12 | 5 |
|  | solvent, | 20- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | without hulls | 638 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | (48% CP) | and |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 5- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 04- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 612 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 562 | 257 | 257 |  | 244 | 247 | 238 | 97 | 143 | 244 | 238 | 238 | 35 | 2 |
| Sugar |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Granulated |  |  | 100.00 | 0.00 | 0.00 |  | 0.00 | 0.00 | 0.00 |  |  | 0.43 | 1.00 | 0.00 | 0.01 | 0 |
|  |  |  | *N* | 9 | 19 | 12 |  | 24 | 21 | 12 |  |  | 16 | 23 | 18 | 2 | 1 |
|  | Brown |  |  | 98.40 | 0.09 | 0.02 |  | 0.03 | 0.35 | 0.04 |  |  | 2.98 | 19.00 | 3.00 | 0.01 | 2 |
|  |  |  | *N* | 5 | 6 | 4 |  | 6 | 6 | 6 |  |  | 6 | 6 | 7 | 4 | 6 |
| Wheat |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Flour, whole grain |  |  | 89.70 | 0.03 | 0.00 |  | 0.14 | 0.41 | 0.01 |  |  | 3.82 | 39.00 | 38.00 | 0.71 | 2 |
|  |  |  | *N* | 15 | 8 | 8 |  | 6 | 7 | 7 |  |  | 11 | 8 | 10 | 3 | 1 |
|  | Germ |  |  | 88.90 | 0.04 | 0.84 |  | 0.24 | 0.89 | 0.01 |  |  | 7.96 | 63.00 | 133.00 | 0.79 | 1 |
|  |  |  | *N* | 10 | 6 | 6 |  | 6 | 6 | 6 |  |  | 6 | 7 | 9 | 1 | 6 |
|  | Germ meal | 5- |  | 89.00 | 0.01 | 1.00 | 0.31 | 0.22 | 0.90 | 0.02 | 0.08 | 0.31 | 10.00 | 41.00 | 100.00 | 0.60 | 1 |
|  |  | 05- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 218 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  | Flour, white, unenriched |  |  | 88.10 | 0.02 | 0.11 |  | 0.02 | 0.11 | 0.00 |  |  | 1.44 | 12.00 | 7.00 | 0.34 | 7 |
|  |  |  | *N* | 72 | 113 | 47 |  | 129 | 94 | 82 |  |  | 49 | 1 | 48 | 46 | 1 |
|  | Middlings | 4- |  | 89.50 | 0.14 | 0.91 |  | 0.37 | 1.23 | 0.03 | 0.09 | 0.16 | 9.00 | 141.00 | 112.00 | 0.45 | 8 |
|  |  | 05- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 205 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 294 | 196 | 197 |  | 182 | 183 | 171 | 17 | 59 | 176 | 178 | 176 | 10 | 1 |
|  | Mill run |  |  | 90.00 | 0.10 | 1.02 |  | 0.47 |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 1 | 1 | 1 |  | 1 |  |  |  |  |  |  |  |  |  |
| Yeast |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Brewers, | 7- |  | 93.00 | 0.54 | 1.64 | 0.45 | 0.13 | 1.79 | 0.09 | 0.10 | 0.32 | 13.70 | 95.00 | 13.00 | 1.00 | 9 |
|  | Torula, dried | 05- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 534 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

*[a](#_bookmark77)*For each ingredient two numbers are given: the first is the percent composition of each respective amino acid in the ingredient; the second, the number (*N*) of observations on which the data are based.

*[b](#_bookmark79)*International Feed Number.

*[c](#_bookmark78)*Dry matter.

[TABLE 13-7 Vitamin Content of Selected Ingredients (mg/kg, as](#_bookmark29) [fed)](#_bookmark29)[*a*](#_bookmark86)

Pantothenic

Feed Name Description IFN[*b*](#_bookmark87)

Biotin (mg/kg)

Choline (mg/kg)

Folate (mg/kg)

Niacin (mg/kg)

Acid (mg/kg)

Riboflavin (mg/kg)

Thiamin (mg/kg)

B6

(mg/kg)

B12 Ca

(mg/kg) (m

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Ingredients of animal origin* |  | | | | | | | | | | | |
| Bacon |  |  |  |  |  |  |  |  |  |  |  |  |
| Pork, cured |  |  |  |  | 0.02 | 28.00 | 3.50 | 1.00 | 3.70 | 1.40 | 0.01 |  |
|  |  | *N* |  |  | 7 | 18 | 6 | 18 | 18 | 18 | 15 |  |
| Beef |  |  |  |  |  |  |  |  |  |  |  |  |
| Meat, mechanically separated |  |  |  |  | 0.05 | 25.00 | 2.80 | 1.20 | 0.70 | 2.90 | 0.03 |  |
|  |  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Broth (or bouillon), dehydrated |  |  |  |  | 0.32 | 45.00 | 3.00 | 2.40 | 0.70 | 2.00 | 0.01 |  |
|  |  | *N* |  |  | 1 | 2 | 1 | 2 | 1 | 1 | 1 |  |
| Heart, raw |  |  |  |  | 0.02 | 95.00 | 23.20 | 10.20 | 1.90 | 4.30 | 0.14 |  |
|  |  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 2 | 2 |  |
| Kidney, raw |  |  |  |  | 0.80 | 80.00 | 36.40 | 25.50 | 3.80 | 5.10 | 0.27 |  |
|  |  | *N* |  |  | 4 | 1 | 2 | 1 | 2 | 3 | 2 |  |
| Liver, raw |  |  |  |  | 2.48 | 128.00 | 76.20 | 27.80 | 2.60 | 9.40 | 0.69 |  |
|  |  | *N* |  |  | 9 | 3 | 2 | 3 | 2 | 4 | 9 |  |
| Tripe, raw |  |  |  |  | 0.02 | 1.00 | 5.60 | 1.70 | 0.10 | 0.40 | 0.02 |  |
|  |  | *N* |  |  | 1 | 1 | 1 | 3 | 6 | 1 | 1 |  |
| Chicken |  |  |  |  |  |  |  |  |  |  |  |  |
| Meat and skin, raw |  |  |  |  | 0.06 | 63.00 | 9.20 | 1.70 | 1.10 | 3.30 | 0.00 |  |
|  |  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Broth (or bouillon), dehydrated |  |  |  |  | 0.32 | 25.00 | 6.00 | 4.30 | 1.00 | 1.00 | 0.00 |  |
|  |  | *N* |  |  | 1 | 2 | 1 | 2 | 1 | 1 | 1 |  |
| Gizzard |  |  |  |  | 0.52 | 47.00 | 7.50 | 1.90 | 0.30 | 1.40 | 0.02 |  |
|  |  | *N* |  |  | 3 | 8 | 1 | 8 | 8 | 6 | 2 |  |
| Liver |  |  |  |  | 7.38 | 93.00 | 61.80 | 19.60 | 1.40 | 7.60 | 0.23 |  |
|  |  | *N* |  |  | 3 | 8 | 6 | 10 | 8 | 7 | 4 |  |
| Egg |  |  |  |  |  |  |  |  |  |  |  |  |
| Dried, whole |  |  |  |  | 1.71 | 3.00 | 59.10 | 15.40 | 2.00 | 3.90 | 0.04 |  |
|  |  | *N* |  |  | 2 | 2 | 2 | 2 | 2 | 2 | 2 |  |
| Fish |  |  |  |  |  |  |  |  |  |  |  |  |
| Meal, | 5- |  | 0.15 | 3080.00 | 1.00 | 55.00 | 8.80 | 4.80 | 0.20 |  | 0.15 |  |
| menhaden | 02- |  |  |  |  |  |  |  |  |  |  |  |
|  | 009 |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  | 1 |  |
| Meal, tuna | 5- |  |  | 3050.00 |  | 65.00 | 8.80 | 8.80 |  |  | 0.14 |  |
|  | 02- |  |  |  |  |  |  |  |  |  |  |  |
|  | 023 |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* |  | 1 |  | 1 | 1 | 1 |  |  | 1 |  |
| Meal, white | 5- |  | 0.80 | 3575.00 | 0.30 | 49.00 | 7.30 | 6.90 | 1.60 | 5.90 | 0.08 |  |
|  | 02- |  |  |  |  |  |  |  |  |  |  |  |
|  | 025 |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 |  |
| Lamb |  |  |  |  |  |  |  |  |  |  |  |  |
| Ground |  |  |  |  | 0.18 | 60.00 | 6.50 | 2.10 | 1.10 | 1.30 | 0.02 |  |
|  |  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |

Feed Name Description IFN[*b*](#_bookmark87)

Biotin (mg/kg)

Choline (mg/kg)

Folate (mg/kg)

Niacin (mg/kg)

Acid (mg/kg)

Riboflavin (mg/kg)

Thiamin (mg/kg)

B6

(mg/kg)

B12 Ca

(mg/kg) (m

*N* 1 1 1 1 1 1

0.90

19

0.03

9.00

1

1.10

3.40

1

0.70

36.30

1

1.20

161.00 61.30

1 1

25.00

2.30

4

0.05

Meat, mechanically separated

*N*

Liver

Meat

Meal, rendered

Meal, with bone, rendered

5-

09-

323

5-

00-

388

0.14 2200.00 0.60 59.00 5.80 5.20 0.20 0.09

*N* 1 1 1 1 1 1 1 1

0.14 1996.00 0.30 46.00 4.10 4.40 0.80 12.80 70.00

*N* 1 1 1 1 1 1 1 1 1

Poultry

By-product meal

5-

03-

798

0.30

5966.00 1.00

40.00 10.60

10.50

1.00

4.40

0.31

*N* 1 2 1 2 2 2 1 1 2

Shrimp

Meat, mixed species

0.03 26.00 2.80 0.30 0.30 1.00 0.01

*N* 1 6 2 6 5 3 19

Milk

Skimmed, dried

5-

01-

175

0.33

1322.00 0.62

12.00 35.80

20.60

3.50

0.40

0.03

2 2 2 2 2 2 2 1 2

Turkey

Mechanically deboned

0.07 20.00 6.70 1.30 0.50 2.10 0.00

*N* 1 1 1 1 1 1 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Whey  Dried 4- 0.37 1675.00 0.90 11.00 45.90 28.50 3.90 4.00 0.02  01-  182 | | | | | | | | | | | | |
| *N* 2 | | | | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | |
| *Ingredients of plant origin* |  |  |  |  |  |  |  |  |  |  |  |  |
| Barley |  |  |  |  |  |  |  |  |  |  |  |  |
| Grain | 4- |  | 0.18 | 1009.00 | 0.20 | 53.00 | 5.70 | 2.40 | 5.00 | 3.10 | 0.00 |  |
|  | 00- |  |  |  |  |  |  |  |  |  |  |  |
|  | 549 |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* | 2 | 2 | 8 | 3 | 3 | 4 | 4 | 4 | 1 |  |
| Beet (sugar) |  |  |  |  |  |  |  |  |  |  |  |  |
| Pulp, dried | 4- |  |  | 809.00 |  | 19.00 | 1.10 | 0.90 | 0.30 | 1.90 | 0.00 | 5.0 |
|  | 00- |  |  |  |  |  |  |  |  |  |  |  |
|  | 669 |  |  |  |  |  |  |  |  |  |  |  |
|  |  | *N* |  | 2 |  | 2 | 2 | 2 | 2 | 1 | 1 | 2 |
| Carrots |  |  |  |  |  |  |  |  |  |  |  |  |
| Whole, raw |  |  |  |  | 0.14 | 9.00 | 2.00 | 0.60 | 1.00 | 1.50 | 0.00 |  |
|  |  | *N* |  |  | 9 | 23 | 11 | 177 | 179 | 21 | 1 |  |
| Cereal |  |  |  |  |  |  |  |  |  |  |  |  |

Biotin

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Feed Name Description | IFN[*b*](#_bookmark87) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (m |
| Cereal by- | 4- | 1230.00 | 0.15 | 18.00 | 14.50 | 1.50 | 1.50 |  |  | 5.00 | 25 |
| product | 00- |  |  |  |  |  |  |  |  |  |  |
|  | 466 |  |  |  |  |  |  |  |  |  |  |
|  | *N* |  | 1 | 1 | 1 | 1 | 1 | 1 |  |  | 1 |
| Chicory |  |  |  |  |  |  |  |  |  |  |  |
| Root |  |  |  | 0.23 | 4.00 | 3.20 | 0.30 | 0.40 | 2.40 | 0.00 |  |
|  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Corn, yellow |  |  |  |  |  |  |  |  |  |  |  |
| Bran, crude |  |  |  | 0.04 | 27.00 | 6.40 | 1.00 | 0.10 | 1.50 | 0.00 |  |
|  | *N* |  |  | 4 | 4 | 4 | 6 | 5 | 4 | 1 |  |
| Distillers | 5- | 0.40 | 1850.00 | 0.00 | 42.00 | 5.90 | 2.80 | 1.60 |  |  | 2.0 |
| grain, dried | 02- |  |  |  |  |  |  |  |  |  |  |
|  | 842 |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  | 1 |
|  | 5- |  |  |  |  |  |  |  |  |  |  |
|  | 02- |  |  |  |  |  |  |  |  |  |  |
|  | 843 |  |  |  |  |  |  |  |  |  |  |
|  | and |  |  |  |  |  |  |  |  |  |  |
| Distillers | 5- *N* | 0.30 | 3400.00 | 0.88 | 80.00 | 11.40 | 9.00 | 3.50 |  |  | 4.0 |
| grain w/ | 28- |  |  |  |  |  |  |  |  |  |  |
| solubles, dried | 236 |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  | 1 |
|  | 5- |  |  |  |  |  |  |  |  |  |  |
|  | 28- |  |  |  |  |  |  |  |  |  |  |
|  | 2433 |  |  |  |  |  |  |  |  |  |  |
|  | and |  |  |  |  |  |  |  |  |  |  |
| Gluten feed, | 5- | 0.22 | 2420.00 | 0.20 | 75.00 | 17.80 | 2.40 | 2.00 |  |  | 8.0 |
| dried | 02- |  |  |  |  |  |  |  |  |  |  |
|  | 903 |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  | 1 |
| Gluten meal | 5- | 0.15 | 330.00 | 0.20 | 55.00 | 3.00 | 2.20 | 0.30 | 6.20 |  |  |
|  | 28- |  |  |  |  |  |  |  |  |  |  |
|  | 242 |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |  |
| Grits |  |  |  | 0.05 | 12.00 | 4.90 | 0.40 | 1.30 | 1.50 | 0.00 |  |
|  | *N* |  |  | 3 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Grain | 4- | 0.07 | 860.00 | 0.24 | 27.00 | 4.00 | 1.40 | 3.30 | 6.50 | 0.00 | 2.0 |
|  | 02- |  |  |  |  |  |  |  |  |  |  |
|  | 935 |  |  |  |  |  |  |  |  |  |  |
|  | *N* | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 |
| Meal, degermed |  |  |  | 0.48 | 10.00 | 3.10 | 0.50 | 1.40 | 2.60 | 0.00 |  |
|  | *N* |  |  | 23 | 1 | 25 | 1 | 1 | 5 | 1 |  |
| Meal, whole kernel |  |  |  | 0.25 | 36.00 | 4.30 | 2.00 | 3.90 | 3.00 | 0.00 |  |
|  | *N* |  |  | 1 | 8 | 6 | 9 | 8 | 3 | 1 |  |
| Starch |  |  |  | 0.00 |  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |  |
|  | *N* |  |  | 1 | 1 | 1 | 1.0 | 1 | 1 | 1 |  |
| Syrup, dark |  |  |  | 0.00 | 0.00 | 0.20 | 0.10 | 0.10 | 0.10 | 0.00 |  |
|  | *N* |  |  | 2 | 2 | 2 | 2 | 2 | 2 | 1 |  |
| Flaxseed (linseed) |  |  |  |  |  |  |  |  |  |  |  |
| Whole |  |  |  | 2.78 | 14.00 | 15.30 | 1.60 | 1.70 | 9.30 | 0.00 |  |
|  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |

Choline

Folate

Niacin

Acid

Riboflavin

Thiamin B6

B12 Ca

Feed Name Description IFN[*b*](#_bookmark87)

Biotin (mg/kg)

Choline (mg/kg)

Folate (mg/kg)

Niacin (mg/kg)

Acid (mg/kg)

Riboflavin (mg/kg)

Thiamin (mg/kg)

B6

(mg/kg)

B12 Ca

(mg/kg) (m

Molasses

Beet, sugar

4-

00-

608

48.00 4.60

2.40

*N* 1 1 1

Oats

Grain 4-

03-

309

Groats 4-

03-

331

0.27 946.00 0.30 12.00 7.80 1.10 6.00 1.00

*N* 1 1 1 1 1 1 1 1

0.20 1232.00 0.30 18.00 11.00 1.30 6.80

*N* 1 1 1 1 1 1 1

Peas

Green, raw

*N*

0.65

1

21.00 1.00

7 1

1.30

7

2.70

7

1.70

7

0.00

1

Potato

Rice

Flesh and skin, raw

0.28 14.00 3.70 0.20 0.70 1.80 0.00

*N* 9 9 9 8 9 9 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bran | | 4- | 0.42 | | 1135.00 | 2.20 | 293.00 | 23.00 | 2.50 | 22.50 | 14.00 | |
|  | | 03- |  | |  |  |  |  |  |  |  | |
|  | | 928 |  | |  |  |  |  |  |  |  | |
|  | |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Brewers | | 4- |  | 0.08 | 800.00 | 0.20 | 30.00 | 8.00 | 0.70 | 1.40 | 28.00 | |
| (broken) | | 03- |  |  |  |  |  |  |  |  |  | |
|  | | 932 |  |  |  |  |  |  |  |  |  | |
|  | | *N* | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Brown, medium grain | |  | |  |  | 0.20 | 43.00 | 14.90 | 0.40 | 4.10 | 5.10 | 0.00 |
|  | | *N* | | 1 | | | 5 | 1 | 5 | 5 | 1 | 1 |
| Flour, brown | |  | | 0.16 | | | 63.00 | 15.90 | 0.80 | 4.40 | 7.40 | 0.00 |
|  | | *N* | | 6 | | | 3 | 3 | 3 | 3 | 3 | 1 |
| Flour, white | |  | | 0.04 | | | 26.00 | 8.20 | 0.20 | 1.40 | 4.40 | 0.00 |
|  | | *N* | | 2 | | | 2 | 2 | 2 | 2 | 2 | 1 |
|  | Hulls | 1- |  |  |  |  |  |  |  |  |  |  |
|  |  | 08- |  |  |  |  |  |  |  |  |  |  |
|  |  | 075 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* |  |  |  |  |  |  |  |  |  |
| Sorghum |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Grain | 4- |  | 0.26 | 668.00 | 0.20 | 41.00 | 12.40 | 1.30 | 3.00 | 5.20 |  |
|  |  | 20- |  |  |  |  |  |  |  |  |  |  |
|  |  | 893 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Soybean |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Flour, defatted |  | *N* |  |  | 3.05 | 26.00 | 20.00 | 2.50 | 7.00 | 5.70 | 0.00 |
|  |  |  |  |  |  | 7 | 5 | 5 | 5 | 5 | 5 | 1 |
|  | Flour, full fat, roasted |  |  |  |  | 2.27 | 33.00 | 12.10 | 9.40 | 4.10 | 3.50 | 0.00 |
|  |  |  | *N* |  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Feed Name Description IFN[*b*](#_bookmark87)

Biotin (mg/kg)

Choline (mg/kg)

Folate (mg/kg)

Niacin (mg/kg)

Acid (mg/kg)

Riboflavin (mg/kg)

Thiamin (mg/kg)

B6

(mg/kg)

B12 Ca

(mg/kg) (m

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Hulls | 1- |  |  |  |  |  |  |  |  |  |  |
|  |  | 04- |  |  |  |  |  |  |  |  |  |  |
|  |  | 560 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* |  |  |  |  |  |  |  |  |  |
|  | Meal, solvent | 5- |  | 0.32 | 2794.00 | 1.30 | 29.00 | 16.00 | 2.90 | 4.50 | 6.00 |  |
|  | (44% CP) | 20- |  |  |  |  |  |  |  |  |  |  |
|  |  | 637  and 5- |  |  |  |  |  |  |  |  |  |  |
|  |  | 04- |  |  |  |  |  |  |  |  |  |  |
|  |  | 604 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
|  | Meal, | 5- |  | 0.32 | 2731.00 | 1.30 | 22.00 | 15.00 | 2.90 | 3.20 | 5.00 |  |
|  | solvent, | 20- |  |  |  |  |  |  |  |  |  |  |
|  | without hulls (48% CP) | 638  and 5- |  |  |  |  |  |  |  |  |  |  |
|  |  | 04- |  |  |  |  |  |  |  |  |  |  |
|  |  | 612 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| Sugar |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Granulated |  |  |  |  | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 |
|  |  |  | *N* |  |  | 3 | 3 | 3 | 3 | 1 | 3 | 1 |
|  | Brown |  |  |  |  | 0.01 | 1.00 | 1.10 | 0.10 | 0.10 | 0.30 | 0.00 |
|  |  |  | *N* |  |  | 2 | 5 | 5 | 4 | 5 | 5 | 1 |
| Wheat |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Flour, whole grain |  |  |  |  | 0.44 | 64.00 | 10.10 | 2.20 | 1.20 | 3.40 | 0.00 |
|  |  |  | *N* |  |  | 7 | 8 | 2 | 20 | 20 | 3 | 1 |
|  | Germ |  |  |  |  | 2.81 | 68.00 | 22.60 | 5.00 | 18.80 | 13.00 | 0.00 |
|  |  |  | *N* |  |  | 10 | 7 | 6 | 7 | 7 | 7 | 1 |
|  | Germ meal | 5- |  |  | 3175.00 | 2.80 |  | 23.20 | 6.10 | 21.90 |  |  |
|  |  | 05- |  |  |  |  |  |  |  |  |  |  |
|  |  | 218 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* |  | 1 | 1 | 0 | 1 | 1 | 1 |  | 0 |
|  | Flour, white, unenriched |  |  |  |  | 0.26 | 13.00 | 4.40 | 0.40 | 1.20 | 0.40 | 0.00 |
|  |  |  | *N* |  |  | 15 | 1 | 10 | 1 | 1 | 45 | 1 |
|  | Middlings | 4- |  | 0.37 | 1439.00 | 0.80 | 98.00 | 13.00 | 2.20 | 16.50 | 9.00 |  |
|  |  | 05- |  |  |  |  |  |  |  |  |  |  |
|  |  | 205 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
|  | Mill run |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* |  |  |  |  |  |  |  |  |  |
| Yeast |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Brewers, | 7- |  | 1.25 | 2871.00 | 11.86 | 498.00 | 78.00 | 55.80 | 6.20 | 36.30 | 0.00 |
|  | Torula, dried | 05- |  |  |  |  |  |  |  |  |  |  |
|  |  | 534 |  |  |  |  |  |  |  |  |  |  |
|  |  |  | *N* | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |

*[a](#_bookmark84)*For each ingredient two numbers are given: the first is the percent composition of each respective amino acid in the ingredient; the second, the number (N) of observations on which the data are based.

*[b](#_bookmark85)*International Feed Number.

[TABLE 13-8 Composition of Selected Inorganic Macro-mineral Sources Used in Petfood](#_bookmark31)

Mineral

Source IFN[*a*](#_bookmark90)

Calcium

%

# Phosphorus

%

# Sodium

%

# Potassium

%

# Chloride

%

# Magnesium

%

Ammonium chloride

8-

08-

814

—

—

—

—

66.28

—

# Ammonium phosphate, monobasic

6-

09-

338

— 24.74 — — — —

Ammonium phosphate, dibasic

6-

00-

370

—

20.60

—

—

—

—

Bone meal, steamed

6-

00-

400

30.71 12.86 5.69 — — —

Calcium carbonate

6-

01-

069

39.39

—

—

—

—

—

Calcium chloride, anhydrous

6-

20-

774

36.11 — — — 63.89 —

Calcium chloride, dihydrate

N/A 27.53

—

—

—

48.23

—

Calcium hydroxide

6-

14-

014

54.09 — — — — —

Calcium oxide

6-

14-

003

71.47

—

—

—

—

—

Calcium phosphate, dibasic

6-

01-

080

22.00 19.30 — — — —

Calcium phosphate, monobasic

6-

01-

082

16.40

24.60

—

—

—

—

Limestone, ground

6-

02-

635

34.00 — — — — 2.06

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Source | IFN[*a*](#_bookmark90) | % | % | % | % | % | % |
| Magnesium | 6- | — | — | — | — | — | 30.81 |
| carbonate | 02- |  |  |  |  |  |  |
|  | 754 |  |  |  |  |  |  |
| Magnesium chloride, hexahydrate | 6-  20-  872 | — | — | — | — | 34.88 | 11.96 |
| Magnesium oxide | 6-  02-  756 | — | — | — | — | — | 56.20 |
| Magnesium sulfate | 6-  02-  758 | — | — | — | — | — | 9.80 |
| Oystershell flour | 6-  03-  481 | 38.00 | — | — | — | — | — |
| Phosphate, defluorinated | 6-  01-  780 | 32.00 | 18.00 | 4.90 | — | — | — |
| Phosphoric acid (H3PO4) | 6-  03-  707 | — | 31.60 | — | — | — | — |
| Potassium bicarbonate | 6-  29-  493 | — | — | — | 39.05 | — | — |
| Potassium carbonate | 6-  09-  336 | — | — | — | 56.58 | — | — |
| Potassium chloride | 6-  03-  755 | — | — | 1.00 | 57.00 | 47.30 | — |
| Potassium iodide | 6-  03-  759 | — | — | — | 21.00 | — | — |
| Potassium sulfate | 6-  06-  098 | — | — | — | 41.84 | — | — |
| Sodium | 6- | — | — | 27.00 | — | — | — |
| bicarbonate | 04- |  |  |  |  |  |  |
|  | 272 |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Source | IFN[*a*](#_bookmark90) | % | % | % | % | % | % |
| Sodium | 6- | — | — | — | — | — | — |
| carbonate | 12- |  |  |  |  |  |  |
|  | 316 |  |  |  |  |  |  |
| Sodium | 6- | — |  | 39.34 | — | 60.66 | — |
| chloride | 04- |  |  |  |  |  |  |
|  | 152 |  |  |  |  |  |  |
| Sodium | 6- | — | 22.50 | 16.68 | — | — | — |
| phosphate, | 04- |  |  |  |  |  |  |
| monobasic | 288 |  |  |  |  |  |  |
| Sodium | 6- | — | — | 12.46 | — | — | — |
| selenate, | 26- |  |  |  |  |  |  |
| decahydrate | 014 |  |  |  |  |  |  |
| Sodium | 6- | — | — | 26.60 | — | — | — |
| selenite | 26- |  |  |  |  |  |  |
|  | 013 |  |  |  |  |  |  |
| Sodium | 6- | — | — | 14.27 | — | — | — |
| sulfate, | 04- |  |  |  |  |  |  |
| decahydrate | 292 |  |  |  |  |  |  |

*[a](#_bookmark89)*International Feed Number.

[TABLE 13-9 Composition of Selected Inorganic Micro-mineral Sources Used in Petfood](#_bookmark32)

Mineral

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Source | Formula | IFN[*a*](#_bookmark93) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Calcium | Ca(IO3)2 | 6- | — | 651,000 | — | — | — | — | — |
| iodate |  | 16- |  |  |  |  |  |  |  |
|  |  | 610 |  |  |  |  |  |  |  |
| Cobalt | CoCO3 | 6- | — | — | — | — | — | — | 450,000 |
| carbonate |  | 01- |  |  |  |  |  |  |  |
|  |  | 566 |  |  |  |  |  |  |  |
| Cobalt sulfate, heptahydrate | CoSO4·7H2O | 6-  01-  564 | 30 | — | 10 | 20 | — | — | 210,000 |
| Cupric carbonate | CuCO3 | 6-  01-  703 | 530,000 | — | — | — | — | — | — |
| Cupric chloride, dihydrate | CuCl2·2H2O | 6-  01-  705 | 372,000 | — | — | — | — | — | — |
| Cupric oxide | CuO | 6-  01-  711 | 798,800 | — | — | — | — | — | — |
| Cupric sulfate, pentahydrate | CuSO4·5H2O | 6-  01-  720 | 254,500 | — | — | — | — | — | — |
| Cuprous iodide | CuI | 6-  01-  721 | 333,600 | 666,400 | — | — | — | — | — |
| Cuprous oxide | Cu2O | 6-  28-  224 | 888,200 | — | — | — | — | — | — |
| Ferrous carbonate | FeCO3 | 6-  01-  863 | 3,000 | — | 430,000 | 3,500 | — | — | — |
| Ferrous sulfate, heptahydrate | FeSO4·7H2O | 6-  20-  734 | — | — | 210,000 | 1,200 | — | 100 | — |
| Manganese carbonate | MnCO3 | 6-  03-  036 | — | — | — | 478,000 | — | — | — |
| Manganese chloride | MnCl2 | 6-  03-  038 | — | — | — | 430,000 | — | — | — |
| Manganese oxide | MnO | 6-  03-  056 | 2,000 | — | 34,000 | 600,000 | — | — | — |
| Manganese sulfate, monohydrate | MnSO4·H2O | N/A | — | — | 400 | 325,069 | — | — | — |
| Manganese sulfate, | MnSO4·5H2O | N/A | — | — | — | 227,891 | — | — | — |
| pentahydrate |  |  |  |  |  |  |  |  |  |

Chemical

Copper

Iodine

Iron

Manganese

Selenium

Zinc

Cobalt

Mineral Source

Chemical

Formula IFN[*a*](#_bookmark93)

Copper (mg/kg)

Iodine (mg/kg)

Iron (mg/kg)

Manganese (mg/kg)

Selenium (mg/kg)

Zinc (mg/kg)

Cobalt (mg/kg)

Potassium iodide

KI 6-

03-

759

— 681,700 — — — — —

Sodium selenate, decahydrate

Na2SeO4·10H2O 6-

26-

014

—

—

—

—

213,920 —

—

Sodium

selenite

Na2SeO3 6-

26-

013

— — — — 456,000 — —

Zinc carbonate

ZnCO3

6-

05-

549

—

—

—

—

—

521,400 —

Zinc

chloride

ZnCl2 6-

05-

551

— — — — — 479,700 —

Zinc oxide ZnO

6-

05-

533

—

—

—

—

—

780,000 —

Zinc sulfate,

monohydrate

ZnSO4·H2O 6-

05-

555

— — — — — 363,600 —

*[a](#_bookmark92)*International Feed Number.

[TABLE 15-3 Nutrient Requirements for Growth of Puppies After Weaning](#_bookmark45)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Minimal Requirement | | | Adequate Intake | Recommended Allowance | | | Safe Upper Limit | | |
| Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt./ kg BW0.75[*c*](#_bookmark111) | Amt./ Amt./  kg DM 1,000 Amt./ (≡4,000 kcal kg kcal)[*a*](#_bookmark109)ME[*b*](#_bookmark110)BW0.75[*c*](#_bookmark111) | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt./ kg BW0.75[*c*](#_bookmark111) | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt. kg BW0 |
|  |  |  |  | ***Growing Puppies 4-14*** |  |  |  |  |  |  |
|  |  |  |  | ***Weeks Old*** |  |  |  |  |  |  |
| *Crude Protein (g)* | 180 | 45 | 12.5 |  | 225 | 56.3 | 15.7 |  |  |  |
| *Amino Acids* |  |  |  |  |  |  |  |  |  |  |
| Arginine (g)[*d*](#_bookmark112) | 6.3 | 1.58 | 0.44 |  | 7.9 | 1.98 | 0.55 |  |  |  |
| Histidine (g) | 3.1 | 0.78 | 0.22 |  | 3.9 | 0.98 | 0.27 |  |  |  |
| Isoleucine (g) | 5.2 | 1.30 | 0.36 |  | 6.5 | 1.63 | 0.45 |  |  |  |
| Methionine (g) | 2.8 | 0.70 | 0.19 |  | 3.5 | 0.88 | 0.24 |  |  |  |
| Methionine & | 5.6 | 1.40 | 0.39 |  | 7.0 | 1.75 | 0.49 |  |  |  |
| Cystine (g) |  |  |  |  |  |  |  |  |  |  |
| Leucine (g) | 10.3 | 2.58 | 0.72 |  | 12.9 | 3.22 | 0.90 |  |  |  |
| Lysine (g) | 7.0 | 1.75 | 0.49 |  | 8.8 | 2.20 | 0.61 | >20 | >5.0 | >1.3 |
| Phenylalanine (g) | 5.2 | 1.30 | 0.36 |  | 6.5 | 1.63 | 0.45 |  |  |  |
| Phenylalanine & | 10.4 | 2.60 | 0.72 |  | 13.0 | 3.25 | 0.90 |  |  |  |
| Tyrosine (g)[*e*](#_bookmark113) |  |  |  |  |  |  |  |  |  |  |
| Threonine (g) | 6.5 | 1.63 | 0.45 |  | 8.1 | 2.03 | 0.56 |  |  |  |
| Tryptophan (g) | 1.8 | 0.45 | 0.13 |  | 2.3 | 0.58 | 0.16 |  |  |  |
| Valine (g) | 5.4 | 1.35 | 0.38 |  | 6.8 | 1.70 | 0.47 |  |  |  |
|  |  |  |  | ***Growing Puppies 14*** |  |  |  |  |  |  |
|  |  |  |  | ***Weeks and Older*** |  |  |  |  |  |  |
| *Crude Protein (g)* | 140 | 35 | 9.7 |  | 175 | 43.8 | 12.2 |  |  |  |
| *Amino Acids* |  |  |  |  |  |  |  |  |  |  |
| Arginine (g)*d* | 5.3 | 1.33 | 0.37 |  | 6.6 | 1.65 | 0.46 |  |  |  |
| Histidine (g) | 2.0 | 0.50 | 0.14 |  | 2.5 | 0.63 | 0.17 |  |  |  |
| Isoleucine (g) | 4.0 | 1.00 | 0.28 |  | 5.0 | 1.25 | 0.35 |  |  |  |
| Methionine (g) | 2.1 | 0.53 | 0.15 |  | 2.6 | 0.65 | 0.18 |  |  |  |
| Methionine & | 4.2 | 1.05 | 0.29 |  | 5.3 | 1.33 | 0.37 |  |  |  |
| Cystine (g) |  |  |  |  |  |  |  |  |  |  |
| Leucine (g) | 6.5 | 1.63 | 0.45 |  | 8.2 | 2.05 | 0.57 |  |  |  |
| Lysine (g) | 5.6 | 1.40 | 0.39 |  | 7.0 | 1.75 | 0.49 | >20 | >5.0 | >1.3 |
| Phenylalanine (g) | 4.0 | 1.00 | 0.28 |  | 5.0 | 1.25 | 0.35 |  |  |  |
| Phenylalanine & | 8.0 | 2.00 | 0.56 |  | 10.0 | 2.50 | 0.70 |  |  |  |
| Tyrosine (g)[*e*](#_bookmark113) |  |  |  |  |  |  |  |  |  |  |
| Threonine (g) | 5.0 | 1.25 | 0.35 |  | 6.3 | 1.58 | 0.44 |  |  |  |
| Tryptophan | 1.4 | 0.35 | 0.10 |  | 1.8 | 0.45 | 0.13 |  |  |  |
| Valine (g) | 4.5 | 1.13 | 0.31 |  | 5.6 | 1.40 | 0.39 |  |  |  |
|  |  |  |  | ***Growing Puppies After*** |  |  |  |  |  |  |
|  |  |  |  | ***Weaning*** |  |  |  |  |  |  |
| *Total Fat (g)* |  |  |  | 85 21.3 5.9 | 85 | 21.3 | 5.9 | 330[*a*](#_bookmark109) | 82.5 | 23.0 |
| *Fatty Acids* |  |  |  |  |  |  |  |  |  |  |
| Linoleic Acid (g) |  |  |  | 11.8 3.0 0.8 | 13 | 3.3 | 0.8 | 65[*a*](#_bookmark109) | 16.3 | 4.5 |
| α-Linolenic Acid |  |  |  | 0.7 0.18 0.05 | 0.8 | 0.2 | 0.05 |  |  |  |
| (g)[*f*](#_bookmark114) |  |  |  |  |  |  |  |  |  |  |
| Arachidonic |  |  |  | 0.3 0.08 0.022 | 0.3 | 0.08 | 0.022 |  |  |  |
| Acid (g) |  |  |  |  |  |  |  |  |  |  |
| Eicosapentaenoic |  |  |  |  |  |  |  |  |  |  |
| & |  |  |  |  |  |  |  |  |  |  |
| Docosahexaenoic |  |  |  | 0.5 0.13 0.036 | 0.5 | 0.13 | 0.036 | 11[*a*](#_bookmark109) | 2.8 | 0.77 |
| Acid (g)[*g*](#_bookmark115) |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Minimal Requirement | | | Adequate Intake | | | Recommended Allowance | | | Safe Upper Limit | | |
| Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt./ kg BW0.75[*c*](#_bookmark111) | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt./ kg BW0.75[*c*](#_bookmark111) | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt./ kg BW0.75[*c*](#_bookmark111) | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark109) | Amt./ 1,000  kcal ME[*b*](#_bookmark110) | Amt. kg BW0 |
| *Minerals*  Calcium (g)[*h*](#_bookmark116)Phosphorus (g) Magnesium (mg) Sodium (mg)  Potassium ( ) Chloride (mg) Iron (mg)[*i*](#_bookmark117)Copper (mg)*i* Zinc (mg) Manganese (mg) Selenium (μg) Iodine(μg)  *Vitamins*  Vitamin A (RE)[*j*](#_bookmark118)Cholecalciferol (μg)[*k*](#_bookmark119)  Vitamin E (α- tocopherol) (mg)[*l*](#_bookmark120)Vitamin K  (Menadione) (mg)[*m*](#_bookmark121)  Thiamin (mg) Riboflavin (mg) Pyridoxine (mg) Niacin (mg)  Pantothenic Acid (mg)  Cobalamin (μg) Folic Acid (μg)  Biotin[*n*](#_bookmark122)Choline (mg) | 8.0 | 2.0 | 0.56 |  |  |  | 12[*h*](#_bookmark116) | 3.0[*h*](#_bookmark116) | 0.68[*h*](#_bookmark116) | 18 | 4.5 | 1.25 |
|  |  |  | 10 | 2.5 | 0.68 | 10 | 2.5 | 0.68 |  |  |  |
| 180 | 45 | 12.5 |  |  |  | 400 | 100 | 27.4 |  |  |  |
|  |  |  | 2,200 | 550 | 0 | 2,200 | 550 | 100 |  |  |  |
|  |  |  |  | 10 |  |  |  |  |  |  |  |
|  |  |  | 4 4 | 1 1 | 0 30 | 4 4 | 1 1 | 0 30 |  |  |  |
|  |  |  | 2,900 | 720 | 200 | 2,900 | 720 | 200 |  |  |  |
| 72 | 18 | 5.0 |  |  |  | 88 | 22 | 6.1 |  |  |  |
|  |  |  | 11 | 2.7 | 0.76 | 11 | 2.7 | 0.76 |  |  |  |
| 40 | 10 | 2.7 |  |  |  | 100 | 25 | 6.84 |  |  |  |
|  |  |  | 5.6 | 1.4 | 0.38 | 5.6 | 1.4 | 0.38 |  |  |  |
| 210 | 52.5 | 13.7 |  |  |  | 350 | 87.5 | 25.1 |  |  |  |
|  |  |  | 880 | 220 | 61.0 | 880 | 220 | 61.0 |  |  |  |
|  |  |  | 1,212 | 303 | 84 | 1,515 | 379 | 105 | 15,000[*j*](#_bookmark118) | 3,750[*j*](#_bookmark118) | 1,04 |
|  |  |  | 11.0 | 2.75 | 0.76 | 13.8 | 3.4 | 0.96 | 80 | 20 | 5.6 |
|  |  |  | 24 | 6.0 | 1.7 | 30 | 7.5 | 2.1 |  |  |  |
|  |  |  | 1.3 | 0.33 | 0.090 | 1.64 | 0.41 | 0.11 |  |  |  |
|  |  |  | 1.08 | 0.27 | 0.075 | 1.38 | 0.34 | 0.096 |  |  |  |
|  |  |  | 4.2 | 1.05 | 0.27 | 5.25 | 1.32 | 0.37 |  |  |  |
|  |  |  | 1.2 | 0.3 | 0.084 | 1.5 | 0.375 | 0.10 |  |  |  |
|  |  |  | 13.6 | 3.4 | 0.94 | 17.0 | 4.25 | 1.18 |  |  |  |
|  |  |  | 12 | 3.0 | 0.84 | 15.0 | 3.75 | 1.04 |  |  |  |
|  |  |  | 28 | 7 | 1.95 | 35 | 8.75 | 2.4 |  |  |  |
|  |  |  | 216 | 54 | 15.0 | 270 | 68 | 18.8 |  |  |  |
|  |  |  | 1,360 | 340 | 95 | 1,700 | 425 | 118 |  |  |  |

*[a](#_bookmark95)*The values for Amt/kg DM have been calculated assuming a dietary energy density of 4,000 kcal ME/kg. (The term ≡ signifies equivalence.) If the energy density of the diet is not 4,000 kcal ME/kg, then to calculate the Amt/kg DM for each nutrient, multiply the value for the nutrient in the column labeled Amt/kg DM by the energy density of the pet food (in kcal ME/kg) and divide by 4,000.

*[b](#_bookmark96)*To calculate the amount to feed of each nutrient, multiply the value for Amt/1,000 kcal ME for each nutrient by the energy requirement for the puppy in kcal (calculated from [Table 15-2](#_bookmark42)) and divide by 1,000.

*[c](#_bookmark97)*The values for Amt/BW0.75 apply only to 5.5-kg puppies of expected mature body weight of 35 kg. To calculate the amount of a nutrient for puppies of different current or expected mature body weights, calculate the energy requirement from [Table 15-2](#_bookmark42) and multiply this by the nutrient Amt/1,000 kcal and divide by 1,000.

*[d](#_bookmark98)*For 4 to 14 week-old puppies, 0.01 g arginine should be added for every g of crude protein above 180 g and 225 g, for the MR and RA, respectively, of arginine. For puppies over 14 weeks of age, 0.01 g arginine should be added for every g of crude protein above 140 g and 175 g for the MR and RA of arginine, respectively.

*[e](#_bookmark99)*The quantity of tyrosine required to maximize black hair color may be about 1.5-2.0 times this quantity.

*[f](#_bookmark100)*The requirement for α-linolenic acid varies depending upon linoleic acid content of the diet. The ratio of linoleic acid to α-linolenic acid should be between 2.6 and 16. Note that 0.8 g/kg DM value shown is the minimum RA of α-linolenic acid at 13 g linoleic acid per kg DM resulting in a ratio of linoleic acid to α-linolenic acid of approximately 16.

*[g](#_bookmark101)*Eicosapentaenoic acid should not exceed 60% of the total amount.

*[h](#_bookmark102)*The RA for the calcium requirements of weaned puppies (of expected mature body weight >25 kg) for up to 14 weeks of life should not be less than 0.54 g calcium/kg body weight.

*[i](#_bookmark103)*Some oxide forms of iron and copper should not be used because of low bioavailability.

*[j](#_bookmark104)*For vitamin A, requirements are expressed as RE (retinol equivalents). One RE is equal to 1 μg of all-*trans* retinol, and one IU of vitamin A is equal to 0.3 RE. Safe upper limit values are expressed as μg retinol.

*[k](#_bookmark105)*1 μg cholecalciferol = 40 IU vitamin D3.

*[l](#_bookmark106)*Higher concentrations of vitamin E are recommended for high PUFA diets. One international unit of vitamin E = 1 mg all-*rac*-α-tocopheryl acetate (see [Chapter 8](#_bookmark2)).

*[m](#_bookmark107)*Dogs have a metabolic requirement, but a dietary requirement has not been demonstrated when natural diets are fed. Adequate vitamin K is probably synthesized by intestinal microbes. The vitamin K allowance is expressed in terms of the commercially used precursor menadione that requires alkylation to the active vitamin K.

*[n](#_bookmark108)*For normal diets not containing raw egg white, adequate biotin is probably provided by microbial synthesis in the intestine. Diets containing antibiotics may need supplementation.

[TABLE 15-5 Nutrient Requirements of Adult Dogs for Maintenance](#_bookmark51)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Minimal | Requirement | | Adequate Intake | | | Recommended Allowance | | | Safe Upper Limit | | |
| Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 |
| *Crude Protein (g) Amino Acids*  Arginine (g)[*c*](#_bookmark138)Histidine (g) Isoleucine (g) Methionine (g) Methionine &  Cystine (g)  Leucine (g) Lysine (g) Phenylalanine Phenylalanine &  Tyrosine (g)[*d*](#_bookmark139)  Threonine (g) Tryptophan (g) Valine (g)  *Total Fat (g) Fatty Acids*  Linoleic Acid (g)  α-Linolenic Acid(g)[*e*](#_bookmark140)  Arachidonic Acid (g)  Eicosapentaenoic  +  Docosahexaenoic Acid (g)[*f*](#_bookmark141)  *Minerals* Calcium (g) Phosphorus (g)  Magnesium (mg) Sodium (mg) Potassium (g) Chloride (mg) Iron (mg)[*g*](#_bookmark142)Copper (mg)[*g*](#_bookmark142)Zinc (mg) Manganese (mg) Selenium (μg) Iodine (μg)  *Vitamins*  Vitamin A (RE)[*h*](#_bookmark143)Cholecalciferol  (μg)[*i*](#_bookmark144)  Vitamin E (α- tocopherol) (mg)[*j*](#_bookmark145) | 80 | 20 | 2.62 |  |  |  | 100 | 25 | 3.28 |  |  |  |
| 2.8 | 0.70 | 0.092 |  |  |  | 3.5 | 0.88 | 0.11 |  |  |  |
| 1.5 | 0.37 | 0.048 |  |  |  | 1.9 | 0.48 | 0.062 |  |  |  |
| 3.0 | 0.75 | 0.098 |  |  |  | 3.8 | 0.95 | 0.12 |  |  |  |
| 2.6 | 0.65 | 0.085 |  |  |  | 3.3 | 0.83 | 0.11 |  |  |  |
| 5.2 | 1.30 | 0.17 |  |  |  | 6.5 | 1.63 | 0.21 |  |  |  |
| 5.4 | 1.35 | 0.18 |  |  |  | 6.8 | 1.70 | 0.22 |  |  |  |
| 2.8 | 0.70 | 0.092 |  |  |  | 3.5 | 0.88 | 0.11 |  |  |  |
| 3.6 | 0.90 | 0.12 |  |  |  | 4.5 | 1.13 | 0.15 |  |  |  |
| 5.9 | 1.48 | 0.19 |  |  |  | 7.4 | 1.85 | 0.24 |  |  |  |
| 3.4 | 0.85 | 0.11 |  |  |  | 4.3 | 1.08 | 0.14 |  |  |  |
| 1.1 | 0.28 | 0.036 |  |  |  | 1.4 | 0.35 | 0.046 |  |  |  |
| 3.9 | 0.98 | 0.13 |  |  |  | 4.9 | 1.23 | 0.16 |  |  |  |
|  |  |  | 40 | 10 | 1.3 | 55 | 13.8 | 1.8 | 330[*a*](#_bookmark136) | 82.5 | 10.8 |
|  |  |  | 9.5 | 2.4 | 0.3 | 11 | 2.8 | 0.36 | 65[*a*](#_bookmark136) | 16.3 | 2.1 |
|  |  |  | 0.36 | 0.09 | 0.012 | 0.44 | 0.11 | 0.014 |  |  |  |
|  |  |  | 0.44 | 0.11 | 0.03 | 0.44 | 0.11 | 0.03 | 11[*a*](#_bookmark136) | 2.8 | 0.37 |
| 2.0 | 0.50 | 0.059 |  |  |  | 4.0 | 1.0 | 0.13 |  |  |  |
|  |  |  | 3.0 | 0.75 | 0.10 | 3.0 | 0.75 | 0.10 |  |  |  |
| 180 | 45 | 5.91 |  |  |  | 600 | 150 | 19.7 |  |  |  |
| 300 | 75 | 9.85 |  |  |  | 800 | 200 | 26.2 | >15 g |  |  |
|  |  |  | 4.0 | 1.0 | 0.14 | 4.0 | 1.0 | 0.14 |  |  |  |
|  |  |  | 1,200 | 300 | 40 | 1,200 | 300 | 40 | 23.5 g |  |  |
|  |  |  | 30 | 7.5 | 1.0 | 30 | 7.5 | 1.0 |  |  |  |
|  |  |  | 6 | 1.5 | 0.2 | 6 | 1.5 | 0.2 |  |  |  |
|  |  |  | 60 | 15 | 2.0 | 60 | 15 | 2.0 |  |  |  |
|  |  |  | 4.8 | 1.2 | 0.16 | 4.8 | 1.2 | 0.16 |  |  |  |
|  |  |  | 350 | 87.5 | 11.8 | 350 | 87.5 | 11.8 |  |  |  |
| 700 | 175 | 23.6 |  |  |  | 880 | 220 | 29.6 | ≥ 4 mg |  |  |
|  |  |  | 1,212 | 303 | 40 | 1,515 | 379 | 50 | 64,000[*h*](#_bookmark143) | 16,000[*h*](#_bookmark143) | 2,099[*h*](#_bookmark143) |
|  |  |  | 11.0 | 2.75 | 0.36 | 13.8 | 3.4 | 0.45 | 80 | 20 | 2.6 |
|  |  |  | 24 | 6.0 | 0.8 | 30 | 7.5 | 1.0 |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Minimal | Requirement | | Adequate Intake | | | Recommended Allowance | | | Safe Upper Limit |
| Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 | Amt./ kg DM (≡4,000  kcal)[*a*](#_bookmark136) | Amt./ 1,000  kcal ME[*b*](#_bookmark137) | Amt./ kg BW0.75 | Amt./ Amt./  kg DM 1,000 Amt./ (≡4,000 kcal kg kcal)[*a*](#_bookmark136)ME[*b*](#_bookmark137)BW0.75 |
| Vitamin K |  |  |  | 1.3 | 0.33 | 0.043 | 1.63 | 0.41 | 0.054 |  |
| (Menadione) (mg)[*k*](#_bookmark146) |  |  |  |  |  |  |  |  |  |
| Thiamin (mg) |  |  |  | 1.8 | 0.45 | 0.059 | 2.25 | 0.56 | 0.074 |
| Riboflavin (mg) | 4.2 | 1.05 | 0.138 |  |  |  | 5.25 | 1.3 | 0.171 |
| Pyridoxine (mg) |  |  |  | 1.2 | 0.30 | 0.04 | 1.5 | 0.375 | 0.049 |
| Niacin (mg) |  |  |  | 13.6 | 3.4 | 0.45 | 17.0 | 4.25 | 0.57 |
| Pantothenic Acid |  |  |  | 12 | 3.0 | 0.39 | 15 | 3.75 | 0.49 |
| (mg) |  |  |  |  |  |  |  |  |  |
| Cobalamin (μg) |  |  |  | 28 | 7 | 0.92 | 35 | 8.75 | 1.15 |
| Folic Acid (μg) |  |  |  | 216 | 54 | 7.1 | 270 | 67.5 | 8.9 |
| Biotin[*l*](#_bookmark147) |  |  |  |  |  |  |  |  |  |
| Choline (mg) |  |  |  | 1,360 | 340 | 45 | 1,700 | 425 | 56 |

*[a](#_bookmark124)*The values for Amt/kg DM have been calculated assuming a dietary energy density of 4,000 kcal ME/kg. (The term ≡ signifies equivalence.) If the energy density of the diet is not 4,000 kcal ME/kg, then to calculate the Amt/kg DM for each nutrient, multiply the value for the nutrient in the column labeled Amt/kg DM by the energy density of the pet food (in kcal ME/kg) and divide by 4,000.

*[b](#_bookmark125)*To calculate the amount to feed of each nutrient, multiply the value for Amt/1,000 kcal ME for each nutrient by the energy requirement for laboratory kennel dogs in kcal (calculated from [Table 15-4](#_bookmark46)) and divide by 1,000. For dogs with an unusually low energy intake (below the suggested requirement), the nutrient concentrations (Amt/1,000 kcal) may not be adequate. These animals should be fed the nutrient amounts shown in the column Amt/kg BW0.75.

*[c](#_bookmark126)*0.01 g arginine should be added for every g of crude protein above 80 g and 100 g for the MR and RA, respectively.

*[d](#_bookmark127)*The quantity of tyrosine required to maximize black hair color may be about 1.5-2.0 times this quantity.

*[e](#_bookmark128)*The requirement for α-linolenic acid varies depending upon linoleic acid content of the diet. The ratio of linoleic acid to α-linolenic acid should be between 2.6 and 26. Note that 0.44 g/kg DM value shown is the minimum RA of α-linolenic acid at 11 g linoleic acid per kg DM, resulting in a ratio of linoleic acid to α-linolenic acid of approximately 25.

*[f](#_bookmark129)*50-60% of the total amount should be eicosapentaenoic acid, and 40-50% should be docosahexaenoic acid.

*[g](#_bookmark130)*Some oxides of iron and copper should not be used because of low bioavailability.

*[h](#_bookmark131)*Vitamin A requirements expressed as RE (retinol equivalents). One RE is equal to 1 μg of all-*trans* retinol, and one IU of vitamin A is equal to 0.3 RE. Safe upper limit values expressed as μg retinol.

*[i](#_bookmark132)*1 μg cholecalciferol = 40 IU vitamin D3.

*[j](#_bookmark133)*Higher concentrations of vitamin E are recommended for high PUFA diets. One international unit of vitamin E = 1 mg all-*rac*-α- tocopheryl acetate (see [Chapter 8](#_bookmark2)).

*[k](#_bookmark134)*Dogs have a metabolic requirement, but a dietary requirement has not been demonstrated when natural diets are fed. Adequate vitamin K is probably synthesized by intestinal microbes. The vitamin K allowance is expressed in terms of the commercially used precursor menadione that requires alkylation to the active vitamin K.

*[l](#_bookmark135)*For normal diets not containing raw egg white, adequate biotin is probably provided by microbial synthesis in the intestine. Diets containing antibiotics may need supplementation.

[TABLE 15-8 Nutrient Requirements of Bitches for Late Gestation and Peak](#_bookmark57) [Lactation](#_bookmark57)[*a*](#_bookmark163)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Minimal Requirement | Adequate Intake | | | Recommended Allowance | | | Safe Upper Limit | | |
| Amt./ Amt./  kg DM 1,000 Amt./ (≡4,000 kcal kg kcal)[*b*](#_bookmark164)ME[*c*](#_bookmark165)BW0.75[*d*](#_bookmark166) | Amt./ kg DM (≡4,000  kcal)[*b*](#_bookmark164) | Amt./ 1,000  kcal ME[*c*](#_bookmark165) | Amt./ kg BW0.75[*d*](#_bookmark166) | Amt./ kg DM (≡4,000  kcal)[*b*](#_bookmark164) | Amt./ 1,000  kcal ME[*c*](#_bookmark165) | Amt./ kg BW0.75[*d*](#_bookmark166) | Amt./ kg DM (≡4,000  kcal)[*b*](#_bookmark164) | Amt./ 1,000  kcal ME[*c*](#_bookmark165) | Amt./ kg BW0.75[*d*](#_bookmark166) |
| *Crude Protein Amino Acids*  Arginine (g)[*e*](#_bookmark167)Histidine (g) Isoleucine (g) Methionine (g) Methionine &  Cystine (g)  Leucine (g) Lysine (g) Phenylalanine (g) Phenylalanine &  Tyrosine(g)[*f*](#_bookmark168)  Threonine (g) Tryptophan (g) Valine (g)  *Total Fat (g) Fatty Acids*  Linoleic Acid (g)  α-Linolenic Acid (g)[*g*](#_bookmark169)  Arachidonic Acid (g)  Eicosapentaenoic  +  Docosahexaenoic Acid (g)[*h*](#_bookmark170)  *Minerals* Calcium (g) Phosphorus (g)  Magnesium (mg) Sodium (mg) Potassium (g) Chloride (mg) Iron (mg)[*i*](#_bookmark171)Copper (mg)[*i*](#_bookmark171)Zinc (mg) Manganese (mg) Selenium (µg) Iodine (μg)  *Vitamins*  Vitamin A (RE)[*j*](#_bookmark172)Cholecalciferol  (μg)[*k*](#_bookmark173)  Vitamin E (α- tocopherol) (mg)[*l*](#_bookmark174) |  | 200 | 50 | 24.6 | 200 | 50 | 24.6 |  |  |  |
| 10.0 | 2.50 | 1.23 | 10.0 | 2.50 | 1.23 |  |  |  |
| 4.4 | 1.10 | 0.54 | 4.4 | 1.10 | 0.54 |  |  |  |
| 7.1 | 1.78 | 0.87 | 7.1 | 1.78 | 0.87 |  |  |  |
| 3.1 | 0.78 | 0.38 | 3.1 | 0.78 | 0.38 |  |  |  |
| 6.2 | 1.55 | 0.76 | 6.2 | 1.55 | 0.76 |  |  |  |
| 20.0 | 5.00 | 2.46 | 20.0 | 5.00 | 2.46 |  |  |  |
| 9.0 | 2.25 | 1.11 | 9.0 | 2.25 | 1.11 |  |  |  |
| 8.3 | 2.08 | 1.02 | 8.3 | 2.08 | 1.02 |  |  |  |
| 12.3 | 3.08 | 1.51 | 12.3 | 3.08 | 1.51 |  |  |  |
| 10.4 | 2.60 | 1.28 | 10.4 | 2.60 | 1.28 |  |  |  |
| 1.2 | 0.30 | 0.15 | 1.2 | 0.30 | 0.15 |  |  |  |
| 13.0 | 3.25 | 1.60 | 13.0 | 3.25 | 1.60 |  |  |  |
| 85 | 21.3 | 10.5 | 85 | 21.3 | 10.5 | 330[*b*](#_bookmark164) | 82.5 | 40.6 |
| 11 | 2.8 | 1.4 | 13 | 3.3 | 1.6 | 65[*b*](#_bookmark164) | 16.3 | 8.0 |
| 0.7 | 0.18 | 0.09 | 0.8 | 0.2 | 0.10 |  |  |  |
| 0.5 | 0.13 | 0.06 | 0.5 | 0.13 | 0.06 | 11[*b*](#_bookmark164) | 2.8 | 1.4 |
| 8.0 | 1.9 | 0.82 | 8.0 | 1.9 | 0.82 |  |  |  |
| 5.0 | 1.2 | 0.58 | 5.0 | 1.2 | 0.58 |  |  |  |
| 600 | 150 | 69 | 600 | 150 | 69 |  |  |  |
| 2,000 | 500 | 238 | 2,000 | 500 | 238 |  |  |  |
| 3.6 | 0.9 | 0.430 | 3.6 | 0.9 | 0.43 |  |  |  |
| 3,000 | 750 | 358 | 3,000 | 750 | 358 |  |  |  |
| 70 | 17 | 8.67 | 70 | 17 | 8.67 |  |  |  |
| 12.4 | 3.1 | 1.52 | 12.4 | 3.1 | 1.52 |  |  |  |
| 96 | 24 | 11.7 | 96 | 24 | 11.7 |  |  |  |
| 7.2 | 1.8 | .87 | 7.2 | 1.8 | .87 |  |  |  |
| 350 | 87.5 | 43 | 350 | 87.5 | 43 |  |  |  |
| 880 | 220 | 108 | 880 | 220 | 108 |  |  |  |
| 1,212 | 303 | 149 | 1,515 | 379 | 186 | 15,000[*j*](#_bookmark172) | 3,750[*j*](#_bookmark172) | 1,846[*j*](#_bookmark172) |
| 11.0 | 2.75 | 1.35 | 13.8 | 3.4 | 1.70 | 80 | 20 | 9.8 |
| 24 | 6.0 | 3.0 | 30 | 7.5 | 3.7 |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Nutrient | Minimal Requirement | Adequate Intake | | | Recommended Allowance | | | Safe Upper Limit |
| Amt./ Amt./  kg DM 1,000 Amt./ (≡4,000 kcal kg kcal)[*b*](#_bookmark164)ME[*c*](#_bookmark165)BW0.75[*d*](#_bookmark166) | Amt./ kg DM (≡4,000  kcal)[*b*](#_bookmark164) | Amt./ 1,000  kcal ME[*c*](#_bookmark165) | Amt./ kg BW0.75[*d*](#_bookmark166) | Amt./ kg DM (≡4,000  kcal)[*b*](#_bookmark164) | Amt./ 1,000  kcal ME[*c*](#_bookmark165) | Amt./ kg BW0.75[*d*](#_bookmark166) | Amt./ Amt./  kg DM 1,000 Amt./ (≡4,000 kcal kg kcal)[*b*](#_bookmark164)ME[*c*](#_bookmark165)BW0.75[*d*](#_bookmark166) |
| Vitamin K |  | 1.3 | 0.33 | 0.16 | 1.6 | 0.41 | 0.20 |  |
| (Menadione)(mg)[*m*](#_bookmark175) |  |  |  |  |  |  |
| Thiamin (mg) | 1.8 | 0.45 | 0.22 | 2.25 | 0.56 | 0.28 |
| Riboflavin (mg) | 4.2 | 1.05 | 0.52 | 5.3 | 1.3 | 0.64 |
| Pyridoxine (mg) | 1.2 | 0.30 | 0.15 | 1.5 | 0.375 | 0.185 |
| Niacin (mg) | 13.6 | 3.4 | 1.67 | 17 | 4.25 | 2.09 |
| Pantothenic Acid | 12 | 3.0 | 1.48 | 15 | 3.75 | 1.84 |
| (mg) |  |  |  |  |  |  |
| Cobalamin (μg) | 28 | 7 | 3.45 | 35 | 8.75 | 4.3 |
| Folic Acid (μg) | 216 | 54 | 26.6 | 270 | 67.5 | 33.2 |
| Biotin[*n*](#_bookmark176) |  |  |  |  |  |  |
| Choline (mg) | 1,360 | 340 | 167 | 1,700 | 425 | 209 |

*[a](#_bookmark149)*Few data could be found for the dietary concentrations for the minimal requirement for gestation for the bitch. The values for lactation relative to kg DM and 1,000 kcal ME may be taken as satisfactory for gestation.

*[b](#_bookmark150)*The values for Amt/kg DM have been calculated assuming a dietary energy density of 4,000 kcal ME/kg. (The term ≡ signifies equivalence.) If the energy density of the diet is not 4,000 kcal ME/kg, then to calculate the Amt/kg DM for each nutrient, multiply the value for the nutrient in the column labeled Amt/kg DM by the energy density of the pet food (in kcal ME/kg) and divide by 4,000.

*[c](#_bookmark151)*To calculate the amount to feed of each nutrient multiply the value for Amt/1 000 kcal ME for each nutrient by the energy requirement in kcal (calculated from [Tables 15-6](#_bookmark53) and [15-7](#_bookmark55)) and divide by 1 000.

*[d](#_bookmark152)*The values for Amt/BW0.75 apply only to a 22-kg bitch in peak lactation with 8 puppies and consuming 5,000 kcal/day. To calculate the amount for bitches of different body weights or litter sizes, calculate the energy requirement from [Table 15-7](#_bookmark55) and multiply this value by the nutrient Amt/1,000 kcal and divide by 1,000. To calculate the amount of a nutrient for gestating dogs, calculate the energy requirement from [Table 15-6](#_bookmark53) and multi l this value b the nutrient Amt/1 000 kcal and divide b 1 000

*[e](#_bookmark153)*0.01 g arginine should be added for every g of crude protein above 200.

*[f](#_bookmark154)*The quantity of tyrosine required to maximize black hair color may be about 1.5-2.0 times this quantity.

*[g](#_bookmark155)*The requirement for α-linolenic acid varies depending upon linoleic acid content of the diet. The ratio of linoleic acid to α-linolenic acid should be between 2.6 and 16. Note that 0.8 g/kg DM value shown is the minimum RA of α-linolenic acid at 13 g linoleic acid per kg DM, resulting in a ratio of linoleic acid to α-linolenic acid of approximately 16.

*[h](#_bookmark156)*50-60% of the total amount should be eicosapentaenoic, acid and 40-50% should be docosahexaenoic acid.

*[i](#_bookmark157)*Some oxides of iron and copper should not be used because of low bioavailability.

*[j](#_bookmark158)*Vitamin A requirements expressed as RE (retinol equivalents). One RE is equal to 1 μg of all-*trans* retinol, and one IU of vitamin A is equal to 0.3 RE. Safe upper limit values expressed as μg retinol.

*[k](#_bookmark159)*1 μg cholecalciferol = 40 IU vitamin D3.

*[l](#_bookmark160)*Higher concentrations of vitamin E are recommended for high PUFA diets. One international unit of vitamin E = 1 mg all-*rac*-α-tocopheryl acetate (see [Chapter 8](#_bookmark2)).

*[m](#_bookmark161)*Dogs have a metabolic requirement, but a dietary requirement has not been demonstrated when natural diets are fed. Adequate vitamin K is probably synthesized by intestinal microbes. The vitamin K allowance is expressed in terms of the commercially used precursor menadione that requires alkylation to the active vitamin K.

*[n](#_bookmark162)*For normal diets not containing raw egg white, adequate biotin is probably provided by microbial synthesis in the intestine. Diets containing antibiotics may need supplementation.