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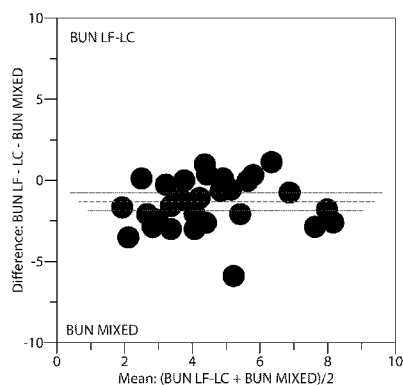
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(54) Title: PET FOOD COMPOSITIONS AND METHODS FOR IMPROVING POSTPRANDIAL RENAL STATUS



|                 |         |           |          |
|-----------------|---------|-----------|----------|
| TEST            | 3.85278 | t-Ratio   | -5.15074 |
| Control         | 5.14722 | DF        | 35       |
| Mean Difference | -1.2944 | Prob >  t | <0.0001* |
| Std Error       | 0.25131 | Prob > t  | 1.0000   |
| Upper 95%       | -0.7843 | Prob < t  | <.0001*  |
| Lower 95%       | -1.8046 |           |          |
| N               | 36      |           |          |
| Correlation     | 0.62802 |           |          |

FIG. 1

(57) Abstract: Described herein are pet food meal compositions and methods for improving postprandial renal status by decreasing circulating markers of CKD. The certain pet food meal compositions comprise a first portion and a second portion, which are adapted to have different macronutrient values. The pet food meal compositions and methods described herein can attenuate postprandial increase in circulating markers of CKD and reduce the risk for renal diseases.

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## **PET FOOD COMPOSITIONS AND METHODS FOR IMPROVING POSTPRANDIAL RENAL STATUS**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

**[0001]** This application claims the benefit of priority from U.S. Patent Application No. 63/524,572, filed June 30, 2023, titled Pet Food Compositions and Methods for Improving Postprandial Renal Status, the content of which are hereby incorporated herein in their entirety, for all purposes.

### **BACKGROUND**

**[0002]** There are three main components in macronutrients—fat, carbohydrates, and protein. Additionally, pet food compositions usually contain dietary fiber. Each of these four components of the diet can differentially impact the processes of digestion, absorption and catabolism when used in varying ratios in the diet. They can each also determine the levels of markers which can influence the postprandial renal status.

**[0003]** It would be desirable to provide pet food compositions and methods for helping lessen postprandial increases in circulating markers of CKD risk.

### **BRIEF SUMMARY**

**[0004]** This summary is intended merely to introduce a simplified summary of some aspects of one or more implementations of the present disclosure. Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. This summary is not an extensive overview, nor is it intended to identify key or critical elements of the present teachings, nor to delineate the scope of the disclosure. Rather, its purpose is merely to present one or more concepts in simplified form as a prelude to the detailed description below.

**[0005]** Aspects of the invention are directed to pet food compositions and methods of feeding an animal to improve postprandial renal status in the animal. In accordance with a first aspect of the invention, provided is a method comprising feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal, and providing the animal a second portion of the pet food meal subsequently to the first portion, wherein the second portion has a different macronutrient value from the first portion of the pet food meal.

**[0006]** The second portion of the pet food meal is provided after the animal finishes eating the first portion of the pet food meal.

**[0007]** According to certain embodiments of the invention, provided is that the second portion of the pet food meal may be provided after a period of time of about 1 minute or more.

**[0008]** For example, the second portion of the pet food meal is provided after a period of time ranging from about 1 minute to about 60 minutes from providing the first portion of the pet food meal.

**[0009]** According to certain embodiments of the invention, the first portion of the pet food meal comprises at least 51 wt.% of the total amount of dietary starch in the pet food meal.

**[0010]** Additionally or alternatively, the second portion of the pet food meal may comprise at least 50 wt.% of the total amount of fat in the pet food meal.

**[0011]** In some instances, the second portion of the pet food meal comprises at least 51 wt.% of the total amount of fiber in the pet food meal.

**[0012]** According to certain embodiments of the invention, the first portion of the pet food meal contains about 51 % of calories of the pet food meal.

**[0013]** According to some embodiments of the invention, provided is that the pet food meal may have a macronutrient value comprising from about 20 to about 65 kcal%, based on the total amount of kcal, of protein; from about 15 to about 75 kcal%, based on the total amount of kcal, of fat; and from about 1 to about 60 kcal%, based on the total amount of kcal, of dietary starch.

**[0014]** The pet food meal may be adapted to reduce chronic kidney disease markers relative to when the animal eats the first portion and the second portion of the pet food meal together.

**[0015]** A list of non-limiting embodiments in accordance with aspects of the invention is provided below:

**[0016]** In accordance with an embodiment 1, provided is a method of feeding an animal, the method comprising:

feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal; and providing the animal a second portion of the pet food meal subsequently to the first portion, wherein the second portion has a different macronutrient value from the first portion of the pet food meal.

**[0017]** In accordance with embodiment 2, provided is the method according to claim 1, wherein

the second portion of the pet food meal is provided after the animal finishes eating the first portion of the pet food meal.

**[0018]** In accordance with embodiment 3, provided is the method according to claim 1 or claim 2, wherein the second portion of the pet food meal is provided after a period of time of about 1 minute or more.

**[0019]** In accordance with embodiment 4, provided is the method according to any foregoing claim, wherein the second portion of the pet food meal is provided after a period of time ranging from about 1 minute to about 60 minutes from providing the first portion of the pet food meal.

**[0020]** In accordance with embodiment 5, provided is the method according to any foregoing claim, wherein the first portion of the pet food meal comprises starch in an amount of about 51 to about 100 wt.%, based on the total weight of the pet food meal on a dry matter basis.

**[0021]** In accordance with embodiment 6, provided is the method according to any foregoing claim, wherein the pet food meal has a weight ratio of an amount of starch in the first portion to an amount of starch in the second portion that is from about 35:1 to about 15:1, optionally, from about 30:1 to about 20:1, or about 25:1.

**[0022]** In accordance with embodiment 7, provided is the method according to any foregoing claim, wherein the second portion of the pet food meal comprises starch in an amount of about 2 wt.% to about 49 wt.%, based on the total weight of the pet food meal on a dry matter basis.

**[0023]** In accordance with embodiment 8, provided is the method according to any foregoing claim, wherein the first portion of the pet food meal comprises fat in an amount that is less than half of a total amount of fat in the pet food meal.

**[0024]** In accordance with embodiment 9, provided is the method according to any foregoing claim, wherein the pet food meal has a weight ratio of the amount of the fat in the first portion to the amount of the fat in the second portion of about 1:1.5 to about 1:7.

**[0025]** In accordance with embodiment 10, provided is the method according to claim 9, wherein the weight ratio of the amount of the fat in the first portion to the amount of the fat in the second portion is from about 1:2 to about 1:6, optionally, about 1:2 to about 1:5 or about 1:2 to about 1:4.

**[0026]** In accordance with embodiment 11, provided is the method according to any foregoing claim, wherein the second portion of the pet food meal comprises fat in an amount that is greater than half of the total amount of the fat in the pet food meal.

**[0027]** In accordance with embodiment 12, provided is the method according to any foregoing

claim, wherein the first portion of the pet food meal comprises fiber in an amount that is less than half of the total amount of the fiber in the pet food meal.

**[0028]** In accordance with embodiment 13, provided is the method according to any foregoing claim, wherein the pet food meal has a weight ratio of the amount of the fiber in the first portion of the pet food meal to the amount of the fiber in the second portion of the pet food meal of about 1:5 to about 1:1.

**[0029]** In accordance with embodiment 14, provided is the method according to claim 13, wherein the weight ratio of the amount of the fiber in the first portion to the amount of the fiber in the second portion is about 1:3 to about 1:1.

**[0030]** In accordance with embodiment 15, provided is the method according to any foregoing claim, wherein the second portion of the pet food meal comprises an amount of fiber that is 2 times greater than the amount of fiber in the first portion.

**[0031]** In accordance with embodiment 16, provided is the method according to any foregoing claim, wherein the first portion of the pet food meal comprises protein in an amount that is about equal to the amount of protein in the second portion of the pet food meal.

**[0032]** In accordance with embodiment 17, provided is the method according to any foregoing claim, wherein the pet food meal has a macronutrient value comprising:

- from about 20 to about 60 kcal%, based on the total amount of kcal, of protein,
- from about 8 to about 25 kcal%, based on the total amount of kcal, of fat, and
- from about 30 to about 60 kcal%, based on the total amount of kcal, of dietary starch.

**[0033]** In accordance with embodiment 18, provided is the method according to any foregoing claim, wherein the animal is a pet.

**[0034]** In accordance with embodiment 19, provided is the method according to any foregoing claim, wherein the pet is a canine.

**[0035]** In accordance with embodiment 20, provided is the method according to any foregoing claim, wherein the method comprises feeding the animal the pet food meal only once in one day.

**[0036]** In accordance with embodiment 21, provided is the method according to any foregoing claim, wherein the animal has access to the first portion of the pet food meal for a period of about 5 to about 15 minutes.

**[0037]** In accordance with embodiment 22, provided is the method according to any foregoing claim, wherein the animal has access to the second portion of the pet food meal for a period of

about 5 to about 15 minutes.

**[0038]** In accordance with an embodiment 23, provided is a pet food meal in the form of a first portion and a second portion, the pet food meal composition comprising:

a macronutrient value comprising:

from about 20 to about 60 kcal%, based on the total amount of kcal, of protein,

from about 8 to about 25 kcal%, based on the total amount of kcal, of fat, and

from about 30 to about 60 kcal%, based on the total amount of kcal, of dietary starch,

wherein the first portion of the first portion of the pet food meal comprises at least 50 kcal%, based on the total amount of kcal, of the fat in the pet food meal and at least 50 kcal%, based on the total amount of kcal, of the fiber in the pet food meal.

**[0039]** In accordance with embodiment 24, provided is the pet food meal according to claim 23, wherein the pet food meal is adapted to reduce chronic kidney disease markers relative to when the animal eats the first portion and the second portion of the pet food meal together.

**[0040]** In accordance with embodiment 25, provided is the pet food meal according to claim 23 or claim 24, wherein the chronic kidney disease markers comprise blood urea nitrogen, creatinine, phosphorus, triglycerides, and a combination thereof.

**[0041]** In accordance with embodiment 26, provided is the pet food meal according to one of claim 23 to claim 26, wherein the animal is *Canis familiaris*.

**[0042]** In accordance with embodiment 27, provided is the pet food meal according to one of claim 23 to claim 25, wherein the animal is *Felis domesticus*.

**[0043]** In accordance with an embodiment 28, provided is a method of feeding an animal to improve the renal health of the animal, the method comprising:

feeding an animal a pet food meal comprising a first portion and a second portion by

providing the animal a first portion of the pet food meal; and

providing the animal a second portion of the pet food meal subsequently to the first portion,

wherein the second portion has a different macronutrient value from the first portion of the pet food meal.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0044]** The features, and advantages of the invention will be apparent from the following more detailed description of certain embodiments of the invention and as illustrated in the accompanying

drawings in which:

**[0045]** FIG. 1 is a graph showing the difference in postprandial levels of BUN for animals consuming a non-limiting, exemplary pet food meal as compared to a comparative meal in accordance with an aspect of the invention;

**[0046]** FIG. 2 is a graph showing the difference in postprandial levels of creatinine for animals consuming a non-limiting, exemplary pet food meal as compared to a comparative meal in accordance with an aspect of the invention;

**[0047]** FIG. 3A is a graph showing the difference in fasting triglycerides for animals consuming a non-limiting, exemplary pet food meal as compared to a comparative meal in accordance with an aspect of the invention;

**[0048]** FIG. 3B is a graph showing the difference in lipidemia for animals consuming a non-limiting, exemplary pet food meal as compared to a comparative meal in accordance with an aspect of the invention; and

**[0049]** FIG. 4 is a graph showing the difference in postprandial levels of phosphorus for animals consuming a non-limiting, exemplary pet food meal as compared to a comparative meal in accordance with an aspect of the invention.

**[0050]** It should be understood that the various aspects are not limited to the compositions, arrangements, and instrumentality shown in the figures.

### DETAILED DESCRIPTION

**[0051]** For illustrative purposes, the principles of the present invention are described by referencing various exemplary embodiments thereof. Although certain embodiments of the invention are specifically described herein, one of ordinary skill in the art will readily recognize that the same principles are equally applicable to, and can be employed in other compositions and methods. Before explaining the disclosed embodiments of the present invention in detail, it is to be understood that the invention is not necessarily limited in its application to the details of any particular embodiment disclosed. The terminology used herein is for the purpose of description and not of limitation.

**[0052]** As used herein and in the appended claims, the singular forms “a”, “an”, and “the” include plural references unless the context dictates otherwise. The singular form of any class of the ingredients refers not only to one ingredient within that class, but also to a mixture of those

ingredients. The terms “a” (or “an”), “one or more” and “at least one” may be used interchangeably herein. The terms “comprising”, “including”, and “having” may be used interchangeably. The term “include” should be interpreted as “include, but are not limited to”. The term “including” should be interpreted as “including, but are not limited to”.

**[0053]** As used throughout, ranges are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range. Thus, a range from 1-5, includes specifically 1, 2, 3, 4 and 5, as well as subranges such as 2-5, 3-5, 2-3, 2-4, 1-4, etc. The term “about” when referring to a number means any number within a range of 10% of the number. For example, the phrase “about 2 wt.%” refers to a number between and including 1.8 wt.% and 2.2 wt.%.

**[0054]** The abbreviations and symbols as used herein, unless indicated otherwise, take their ordinary meaning. The abbreviation “wt.%” means percent by weight with respect to the pet food composition. The symbol “°” refers to a degree, such as a temperature degree or a degree of an angle. The symbols “h”, “min”, “mL”, “nm”, “μm” means hour, minute, milliliter, nanometer, and micrometer, respectively. The abbreviation “UV-VIS” referring to a spectrometer or spectroscopy, means Ultraviolet-Visible. The abbreviation “rpm” means revolutions per minute.

**[0055]** All references cited herein are hereby incorporated by reference in their entireties. In the event of a conflict in a definition in the present disclosure and that of a cited reference, the present disclosure controls.

**[0056]** Any member in a list of species that are used to exemplify or define a genus, may be mutually different from, or overlapping with, or a subset of, or equivalent to, or nearly the same as, or identical to, any other member of the list of species. Further, unless explicitly stated, such as when reciting a Markush group, the list of species that define or exemplify the genus is open, and it is given that other species may exist that define or exemplify the genus just as well as, or better than, any other species listed.

**[0057]** All components and elements positively set forth in this disclosure can be negatively excluded from the claims. In other words, the pet food meal compositions of the instant disclosure can be free or essentially free of all components and elements positively recited throughout the instant disclosure. In some instances, the pet food meal compositions of the present disclosure may be substantially free of non-incidental amounts of the ingredient(s) or compound(s) described herein. A non-incidental amount of an ingredient or compound is the amount of that ingredient or

compound that is added into the pet food meal compositions by itself. For example, a pet food meal composition may be substantially free of a non-incidental amount of an ingredient or compound, although such ingredient(s) or compound(s) may be present as part of a raw material that is included as a blend of two or more compounds. Substantially free, unless other defined or described herein, typically refers to an ingredient or compound in an amount of about 2 wt.% or less, about 1.5 wt.% or less, about 1 wt.% or less, about 0.5 wt.% or less, about 0.1 wt.% or less, or about 0.05 wt.% or less, or about 0.01 wt.% or less, based on the total weight of the pet food meal compositions on a dry matter basis.

**[0058]** Some of the various categories of components identified may overlap. In such cases where overlap may exist and the pet food meal composition includes both components (or the composition includes more than two components that overlap), an overlapping compound does not represent more than one component. For example, certain components or ingredients may be characterized as both a grain and a rice. If a particular pet food care composition recites both a grain and a rice, an ingredient and/or compound that may be characterized as both a grain and a rice will serve only as either a grain or a rice—not both.

**[0059]** As used herein, the term “pet” could be used interchangeably with “companion animal” and refers to an animal of any species kept by a caregiver as a pet or any animal of a variety of species that have been widely domesticated as pets, including canines (*Canis familiaris*) and felines (*Felis domesticus*). Thus, a pet may include but is not limited to, working dogs, pet dogs, cats kept for rodent control (i.e., farm cats), pet cats, ferrets, birds, reptiles, rabbits, and fish.

**[0060]** To the extent that food and food ingredient contain water/moisture, the dry matter represents everything in the sample other than water including, for example, protein, fiber, fat, carbohydrates, minerals, etc. Dry matter weight is the total weight minus the weight of any water. The skilled artisan would readily recognize and understand nutritional amounts and percentages expressed as dry matter amounts, dry matter weights and dry matter percentages.

**[0061]** Dry matter intake per day is calculated as the total nutritional intake per day excluding all water. For example, an amount of an ingredient equal to a specific percent of daily nutritional intake refers to the amount of that ingredient in dry matter form (i.e., excluding all water) relative to the total amount of dry matter consumed (also excluding all water) in a day.

**[0062]** “Daily nutritional intake” and “total nutritional intake per day” refer to dry matter intake per day. That is, water weight is not included in calculating the amount of nutrition consumed per

day. To calculate percent of an ingredient of total daily intake on a dry matter basis, water is removed from the total intake to give total daily dry matter intake and the percentage of the ingredient is based on amount of ingredient present as dry matter.

**[0063]** As used herein, an “ingredient” refers to any component of a pet food composition. The term “nutrient” refers to a substance that provides nourishment and thus has a nutrient value. In some cases, an ingredient may comprise more than one “nutrient,” for example, a composition may comprise corn comprising important nutrients including both protein and carbohydrate.

**[0064]** Aspects of the invention are directed to pet food meal compositions and methods for improving postprandial renal status by decreasing circulating markers of CKD. The inventors discovered that certain pet food meals comprising a first and a second portion, which are adapted to have different compositions and/or macronutrient values, can unexpectedly attenuate postprandial increase in circulating markers of CKD and reduce the risk for renal diseases. Without being limited to any particular theory, it is believed that certain pet food meal compositions and methods disclosed herein aid in the prevention of sarcopenic wasting and increasing microbiome benefits, while also concurrently attenuates postprandial rises in CKD markers which normally accompanies increased dietary protein, fat and fiber. In some aspects, for instance, certain embodiments of the pet food meal compositions of the invention contain certain proteins, fats, and fibers in particular amounts and/or ratios to achieve improvements in postprandial renal status without decreasing the levels of protein, fat, and fiber in the daily nutritional intake.

**[0065]** In one aspect of the invention, provided is a method of feeding an animal comprising feeding the animal a first portion of a pet food meal and feeding the animal a second portion of the pet food meal. The first portion of the pet food meal comprises carbohydrate in a greater wt.% than carbohydrate in the second portion of the pet food meal. The first portion of the pet food meal may contain at least 51 wt.% of the total amount of carbohydrate in the pet food meal. The second portion of the pet food meal comprises fat and fiber in a greater wt.% than fat and fiber in the first portion of the pet food meal. The second portion of the pet food meal may contain at least 50 wt.% of the total amount of fat and fiber in the pet food meal. The pet food meal composition may be specifically formulated for felines and/or canines.

**[0066]** The pet food meal and/or method of use thereof may, in some embodiments, achieve a reduction in BUN of about 20% or more, about 30% or more, or about 40% or more, based a pet consuming the pet food meal composition as disclosed herein for about 5 weeks. In some

embodiments, the pet food meal composition and/or method of use thereof achieve a reduction of about 20% or more, about 30% or more, or about 40% or more in the rise in blood urea nitrogen (BUN) about 2 hours after consumption of the second portion the pet food meal composition, where the pet consumed the pet food meal composition as disclosed herein for about 5 weeks as compared to a comparative pet food meal composition having the same caloric and macronutrient value as the pet food meal, but the comparative composition is provided as two portions have the same composition. In some instances, the reduction of about 5% or more, about 20% or more, about 30% or more, or about 40% or more in the rise in blood urea nitrogen (BUN) about 2 hours after consumption of the second portion the pet food meal composition may be achieved by a pet consuming a pet food meal compositions for 5 weeks according to method, the method comprising: feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal; and providing the animal a second portion of the pet food meal subsequently to the first portion, wherein the second portion has a different macronutrient value from the first portion of the pet food meal.

**[0067]** Additionally and/or alternatively, the pet food meal and/or method of use thereof may, in some embodiments, achieve a reduction in creatinine of about 60% or more, about 70% or more, about 80% or more, about 90% or more, or about 95% or more, based on a pet consuming the pet food meal composition as disclosed herein for about 5 weeks. In some embodiments, the pet food meal composition and/or method of use thereof achieve a reduction in creatinine of about 60% or more, about 70% or more, about 80% or more, about 90% or more, or about 95% or more about 2 hours after consumption of the second portion the pet food meal composition, where the pet consumed the pet food meal composition as disclosed herein for about 5 weeks as compared to a comparative pet food meal composition having the same caloric and macronutrient value as the pet food meal, but the comparative composition is provided as two portions have the same composition. In some instances, the reduction in creatinine of about 60% or more, about 70% or more, about 80% or more, about 90% or more, or about 95% or more about 2 hours after consumption of the second portion the pet food meal composition may be achieved by a pet consuming a pet food meal compositions for 5 weeks according to method, the method comprising: feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal; and providing the animal a second portion of the pet food meal subsequently to the first portion, wherein the second portion has a different

macronutrient value from the first portion of the pet food meal.

**[0068]** Additionally and/or alternatively, the pet food meal and/or method of use thereof may, in some embodiments, achieve a reduction in lipemia of about 30% or more, about 40% or more, about 50% or more, or about 60% or more, based on a pet consuming the pet food meal composition as disclosed herein for about 5 weeks. In some embodiments, the pet food meal composition and/or method of use thereof achieve a reduction in lipemia of about 30% or more, about 40% or more, about 50% or more, or about 60% or more about 2 hours after consumption of the second portion the pet food meal composition, where the pet consumed the pet food meal composition as disclosed herein for about 5 weeks as compared to a comparative pet food meal composition having the same caloric and macronutrient value as the pet food meal, but the comparative composition is provided as two portions have the same composition. In some instances, the reduction in lipemia of about 30% or more, about 40% or more, about 50% or more, or about 60% or more about 2 hours after consumption of the second portion the pet food meal composition may be achieved by a pet consuming a pet food meal compositions for 5 weeks according to method, the method comprising: feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal; and providing the animal a second portion of the pet food meal subsequently to the first portion, wherein the second portion has a different macronutrient value from the first portion of the pet food meal.

**[0069]** The pet food meal and/or method of use thereof may, in some embodiments, achieve a reduction in postprandial rise in triglyceride of about 40% or more, about 50% or more, or about 60% or more, or about 65% or more, based on a pet consuming the pet food meal composition as disclosed herein for about 5 weeks. In some embodiments, the pet food meal composition and/or method of use thereof achieve a reduction in postprandial rise in triglyceride of about 40% or more, about 50% or more, or about 60% or more, or about 65% or more about 2 hours after consumption of the second portion the pet food meal composition, where the pet consumed the pet food meal composition as disclosed herein for about 5 weeks as compared to a comparative pet food meal composition having the same caloric and macronutrient value as the pet food meal, but the comparative composition is provided as two portions have the same composition. In some instances, the reduction in postprandial rise in triglyceride of about 40% or more, about 50% or more, or about 60% or more, or about 65% or more about 2 hours after consumption of the second

portion the pet food meal composition may be achieved by a pet consuming a pet food meal compositions for 5 weeks according to method, the method comprising: feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal; and providing the animal a second portion of the pet food meal subsequently to the first portion, wherein the second portion has a different macronutrient value from the first portion of the pet food meal.

**[0070]** Suitable components, such as those listed below, may be included or excluded from the formulations for the pet food meal compositions depending on the specific combination of other ingredients and the form of the pet food meal compositions. In some embodiments, the pet food meal compositions disclosed herein may be in the form of a stand-alone pet food, as a supplement to pet food, as a pet food treat, or the like.

**[0071]** The pet food meal composition may be formulated to have a total amount of carbohydrate and/or starch from about 10 to about 60 wt.%, based on the total weight of the pet food meal composition (e.g., the combined first portion and second portion of the pet food meal composition) on a dry matter basis. Carbohydrates as used herein are determined as the nitrogen free extract (“NFE”), which can be calculated as follows:  $\text{NFE \%} = 100\% - (\text{moisture \%}) - (\text{protein \%}) - (\text{fat \%}) - (\text{ash \%}) - (\text{crude fiber \%})$ . Starch, as used herein, is determined by AOAC International Standard No. AOAC 996.11, which is incorporated herein by reference in its entirety for all purposes. For example, the total amount of carbohydrate and/or starch in the pet food meal composition may be from about 11 to about 58 wt.%, about 12 to about 55 wt.%, about 14 to about 55 wt.%, about 15 to about 54 wt.%, about 18 to about 50 wt.%, about 20 to about 50 wt.%, about 25 to about 50 wt.%, from about 28 to about 50 wt.%, about 30 to about 50 wt.%, about 35 to about 50 wt.%, about 40 to about 50 wt.%, about 41 to about 50 wt.%, about 42 to about 50 wt.%, about 43 to about 50 wt.%, from about 44 to about 50 wt.%, about 44 to about 48 wt.%, about 44 to about 47 wt.%, or about 44 to about 46 wt.%, including any ranges or subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[0072]** The first portion of the pet food meal composition may be formulated to include carbohydrate and/or starch in an amount that equates to about half of the calories of the pet food meal and/or half of the amount of calories that the animal consumes in one day. The amount of carbohydrate and/or starch in the first portion of the pet food meal may vary, but typically is in the range of about 40 to about 50 wt.%, endpoints included, based on the total weight of the pet food

meal composition on a dry matter basis. For example, the first portion of the pet food meal composition may include carbohydrate in an amount ranging from about 41 to about 50 wt.%, about 42 to about 50 wt.%, about 41 to about 49 wt.%, about 41 to about 48 wt.%, about 41 to about 47 wt.%, about 41 to about 47 wt.%, about 41 to about 46 wt.%, about 41 to about 45 wt.%, about 41 to about 44 wt.%, about 42 to about 49 wt.%, about 42 to about 48 wt.%, about 42 to about 47 wt.%, about 42 to about 46 wt.%, about 42 to about 45 wt.%, about 42 to about 44 wt.%, about 43 to about 49 wt.%, about 43 to about 48 wt.%, about 43 to about 47 wt.%, about 43 to about 46 wt.%, about 43 to about 45 wt.%, about 43 to about 44 wt.%, including any ranges or subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[0073]** Additionally or alternatively, the first portion of the pet food meal composition may be formulated to include carbohydrate and/or starch in an amount that is greater than half of the total amount of carbohydrate and/or starch grams in the pet food meal (e.g., measured weight percentages and/or as macronutrient grams of carbohydrate and/or starch relative to the total macronutrient grams of the pet food meal composition). The amount of carbohydrate and/or starch in the first portion of the pet food meal composition (e.g., measured as weight percentages and/or a percentage of macronutrient grams of carbohydrate and/or starch relative to the total macronutrient grams of carbohydrate and/or starch in the pet food meal composition) may vary, but typically is in the range of about 51 to about 100%, endpoints included, based on the total amount of carbohydrate and/or starch in the pet food composition, which may be the total amount of carbohydrate and/or starch that the animal consumes in one day. For example, the first portion of the pet food meal composition may include carbohydrate and/or starch in an amount ranging from about 51 to about 91%, about 51 to about 92%, about 51 to about 93%, about 51 to about 94%, about 51 to about 95%, about 51 to about 96%, about 51 to about 97%, about 51 to about 98%, about 51 to about 99%, about 51 to about 80%, about 51 to about 81%, about 51 to about 82%, about 51 to about 83%, about 51 to about 84%, about 51 to about 85%, about 51 to about 86%, about 51 to about 87%, about 51 to about 88%, about 51 to about 89%, about 51 to about 90%, about 51 to about 70%, about 51 to about 71%, about 51 to about 72%, about 51 to about 73%, about 51 to about 74%, about 51 to about 75%, about 51 to about 76%, about 51 to about 77%, about 51 to about 78%, about 51 to about 79%, about 51 to about 80%, about 51 to about 60%, about 51 to about 61%, about 51 to about 62%, about 51 to about 63%, about 51 to about

64%, about 51 to about 65%, about 51 to about 66%, about 51 to about 67%, about 51 to about 68%, about 51 to about 69%, about 51 to about 70 wt.%, about 51 to about 59%, about 51 to about 58%, about 51 to about 57%, about 51 to about 56%, about 51 to about 55%, about 51 to about 54%, about 51 to about 53%, about 51 to about 52%, including ranges and subranges thereof, based on the total amount of carbohydrate (e.g., as measured weight percentages and/or as a percentage of macronutrient grams of carbohydrate and/or starch in the first portion relative to the total macronutrient grams of carbohydrate and/or starch in the pet food meal composition).

**[0074]** Additionally or alternatively, the first portion of the pet food meal composition may be formulated to include carbohydrate and/or starch in an amount that is about 25 times (25X) greater than the amount of carbohydrate and/or starch in the second portion of the pet food meal composition (e.g., measured as weight percentages and/or macronutrient grams of carbohydrate and/or starch relative to the total macronutrient grams of the pet food meal composition). For instance, the pet food meal may be formulated to have a weight ratio of the amount of carbohydrate in the first portion of the pet food meal to the amount of carbohydrate in the second portion of the pet food meal (e.g., measured as weight percentages and/or macronutrient grams of carbohydrate and/or starch relative to the total macronutrient grams of the pet food meal composition) that is from about 35:1 to about 15:1, about 30:1 to about 15:1, about 25:1 to about 15:1, about 20:1 to about 15:1; from about 35:1 to about 20:1, about 30:1 to about 20:1, about 25:1 to about 20:1; from about 35:1 to about 25:1, about 30:1 to about 25:1, about 35:1 to about 30:1, or any range or subrange thereof.

**[0075]** The first portion of the pet food meal composition is preferably formulated such that the calories from the carbohydrate and/or starch in the first portion of the pet food meal composition comprise about 45 to about 55% of the total calories of the pet food meal, which may be the total amount that the animal consumes in one day. The range for the amount of carbohydrates and/or starch in the first portion of the pet food composition may be from about 44 to about 54%, about 44 to about 53%, about 44 to about 52%, about 44 to about 51%, about 44 to about 50%, about 43 to about 54%, about 43 to about 53%, about 43 to about 52%, about 43 to about 51%, about 43 to about 50%, about 44 to about 54%, about 44 to about 54%, about 44 to about 53%, about 44 to about 52%, about 44 to about 51%, about 44 to about 50%, about 45 to about 54%, about 45 to about 53%, about 45 to about 52%, about 45 to about 51%, about 45 to about 50%, about 46 to about 54%, about 46 to about 53%, about 46 to about 52%, about 46 to about 51%, about 46 to

about 50%, about 47 to about 54%, about 47 to about 53%, about 47 to about 52%, about 47 to about 51%, about 47 to about 50%, about 48 to about 54%, about 48 to about 53%, about 48 to about 52%, about 48 to about 51%, about 48 to about 50%, about 49 to about 54%, about 49 to about 54%, about 49 to about 53%, about 49 to about 52%, about 49 to about 51%, or about 49 to about 50%, including ranges and subranges thereof, by calorie percentage (cal.%) relative to the total calories of the pet food meal composition.

**[0076]** The second portion of the pet food meal composition may be formulated to include carbohydrate and/or starch in an amount that is less than about half of the calories of the pet food meal composition, which may be the total amount an animal consumes in one day. The amount of carbohydrate and/or starch in the second portion of the pet food meal may vary, but typically is in the range of from about 0.1 to about 4 wt.%, endpoints included, based on the total weight of the pet food meal composition on a dry matter basis. For example, the second portion of the pet food meal composition may include carbohydrate and/or starch in an amount ranging from about 0.1 to about 3.9 wt.%, about 0.1 to about 3.8 wt.%, about 0.1 to about 3.7 wt.%, about 0.1 to about 3.6 wt.%, about 0.1 to about 3.5 wt.%, about 0.1 to about 3.4 wt.%, about 0.1 to about 3.3 wt.%, about 0.1 to about 3.2 wt.%, about 0.1 to about 3.1 wt.%, about 0.1 to about 3 wt.%, about 0.1 to about 2.9 wt.%, about 0.1 to about 2.8 wt.%, about 0.1 to about 2.7 wt.%, about 0.1 to about 2.6 wt.%, about 0.1 to about 2.5 wt.%, about 0.1 to about 2.4 wt.%, about 0.1 to about 2.3 wt.%, about 0.2 to about 3.9 wt.%, about 0.2 to about 3.8 wt.%, about 0.2 to about 3.7 wt.%, about 0.2 to about 3.6 wt.%, about 0.2 to about 3.5 wt.%, about 0.2 to about 3.4 wt.%, about 0.2 to about 3.3 wt.%, about 0.2 to about 3.2 wt.%, about 0.2 to about 3.1 wt.%, about 0.2 to about 3 wt.%, about 0.2 to about 2.9 wt.%, about 0.2 to about 2.8 wt.%, about 0.2 to about 2.7 wt.%, about 0.2 to about 2.6 wt.%, about 0.2 to about 2.5 wt.%, about 0.2 to about 2.4 wt.%, about 0.2 to about 2.3 wt.%, about 0.3 to about 3.9 wt.%, about 0.3 to about 3.8 wt.%, about 0.3 to about 3.7 wt.%, about 0.3 to about 3.6 wt.%, about 0.3 to about 3.5 wt.%, about 0.3 to about 3.4 wt.%, about 0.3 to about 3.3 wt.%, about 0.3 to about 3.2 wt.%, about 0.3 to about 3.1 wt.%, about 0.3 to about 3 wt.%, about 0.3 to about 2.9 wt.%, about 0.3 to about 2.8 wt.%, about 0.3 to about 2.7 wt.%, about 0.3 to about 2.6 wt.%, about 0.3 to about 2.5 wt.%, about 0.3 to about 2.4 wt.%, about 0.3 to about 2.3 wt.%, about 0.5 to about 3.9 wt.%, about 0.5 to about 3.8 wt.%, about 0.5 to about 3.7 wt.%, about 0.5 to about 3.6 wt.%, about 0.5 to about 3.5 wt.%, about 0.5 to about 3.4 wt.%, about 0.5 to about 3.3 wt.%, about 0.5 to about 3.2 wt.%, about 0.5 to about 3.1 wt.%, about 0.5 to about 3 wt.%, about 0.5 to about

[illegible]

about 1.5 to about 2.5 wt.%, about 1.5 to about 2.4 wt.%, about 1.5 to about 2.3 wt.%, about 1.7 to about 3.9 wt.%, about 1.7 to about 3.8 wt.%, about 1.7 to about 3.7 wt.%, about 1.7 to about 3.6 wt.%, about 1.7 to about 3.5 wt.%, about 1.7 to about 3.4 wt.%, about 1.7 to about 3.3 wt.%, about 1.7 to about 3.2 wt.%, about 1.7 to about 3.1 wt.%, about 1.7 to about 3 wt.%, about 1.7 to about 2.9 wt.%, about 1.7 to about 2.8 wt.%, about 1.7 to about 2.7 wt.%, about 1.7 to about 2.6 wt.%, about 1.7 to about 2.5 wt.%, about 1.7 to about 2.4 wt.%, about 1.7 to about 2.3 wt.%, about 1.9 to about 3.9 wt.%, about 1.9 to about 3.8 wt.%, about 1.9 to about 3.7 wt.%, about 1.9 to about 3.6 wt.%, about 1.9 to about 3.5 wt.%, about 1.9 to about 3.4 wt.%, about 1.9 to about 3.3 wt.%, about 1.9 to about 3.2 wt.%, about 1.9 to about 3.1 wt.%, about 1.9 to about 3 wt.%, about 1.9 to about 2.9 wt.%, about 1.9 to about 2.8 wt.%, about 1.9 to about 2.7 wt.%, about 1.9 to about 2.6 wt.%, about 1.9 to about 2.5 wt.%, about 1.9 to about 2.4 wt.%, about 1.9 to about 2.3 wt.%, about 2.0 to about 3.9 wt.%, about 2.0 to about 3.8 wt.%, about 2.0 to about 3.7 wt.%, about 2.0 to about 3.6 wt.%, about 2.0 to about 3.5 wt.%, about 2.0 to about 3.4 wt.%, about 2.0 to about 3.3 wt.%, about 2.0 to about 3.2 wt.%, about 2.0 to about 3.1 wt.%, about 2.0 to about 3 wt.%, about 2.0 to about 2.9 wt.%, about 2.0 to about 2.8 wt.%, about 2.0 to about 2.7 wt.%, about 2.0 to about 2.6 wt.%, about 2.0 to about 2.5 wt.%, about 2.0 to about 2.4 wt.%, about 2.0 to about 2.3 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[0077]** In certain embodiments, the second portion of the pet food meal composition may be formulated to include carbohydrate and/or starch in an amount of about 49 to about 2 wt.%, endpoints included, based on the total weight of carbohydrate in the pet food composition on a dry matter basis, which may be the total amount that an animal consumes in one day. For example, the amount of carbohydrate in the second portion of the pet food meal composition may be about 49 to about 3%, about 49 to about 4%, about 49 to about 5%, about 49 to about 6%, about 49% to about 7 %, about 49% to about 8%, about 49% to about 9%, about 49% to about 10%, about 49% to about 11%, about 49% to about 12%, about 49% to about 13%, about 49% to about 14%, about 49% to about 15%, about 49% to about 16%, about 49% to about 17%, about 49% to about 18%, about 49% to about 19%, about 49% to about 20%, about 49% to about 21%, about 49% to about 22%, about 49% to about 23%, about 49% to about 24%, about 49% to about 25%, about 49% to about 26%, about 49% to about 27%, about 49% to about 28%, about 49% to about 29%, about 49% to about 30%, about 49% to about 31%, about 49% to about 32%, about 49% to about 33%,

about 49% to about 34%, about 49% to about 35%, about 49% to about 36%, about 49% to about 37%, about 49% to about 38%, about 49% to about 39%, about 49% to about 40%, about 49% to about 41%, about 49% to about 42%, about 49% to about 43%, about 49% to about 44%, about 49% to about 45%, about 49% to about 46%, about 49% to about 47%, about 49% to about 48%, endpoints included, based on the total amount of carbohydrate (e.g., measured as weight percentages and/or percentage of macronutrient grams of carbohydrate and/or starch in the second portion relative to the total macronutrient grams of carbohydrate and/or starch in the pet food meal composition) in the pet food meal composition on a dry matter basis, which may be the total amount that the animal consumes in one day.

**[0078]** In certain embodiments, the second portion of the pet food meal composition may be formulated to include carbohydrate and/or starch in an amount that is less than half of the total amount of carbohydrate and/or starch in the pet food meal composition. For example, the second portion of the pet food meal composition may be formulated to include carbohydrate in an amount that is 1/25th of the amount of carbohydrate and/or starch in the first portion of the pet food meal composition (e.g., measured as weight percentages or as a percentage of macronutrient grams of carbohydrate and/or starch in the second portion relative to the total macronutrient grams of carbohydrate and/or starch in the first portion in the pet food meal composition). For instance, the pet food meal may be formulated to have a weight ratio of the amount of carbohydrate and/or starch in the second portion of the pet food meal composition to the amount of carbohydrate and/or starch in the first portion of the pet food meal composition that is from about 1:35 to about 1:15, about 1:30 to about 1:15, about 1:25 to about 1:15, about 1:20 to about 1:15; from about 1:35 to about 1:20, about 1:30 to about 1:20, about 1:25 to about 1:20, from about 1:35 to about 1:25, about 1:30 to about 1:25, about 1:35 to about 1:30, or any range or subrange thereof.

**[0079]** In certain embodiments, the second portion of the pet food meal composition may be formulated such that the calories from carbohydrate and/or starch comprise about 0 to about 5% of the total amount of calories in the pet food meal composition, which may be the total amount of calories that the animal consumes in one day. For example, the calories from the carbohydrate and/or starch in the second portion of the pet food meal composition may range from about 0 to about 4.5%, about 0 to about 4%, about 0 to about 3.5%, about 0 to about 3%, about 0 to about 2.5%, about 0 to about 2%, about 1 to about 4.5%, about 1 to about 4%, about 1 to about 3.5%, about 1 to about 3%, about 1 to about 2.5%, about 2 to about 4.5%, about 2 to about 4%, about 2

to about 3.5%, about 2 to about 3%, or about 2 to about 2.5%, including ranges and subranges thereof, based on the total calories of the pet food meal composition.

**[0080]** The carbohydrate source may be selected from polysaccharides (e.g., starches and dextrins) and sugars (e.g., sucrose, lactose, maltose, glucose, and fructose) that are metabolized for energy. The texture of the final product by properly balancing carbohydrate sources. For example, short chain polysaccharides lend to be sticky and gluey, and longer chain polysaccharides are less sticky and gluey than the shorter chain; the desired texture of this hybrid food is achieved by longer chain polysaccharide and modified starches such as native or modified starches, cellulose and the like. The carbohydrate mixture may additionally comprise optional components such as added salt, spices, seasonings, vitamins, minerals, flavorants, colorants, and the like. The amount of the optional components is at least partially dependent on the nutritional requirements for different life stages of animals.

**[0081]** Carbohydrate and/or starches can be supplied by any of a variety of sources known by those skilled in the art, including, but not limited to, oat fiber, cellulose, peanut hulls, beet pulp, parboiled rice, cornstarch, corn gluten meal, cereal, and sorghum. Grains supplying carbohydrate and/or starch can include, but are not limited to, wheat, durum, semolina, corn, barley, and rice. In certain embodiments, the carbohydrate and/or starch component comprises a mixture of one or more carbohydrate and/or starch sources. Carbohydrate and/or starch content of foods can be determined by any number of methods known by those of skill in the art.

**[0082]** The pet food meal composition may be formulated to have a total amount of fat from about 15 to about 50 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. For example, the total amount of fat in the pet food meal composition may be from about 15 to about 48 wt.%, about 15 to about 47 wt.%, about 15 to about 46 wt.%, about 15 to about 45 wt.%, about 16 to about 48 wt.%, about 16 to about 47 wt.%, from about 16 to about 46 wt.%, about 16 to about 45 wt.%, about 17 to about 49 wt.%, about 17 to about 48 wt.%, about 17 to about 47 wt.%, about 17 to about 46 wt.%, about 17 to about 45 wt.%, from about 18 to about 48 wt.%, about 18 to about 47 wt.%, about 18 to about 46 wt.%, about 18 to about 45 wt.%, about 19 to about 48 wt.%, about 19 to about 47 wt.%, about 19 to about 46 wt.%, about 19 to about 45 wt.%, about 20 to about 44 wt.%, about 20 to about 43 wt.%, about 21 to about 44 wt.%, about 21 to about 43 wt.%, about 22 to about 44 wt.%, from about 22 to about 43 wt.%, about 23 to about 44 wt.%, about 23 to about 43 wt.%, about 24 to about 44 wt.%, about 24 to about 43 wt.%, about

25 to about 43 wt.%, about 25 to about 44 wt.%, about 26 to about 43 wt.%, from about 26 to about 44 wt.%, about 27 to about 44 wt.%, about 27 to about 43 wt.%, about 28 to about 44 wt.%, about 28 to about 43 wt.%, about 30 to about 44 wt.%, about 30 to about 43 wt.%, about 31 to about 44 wt.%, or about 31 to about 43 wt.%, about 32 to about 44 wt.%, about 32 to about 43 wt.%, about 33 to about 44 wt.%, about 33 to about 43 wt.%, about 35 to about 44 wt.%, about 35 to about 43 wt.%, about 35 to about 48 wt.%, about 35 to about 47 wt.%, about 35 to about 46 wt.%, about 35 to about 45 wt.%, about 36 to about 48 wt.%, about 36 to about 47 wt.%, from about 36 to about 46 wt.%, about 36 to about 45 wt.%, about 37 to about 49 wt.%, about 37 to about 48 wt.%, about 37 to about 47 wt.%, about 37 to about 46 wt.%, about 37 to about 45 wt.%, from about 38 to about 48 wt.%, about 38 to about 47 wt.%, about 38 to about 46 wt.%, about 38 to about 45 wt.%, about 39 to about 48 wt.%, about 39 to about 47 wt.%, about 39 to about 46 wt.%, about 39 to about 45 wt.%, 35 to about 44 wt.%, about 34 to about 44 wt.%, about 34 to about 43 wt.%, about 35 to about 44 wt.%, about 35 to about 43 wt.%, about 36 to about 44 wt.%, from about 36 to about 43 wt.%, about 35 to about 44 wt.%, about 35 to about 43 wt.%, about 36 to about 44 wt.%, about 37 to about 44 wt.%, about 37 to about 43 wt.%, from about 38 to about 44 wt.%, about 38 to about 43 wt.%, about 39 to about 44 wt.%, about 39 to about 43 wt.%, about 40 to about 44 wt.%, about 40 to about 43 wt.%, about 41 to about 44 wt.%, about 41 to about 43 wt.%, about 42 to about 44 wt.%, or about 42 to about 43 wt.%, including any ranges or subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[0083]** In certain embodiments, the first portion of the pet food meal composition may be formulated to include from about 1 to about 10 wt.% of fat, based on the total weight of the pet food meal composition on a dry matter basis. The amount of fat in the first portion of the pet food meal composition may be from about 3 to about 9 wt.%, about 4 to about 9 wt.%, about 5 to about 9 wt.%, about 6 to about 9 wt.%, about 7 to about 9 wt.%, 3 to about 8 wt.%, about 4 to about 8 wt.%, about 5 to about 8 wt.%, about 6 to about 8 wt.%, about 7 to about 8 wt.%, or about 8%, including any ranges or subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[0084]** In certain embodiments, the amount of fat in the first portion of the pet food meal composition may vary, but typically is in the range of about 49 to about 10%, endpoints included, based on the total amount of fat in the pet food composition on a dry matter basis (e.g., measured as weight percentages and/or percentage of macronutrient grams of fat relative to the total

macronutrient grams of fat in the pet food meal composition). For example, the amount of fat in the first portion of the pet food meal composition may be from about 48 to about 10%, about 47 to about 10%, about 46 to about 10%, about 45 to about 10%, about 44 to about 10%, about 43 to about 10%, about 42 to about 10%, about 41 to about 10%, about 40 to about 10%, about 39 to about 10%, about 38 to about 10%, about 37 to about 10%, about 36 to about 10%, about 35 to about 10%, about 34 to about 10%, about 33 to about 10%, about 32 to about 10%, about 31 to about 10%, about 30 to about 10%, about 29 to about 10%, about 28 to about 10%, about 27 to about 10%, about 26 to about 10%, about 25 to about 10%, about 24 to about 10%, about 23 to about 10%, about 22 to about 10%, about 21 to about 10%, about 20 to about 10%, about 19 to about 10%, about 18 to about 10%, about 17 to about 10%, about 16 to about 10%, about 15 to about 10%, about 14 to about 10%, about 13 to about 10%, about 12 to about 10%, about 11 to about 10%, endpoints included, based on the total amount of fat in the pet food meal composition on a dry matter basis (e.g., measured as weight percentages and/or percentage of macronutrient grams of fat relative to the total macronutrient grams of fat in the pet food meal composition).

**[0085]** In certain embodiments, the first portion of the pet food meal composition may be formulated to include fat that is  $1/3^{\text{rd}}$  of the total amount of fat present in the second portion of the pet food meal composition. For instance, the pet food meal composition may, in some preferred embodiments, be formulated to have a weight ratio of the fat in the first portion of the pet food meal composition to the fat in the second portion of the pet food meal composition of about 1:1.5 to about 1:7, about 1:1.5 to about 1:6, about 1:1.5 to about 1:5, about 1:1.5 to about 1:4, about 1:1.5 to about 1:3; from about 1:2 to about 1:7, about 1:2 to about 1:6, about 1:2 to about 1:5, about 1:2 to about 1:4, about 1:2 to about 1:3; from about 1:3 to about 1:7, about 1:3 to about 1:6, about 1:3 to about 1:5, about 1:3 to about 1:4; from about 1:4 to about 1:7, about 1:4 to about 1:6, about 1:4 to about 1:5, or any range or subrange thereof.

**[0086]** In certain embodiments, the first portion of the pet food meal composition may be formulated to include an amount of fat such that the calories from the fat in the first portion comprise about 10 to about 30% of the total amount of calories in the pet food composition, which may be the total amount of calories that the animal consumes in one day. The range for the amount of fat in the first portion of the pet food composition may be from about 10 to about 28%, about 10 to about 27%, about 10 to about 26%, about 10 to about 25%, about 10 to about 24%, about 10 to about 23%, about 10 to about 22%, about 12 to about 28%, about 12 to about

27%, about 12 to about 26%, about 12 to about 25%, about 12 to about 25%, about 12 to about 24%, about 12 to about 23%, about 12 to about 22%, about 14 to about 27%, about 14 to about 26%, about 14 to about 25%, about 14 to about 25%, about 14 to about 24%, about 14 to about 23%, about 14 to about 22%, about 16 to about 27%, about 16 to about 26%, about 16 to about 25%, about 16 to about 25%, about 16 to about 24%, about 16 to about 23%, about 16 to about 22%, about 18 to about 27%, about 18 to about 26%, about 18 to about 25%, about 18 to about 25%, about 18 to about 24%, about 18 to about 23%, about 18 to about 22%, about 20 to about 27%, about 20 to about 26%, about 20 to about 25%, about 20 to about 25%, about 20 to about 24%, about 20 to about 23%, about 20 to about 22%, or about 22%, including any ranges or subranges thereof, by calorie percentage (cal.%), based on the total amount of calories of the pet food meal composition.

**[0087]** In some cases, the fat in the first portion of the pet food meal composition is crude fat. Crude fat may be included into the pet food meal composition in the amounts disclosed above with respect to the total fat, such as from about 0.5 to about 15 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. In some embodiments, the pet food meal composition comprises crude fat in an amount of about 1 to about 12 wt.%, about 2 to about 13 wt.%, about 3 to about 12 wt.%, about 4 to about 10 wt.%, about 5 to about 9 wt.%, or about 6 to about 9 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. In some cases, it may be preferable that about 50 wt.% or more, about 60 wt.% or more, about 70 wt.% or more, about 80 wt.% or more, or about 90 wt.% or more of the total fat is obtained from an animal source. Alternatively, about 50 wt.% or more, about 60 wt.% or more, about 70 wt.% or more, about 80 wt.% or more, or about 90 wt.% or more of the total fat may be obtained from a plant source.

**[0088]** The second portion of the pet food meal compositions may be formulated to include from about 25 to about 40 wt.% of fat, based on the total weight of the pet food meal compositions on a dry matter basis. The amount of fat in the second portion of the pet food meal composition may be from about 27 to about 38 wt.%, about 30 to about 38 wt.%, about 27 to about 35 wt.%, about 26 to about 35 wt.%, about 30 to about 35 wt.%, 29 to about 38 wt.%, about 30 to about 38 wt.%, about 31 to about 35 wt.%, about 32 to about 35 wt.%, about 33 to about 35 wt.%, or about 35%, including any ranges or subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[0089]** In certain embodiments, the second portion of the pet food meal composition may be formulated to have from about 51 to about 100% of the total amount of fat in the pet food meal composition (e.g., measured as weight percentages and/or percentage of macronutrient grams of fat in the second portion relative to the total amount of macronutrient grams of fat in the pet food meal composition on a dry matter basis). For example, the amount of fat in the second portion of the pet food meal may range from about 51 to about 99%, about 51 to about 98%, about 51 to about 97%, about 51 to about 96%, about 51 to about 95%, about 51 to about 94%, about 51 to about 93%, about 51 to about 92%, about 51 to about 91%, about 51 to about 90%, about 51 to about 89%, about 51 to about 88%, about 51 to about 87%, about 51 to about 86%, about 51 to about 85%, about 51 to about 84%, about 51 to about 83%, about 51 to about 82%, about 51 to about 81%, about 51 to about 80%, about 51 to about 79%, about 51 to about 78%, about 51 to about 77%, about 51 to about 76%, about 51 to about 75%, about 51 to about 74%, about 51 to about 73%, about 51 to about 72%, about 51 to about 71%, about 51 to about 70%, about 51 to about 69%, about 51 to about 68%, about 51 to about 67%, about 51 to about 66%, about 51 to about 65%, about 51 to about 64%, about 51 to about 63%, about 51 to about 62%, about 51 to about 61%, about 51 to about 60%, about 51 to about 59%, about 51 to about 58%, about 51 to about 57%, about 51 to about 56%, about 51 to about 55%, about 51 to about 54%, about 51 to about 53%, about 51 to about 52%, endpoints included, relative to the total amount of fat in the pet food meal composition on a dry matter basis (e.g., measured as weight percentages and/or percentage of macronutrient grams of the fat in the second portion relative to the total amount of macronutrient grams of fat in the pet food meal composition on a dry matter basis).

**[0090]** In certain embodiments, the second portion of the pet food meal composition may be formulated to include fat that is about 3 times (3X) greater than the amount of fat present in the first portion of the pet food meal composition. For instance, the pet food meal composition may, in some preferred embodiments, be formulated to have a weight ratio of the amount of fat in the second portion of the pet food meal composition to the amount of fat in the first portion of the pet food meal composition of about 1.5:1 to about 7:1, about 1.5:1 to about 6:1, about 1.5:1 to about 5:1, about 1.5:1 to about 4:1, about 1.5:1 to about 3:1; from about 2:1 to about 7:1, about 2:1 to about 6:1, about 2:1 to about 5:1, about 2:1 to about 4:1, about 2:1 to about 3:1; from about 3:1 to about 7:1, about 3:1 to about 6:1, about 3:1 to about 5:1, about 3:1 to about 4:1; from about 4:1 to about 7:1, about 4:1 to about 6:1, about 4:1 to about 5:1, or any range or subrange thereof.

**[0091]** In certain embodiments, the second portion of the pet food meal composition may be formulated to include an amount of fat such that the calories from fat in the second portion may be from about 55 to about 75 cal.% of the total amount of calories of the pet food meal composition, which may be the total amount of calories that the animal consumes in one day. For instance, the amount of fat in the second portion of the pet food meal composition may be from about 55 to about 74%, about 55 to about 73%, about 55 to about 72%, about 55 to about 71%, about 57 to about 74%, about 57 to about 73%, about 57 to about 72%, about 57 to about 71%, about 59 to about 74%, about 59 to about 73%, about 59 to about 72%, about 59 to about 71%, about 60 to about 74%, about 60 to about 73%, about 60 to about 72%, about 60 to about 71%, %, about 62 to about 74%, about 62 to about 73%, about 62 to about 72%, about 62 to about 71%, about 64 to about 74%, about 64 to about 73%, about 64 to about 72%, about 64 to about 71%, about 66 to about 74%, about 66 to about 73%, about 66 to about 72%, about 66 to about 71%, about 68 to about 74%, about 68 to about 73%, about 68 to about 72%, about 68 to about 71%, about 69 to about 74%, about 69 to about 73%, about 69 to about 72%, about 69 to about 71%, or about 70%, including any ranges or subranges thereof, by calorie percentage (cal.%) relative to the total calories of the pet food meal composition.

**[0092]** In some cases, the fat in the second portion of the pet food meal composition comprises crude fat. Crude fat may be included into the compositions in the amounts disclosed above with respect to the total fat, such as from about 25 to about 40 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. In some embodiments, the pet food meal composition comprises crude fat in an amount of about 27 to about 40 wt.%, about 28 to about 39 wt.%, about 29 to about 38 wt.%, about 30 to about 37 wt.%, about 30 to about 36 wt.%, about 33 to about 37 wt.%, about 34 to about 36 wt.%, or about 34 to about 36 wt.% based on the total weight of the pet food meal composition on a dry matter basis. In some cases, it may be preferable that about 50 wt.% or more, about 60 wt.% or more, about 70 wt.% or more, about 80 wt.% or more, or about 90 wt.% or more of the total fat is obtained from an animal source. Alternatively, about 50 wt.% or more, about 60 wt.% or more, about 70 wt.% or more, about 80 wt.% or more, or about 90 wt.% or more of the total fat may be obtained from a plant source on a dry matter basis.

**[0093]** The term “fat” generally refers to a lipid or mixture of lipids that may generally be a solid or a liquid at ordinary room temperatures (e.g., 25°C) and pressures (e.g., 1 atm). In some instances, the fat may be a viscous liquid or an amorphous solid at standard room temperature and

pressure. The fat may be incorporated completely within the food composition, deposited on the outside of the pet food meal composition, or a mixture of the two methods. In some embodiments, the pet food meal compositions further include an effective amount of one or more substances selected from the group consisting of glucosamine, chondroitin, chondroitin sulfate, methylsulfonylmethane ("MSM"), creatine, antioxidants, *Perna canaliculata*, and mixtures thereof.

**[0094]** The fat may comprise dietary fats, such as triglycerides. In some embodiments, the triglyceride may comprise about 20 to about 100 wt.%, about 40 to about 100 wt.%, about 50 to about 100 wt.%, about 60 to about 100 wt.%, about 70 to about 100 wt.%, about 80 to about 100 wt.%, or about 90 to about 100 wt.%, based on the total weight of the fat in the pet food meal composition on a dry matter basis. In further embodiments, the triglyceride comprises about 20 to about 95 wt.%, about 40 to about 95 wt.%, about 50 to about 95 wt.%, about 60 to about 95 wt.%, about 70 to about 95 wt.%, about 80 to about 95 wt.%, about 90 to about 95 wt.%, based on the total weight of the fat in the pet food meal composition on a dry matter basis. In additional embodiments, the triglyceride comprises about 20 to about 90 wt.%, about 40 to about 90 wt.%, about 50 to about 90 wt.%, about 60 to about 90 wt.%, about 70 to about 90 wt.%, about 80 to about 90 wt.%, based on the total weight of the fat in the pet food meal composition on a dry matter basis. In yet further embodiment, the triglyceride comprises about 20 to about 80 wt.%, about 40 to about 80 wt.%, about 50 to about 80 wt.%, about 60 to about 80 wt.%, about 70 to about 80 wt.%, based on the total weight of the fat in the pet food meal composition on a dry matter basis.

**[0095]** The triglyceride may include one or more constituents that comprise a fatty acid(s) component/moiety. For example, the triglyceride may include one, two, or three aplanatic chains that are selected from fatty acid component. Non-limiting examples of fatty acid components include, but are not limited to, omega-3 fatty acids, omega-6 fatty acids, lauric acid, myristic acid, palmitic acid, palmitoleic acid, margaric acid, margaroleic acid, stearic acid, oleic acid, stearidonic acid, gadoleic acid, behenic acid, erucic acid, docosatetra acid, and a combination of two or more thereof. The fatty acid(s) moieties may be a polyunsaturated fatty acid, such as an omega-3 fatty acid, an omega-6 fatty acid, or a combination of two or more thereof. Non-limiting examples of omega-3 fatty acid components include those selected from linolenic acid, stearidonic acid, eicosatetraenoic acid, eicosapentaenoic acid, docosapentaenoic acid, docosahexaenoic acid, and a combination of two or more thereof.

**[0096]** Additionally or alternatively, the triglyceride may include a polyunsaturated fatty acid

component selected from omega-6 fatty acids. Examples of omega-6 fatty acid moieties include linolenic acid, calendic acid, eicosadienoic acid, arachidonic acid, docosadienoic acid, adrenic acid, osbond acid, tetracosatetraenoic acid, tetracosapentaenoic acid, or a combination of two or more thereof. In some embodiments, the polyunsaturated fatty acid component is selected from linolenic acid, arachidonic acid, and a combination of two or more thereof.

**[0097]** The triglyceride may be selected from triglycerides having at least one aliphatic carbon chain comprised of 6 to 10 carbons. For example, the triglyceride may have one, two, or three aliphatic carbon chains of 6 to 10 carbons. In some embodiments, the triglyceride has an aliphatic carbon chain of 6 carbons, 7 carbons, 8 carbons, 9 carbons, and/or 10 carbons. For example, the aliphatic carbon chain of the medium chain triglyceride may include from 6 to 9 carbons, 6 to 8 carbons, 6 or 7 carbons, 7 to 10 carbons, 7 to 9 carbons, 7 to 8 carbons, 8 to 10 carbons, or 8 or 9 carbons, or 9 or 10 carbons. In some embodiments, the triglyceride(s) comprises an aliphatic carbon chain having 6 carbons, 8 carbons, or 10 carbons. For example, the triglyceride may have an aliphatic carbon chain selected from caprylate, caprate, and/or decanoate.

**[0098]** Fat can be supplied by any of a variety of sources known by those skilled in the art, including meat, meat by-products, canola oil, fish oil such as anchovy oil and menhaden oil, and plants. Meat fat sources include poultry fat, turkey fat, pork fat, lard, tallow, and beef fat. Plant fat sources include wheat, flaxseed, rye, barley, rice, sorghum, corn, oats, millet, wheat germ, corn germ, soybeans, peanuts, and cottonseed, as well as oils derived from these and other plant fat sources such as corn oil, soybean oil, cottonseed oil, palm oil, palm kernel oil, linseed oil, canola oil, rapeseed oil, and/or olestra.

**[0099]** The pet food meal composition is typically formulated to have a total amount of dietary fiber from about 10 to about 25 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. For example, the total amount of fiber in the pet food meal composition may be from about 10 to about 24 wt.%, about 10 to about 23 wt.%, about 10 to about 22 wt.%, about 10 to about 21 wt.%, about 12 to about 24 wt.%, about 12 to about 23 wt.%, about 12 to about 22 wt.%, about 12 to about 21 wt.%, about 14 to about 24 wt.%, about 14 to about 23 wt.%, about 14 to about 22 wt.%, about 14 to about 21 wt.%, about 16 to about 24 wt.%, about 16 to about 23 wt.%, about 16 to about 22 wt.%, about 16 to about 21 wt.%, about 18 to about 24 wt.%, about 18 to about 23 wt.%, about 18 to about 22 wt.%, about 18 to about 21 wt.%, about 20 wt.%, or about 21 wt.%, including any ranges or subranges thereof, based on the total weight of the pet food meal

composition on a dry matter basis.

**[00100]** The first portion of the pet food meal composition may be formulated to include from about 1 to about 10 wt.% of dietary fiber, based on the total weight of the pet food meal composition on a dry matter basis. In some embodiments, the amount of dietary fiber present in the first portion of the pet food meal composition is from about 3 to about 10 wt.%, about 3 to about 9 wt.%, about 3 to about 8 wt.%, about 4 to about 10 wt.%, about 4 to about 9 wt.%, about 4 to about 8 wt.%, about 5 to about 8 wt.%, or about 5 to about 7 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00101]** Additionally or alternatively, the first portion of the pet food meal composition may be formulated to include fiber in an amount that is less than half of the total amount of fiber in the pet food meal composition, which may be the total amount of fiber that the animal consumes in one day. For example, the amount of fiber in the first portion of the pet food composition may be from about 49% to about 10%, endpoints included, based on the total amount fiber of the pet food meal composition (e.g., measured as a weight percentage and/or percentage of macronutrient grams of fiber in the first portion relative to the total amount of macronutrient grams of fiber in the pet food meal composition on a dry matter basis). In some embodiments, the amount of fiber in the first portion of the pet food meal composition may be from about 48% to about 10%, about 47% to about 10%, about 46% to about 10%, about 45% to about 10%, about 44% to about 10 %, about 43% to about 10%, about 42% to about 10 %, about 41% to about 10%, about 40% to about 10%, about 39.% to about 10%, about 38% to about 10%, about 37% to about 10%, about 36% to about 10%, about 35% to about 10%, about 34% to about 10%, about 33% to about 10%, about 32% to about 10%, about 31% to about 10%, about 30% to about 10%, about 29% to about 10%, about 28% to about 10%, about 27% to about 10%, about 26% to about 10%, about 25% to about 10%, about 24% to about 10%, about 23% to about 10%, about 22% to about 10%, about 21% to about 10%, about 20% to about 10%, about 19% to about 10%, about 18% to about 10%, about 17% to about 10%, about 16% to about 10%, about 15% to about 10%, about 14% to about 10%, about 13% to about 10%, about 12% to about 10%, about 11% to about 10%, or any range or subrange thereof, endpoints included, relative to the total weight of the fiber in the pet food meal composition on a dry matter basis (e.g., measured as weight percentages and/or percentage of macronutrient grams of fiber in the first portion relative to the total macronutrient grams of fiber

in the pet food meal composition on a dry matter basis).

**[00102]** In certain embodiments, the first portion of the pet food meal composition may be formulated to include fiber in an amount that is  $1/2$  (0.5) the amount of fiber in the second portion of the pet food meal composition. For instance, the pet food composition may be formulated to have a weight ratio of the amount of fiber in the first portion of the pet food meal composition to the amount of fiber in the second portion of the pet food meal composition of about 1:5 to about 1:1, about 1:4 to about 1:1, about 1:3 to about 1:1, about 1:2 to about 1:1; from about 1:5 to about 2:1, about 1:4 to about 2:1, about 1:3 to about 2:1; from about 1:5 to about 3:1, about 1:4 to about 3:1, or any range or subrange thereof.

**[00103]** The second portion of the pet food meal composition may be formulated to include from about 10 to about 20 wt.% of fiber, based on the total weight of the pet food meal composition on a dry matter basis. In some embodiments, the amount of fiber present in the second portion of the pet food meal composition is from about 11 to about 20 wt.%, about 11 to about 19 wt.%, about 11 to about 18 wt.%, about 11 to about 17 wt.%, about 11 to about 16 wt.%, about 11 to about 15 wt.%, about 13 to about 20 wt.%, about 13 to about 19 wt.%, about 13 to about 18 wt.%, about 13 to about 17 wt.%, about 13 to about 16 wt.%, about 13 to about 15 wt.%, about 15 to about 20 wt.%, about 15 to about 19 wt.%, about 15 to about 18 wt.%, about 15 to about 17 wt.%, about 15 to about 16 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00104]** Additionally or alternatively, the second portion of the pet food meal composition may be formulated to include an amount of fiber that is greater than half of the total amount of fiber of the pet food meal (e.g., measured as a weight percentage and/or a percentage of the macronutrient grams of fiber in the second portion relative to the total macronutrient grams of fiber in the pet food meal composition on a dry matter basis). As noted above, the total amount of fiber from the pet food meal composition may be the total amount of fiber that the animal consumes in one day. For example, the amount of fiber in the second portion of the pet food meal composition may be about 51 to about 100%, based on the total amount of fiber in the pet food meal composition (e.g., measured as weight percentages or percentage of macronutrient grams of fiber in the second portion relative to the total amount of macronutrient grams of fiber in the pet food meal composition on a dry matter basis). For example, the second portion of the pet food meal composition may include fiber in an amount from about 51 to about 91%, about 51 to about 92%,

about 51 to about 93%, about 51 to about 94%, about 51 to about 95%, about 51 to about 96%, about 51 to about 97%, about 51 to about 98%, about 51 to about 99%, about 51 to about 80%, about 51 to about 81%, about 51 to about 82%, about 51 to about 83%, about 51 to about 84%, about 51 to about 85%, about 51 to about 86%, about 51 to about 87%, about 51 to about 88%, about 51 to about 89%, about 51 to about 90%, about 51 to about 70%, about 51 to about 71%, about 51 to about 72%, about 51 to about 73%, about 51 to about 74%, about 51 to about 75%, about 51 to about 76%, about 51 to about 77%, about 51 to about 78%, about 51 to about 79%, about 51 to about 80%, about 51 to about 60%, about 51 to about 61%, about 51 to about 62%, about 51 to about 63%, about 51 to about 64%, about 51 to about 65%, about 51 to about 66%, about 51 to about 67%, about 51 to about 68%, about 51 to about 69%, about 51 to about 70%, about 51 to about 59%, about 51 to about 58%, about 51 to about 57%, about 51 to about 56%, about 51 to about 55%, about 51 to about 54%, about 51 to about 53%, or about 51 wt. to about 52%, including ranges and subranges thereof, based on the total amount of fiber in the pet food meal composition on a dry matter basis (e.g., measured as weight percentages or percentage of macronutrient grams of fiber in the second portion relative to the total amount of macronutrient grams of fiber in the pet food meal composition on a dry matter basis).

**[00105]** In certain embodiments, the second portion of the pet food meal composition may be formulated to include an amount of fiber that is 2 times (2X) greater than the amount of present in the first portion of the pet food meal composition (e.g., measured as weight percentages and/or a percentage of macronutrient grams of fiber in the second portion relative to the macronutrient grams of fiber in the first portion of the pet food meal composition). For instance, the pet food composition may be formulated to have a weight ratio of the amount of fiber in the second portion of the pet food meal composition to the amount of fiber in the first portion of the pet food meal composition of about 5:1 to about 1:1, about 4:1 to about 1:1, about 3:1 to about 1:1, about 2:1 to about 1:1; from about 5:1 to about 2:1, about 4:1 to about 2:1, about 3:1 to about 2:1; from about 5:1 to about 3:1, about 4:1 to about 3:1, or any range or subrange thereof.

**[00106]** The total amount of fiber present in the pet food meal composition generally comprises an amount of crude fiber and dietary fiber. The amount of crude fiber and/or dietary fiber may be present in the pet food meal composition in any of the above amounts disclosed for the total amount of fiber. Crude fiber includes indigestible components contained in cell walls and cell contents of plants such as grains, e.g., hulls of grains such as rice, corn, and beans.

**[00107]** In some embodiments, crude fiber comprises the majority of the total amount of dietary fiber. In at least one embodiment, the crude fiber comprises about 45 to about 55 wt.%, about 65 wt.% or more, about 75 wt.% or more, about 80 wt.% or more, about 85 wt.% or more, about 90 wt.% or more, about 95 wt.% or more, or about 98 wt.% or more of the total amount of fiber in the pet food meal composition, based on the total weight of the pet food meal composition on a dry matter basis. In a further embodiment, the total amount of fiber consists essentially of or consists of crude fiber.

**[00108]** Dietary fiber refers to components of a plant that are resistant to digestion by an animal's digestive enzymes. Dietary fiber includes soluble fiber and insoluble fiber. Soluble fibers are resistant to digestion and absorption in the small intestine and undergo complete or partial fermentation in the large intestine, e.g., beet pulp, guar gum, chicory root, psyllium, pectin, blueberry, cranberry, squash, apples, oats, beans, citrus, barley, or peas. Insoluble fibers can be supplied by any of a variety of sources, including, for example, cellulose, whole-wheat products, wheat oat, corn bran, flax seed, grapes, celery, green beans, cauliflower, potato skins, fruit skins, vegetable skins, peanut hulls, and soy fiber. Crude fiber includes indigestible components contained in cell walls and cell contents of plants such as grains, for example, hulls of grains such as rice, corn, and beans.

**[00109]** Dietary fiber in the first portion of the pet food meal may include soluble fiber in an amount from about 1 to 5 wt.%, endpoints included, based on the total weight of the pet food meal composition on a dry matter basis. For example, the first portion of the pet food meal composition may include soluble fiber in an amount ranging from about 1 to about 4 wt.%, about 1 to about 3 wt.%, about 1 to about 2 wt.%, about 2 to about 4 wt.%, about 2 to about 3 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00110]** Dietary fiber in the second portion of the pet food meal may include soluble fiber in an amount from about 1 to 5 wt.%, endpoints included, based on the total weight of the pet food meal composition on a dry matter basis. For example, the first portion of the pet food meal composition may include soluble fiber in an amount ranging from about 1 to about 4 wt.%, about 1 to about 3 wt.%, about 1 to about 2 wt.%, about 2 to about 4 wt.%, about 2 to about 3 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00111]** Dietary fiber in the first portion of the pet food meal may include insoluble fiber in an amount from about 1 to 10 wt.%, endpoints included, based on the total weight of the pet food meal compositions on a dry matter basis. In some embodiments, the amount of insoluble fiber present in the first portion of the pet food meal compositions is from about 3 to about 10 wt.%, about 3 to about 10 wt.%, about 3 to about 10 wt.%, about 4 to about 10 wt.%, about 4 to about 9 wt.%, about 4 to about 8 wt.%, about 5 to about 8 wt.%, or about 5 to about 7 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00112]** Dietary fiber in the second portion of the pet food meal may include insoluble fiber in an amount from about 5 to 15 wt.%, endpoints included, based on the total weight of the pet food meal composition on a dry matter basis. For example, the second portion of the pet food meal composition may include insoluble fiber in an amount ranging from about 6 to about 15 wt.%, about 7 to about 15 wt.%, about 8 to about 14 wt.%, about 8 to about 15 wt.%, about 8 to about 14 wt.%, about 8 to about 13 wt.%, about 8 to about 12 wt.%, about 9 to about 14 wt.%, about 9 to about 13 wt.%, about 9 to about 12 wt.%, about 10 to about 13 wt.%, about 10 to about 12 wt.%, about 11 to about 12 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00113]** The pet food meal composition may be formulated to have a total amount of protein from about 35 to about 70 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. The range of the total amount of protein may vary, but typically from about 35 to about 60 wt.%, about 40 to about 60 wt.%, about 45 to about 60 wt.%, about 50 to about 60 wt.%, from about 35 to about 65 wt.%, about 40 to about 65 wt.%, about 45 to about 65 wt.%, or about 50 to about 65 wt.%, including ranges and subranges thereof, based on the total weight of the pet food meal composition on a dry matter basis.

**[00114]** The first portion and the second portion of the pet food meal composition may individually be formulated to include protein in an amount ranging from about 20 to about 40 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. For instance, the individual amounts of protein in the first portion and/or the second portion of pet food meal composition may be from about 15 to about 50 wt.%, about 15 to about 48 wt.%, about 15 to about 46 wt.%, about 15 to about 44 wt.%, about 15 to about 42 wt.%, about 15 to about 40 wt.%, about 15 to about 38 wt.%, about 15 to about 36 wt.%, about 15 to about 34 wt.%, from about 20

to about 55 wt.%, about 20 to about 50 wt.%, about 20 to about 48 wt.%, about 20 to about 46 wt.%, about 20 to about 44 wt.%, about 20 to about 42 wt.%, about 20 to about 40 wt.%, about 20 to about 38 wt.%, about 20 to about 36 wt.%, about 20 to about 34 wt.%, from about 25 to about 55 wt.%, about 25 to about 50 wt.%, about 25 to about 48 wt.%, about 25 to about 46 wt.%, about 25 to about 44 wt.%, about 25 to about 42 wt.%, about 25 to about 40 wt.%, about 25 to about 38 wt.%, about 25 to about 36 wt.%, about 25 to about 34 wt.%, from about 30 to about 55 wt.%, about 30 to about 50 wt.%, about 30 to about 48 wt.%, about 30 to about 46 wt.%, about 30 to about 44 wt.%, about 30 to about 42 wt.%, about 30 to about 40 wt.%, about 30 to about 38 wt.%, or about 30 to about 36 wt.%, including ranges and subranges therebetween, based on the total weight of the pet food meal composition on a dry matter basis.

**[00115]** In some instances, the amount of protein in the first portion and/or the second portion of the pet food meal composition may individually be from about 40 to about 60%, based on the total protein amount of protein in the pet food meal composition on a dry matter basis (e.g., measured as weight percentages and/or percentages of macronutrient grams of protein relative to the total macronutrient grams of the pet food meal composition on a dry matter basis). For example, the amount of protein in the first portion and/or the second portion of the pet food meal composition may individually be from about 40 to about 59%, about 40 to about 58%, about 41 to about 59%, about 41 to about 58%, about 42 to about 59%, about 42 to about 58%, about 43 to about 59%, about 43 to about 58%, about 44 to about 59%, about 44 to about 58%, about 45 to about 59%, about 45 to about 58%, about 46 to about 59%, about 46 to about 58%, about 40 to about 57%, about 40 to about 56%, about 41 to about 57%, about 41 to about 56%, about 42 to about 57%, about 42 to about 56%, about 43 to about 57%, about 43 to about 56%, about 44 to about 57%, about 44 to about 56%, about 45 to about 57%, about 45 to about 56%, about 46 to about 57%, about 46 to about 56%, including any ranges or subranges thereof, based on the total amount of protein in the first portion or second portion, individually, relative to the total amount of protein in the pet food meal composition on a dry matter basis (e.g., as measured as weight percentages or macronutrient grams of protein in the first portion or second portion relative to the total amount of macronutrient grams of protein in the pet food meal composition on a dry matter basis). In certain embodiments, each of the first portion and the second portion of the pet food meal composition may be formulated to include protein in an amount that is about half of the total protein in the pet food meal composition, which may correspond to the total amount of protein that

an animal consumes in one day.

**[00116]** In certain embodiments, the pet food composition may be formulated to have a weight ratio of the amount of protein in the first portion of the pet food meal composition to the amount of protein in the second portion of the pet food meal composition of about 1:1.25 to about 1.25:1, about 1:1.2 to about 1.25:1, about 1:1.15 to about 1.25:1, about 1:1.1 to about 1.25:1, about 1:1 to about 1:1.25, or any range or subrange thereof.

**[00117]** The protein of the pet food meal composition comprises one or more amino acids selected from Tryptophan, Taurine, Histidine, Carnitine, Carnosine, Alanine, Cysteine, Arginine, Methionine (including DL-methionine, and L-methionine), Tryptophan, Lysine, Asparagine, Aspartate (Aspartic acid), Phenylalanine, Valine, Threonine, Isoleucine, Histidine, Leucine, Glycine, Glutamine, Taurine, Tyrosine, Homocysteine, Ornithine, Citruline, Glutamate (Glutamic acid), Proline, and/or Serine, and a combination of two or more thereof. The pet food meal composition may comprise two or more amino acids. For instance, the pet food meal composition may include two or more, three or more, four or more, five or more, six or more, seven or more, eight or more amino acids. In some embodiments, the pet food meal composition includes glycine and proline, and optionally one or more additional amino acids.

**[00118]** In some cases, one or more amino acid(s) may comprise essential amino acids. Essential amino acids are amino acids that cannot be synthesized de novo, or in sufficient quantities by an organism and thus must be supplied in the diet. Essential amino acids vary from species to species, depending upon the organism's metabolism. For example, it is generally understood that the essential amino acids for dogs and cats (and humans) are phenylalanine, leucine, methionine, lysine, isoleucine, valine, threonine, tryptophan, histidine and arginine. In addition, taurine, while technically not an amino acid but a derivative of cysteine, is an essential nutrient for cats.

**[00119]** A portion of the protein in the composition may be digestible protein. For example, the composition may include an amount of protein, where about 40 wt.% or more, about 50 wt.% or more, about 60 wt.% or more, about 70 wt.% or more, about 80 wt.% or more, about 90 wt.% or more, about 95 wt.% or more, about 98 wt.% or more, or about 99 wt.% or more of the protein is digestible protein. In some embodiments, e.g., when the composition desirable promotes weight loss, the portion of protein that is digestible protein is about 60 wt.% or less, about 50 wt.% or less, about 40 wt.% or less, about 30 wt.% or less, about 20 wt.% or less, or about 10 wt.% or less, based on the total amount of protein in the pet food meal composition on a dry matter basis. In

further embodiment, the amount of protein that is digestible protein is about 10 to about 99 wt.%, about 10 to about 95 wt.%, about 10 to about 90 wt.%, about 10 to about 70 wt.%, about 10 to about 50 wt.%, about 10 to about 30 wt.%, about 30 to about 99 wt.%, about 30 to about 95 wt.%, about 30 to about 90 wt.%, about 30 to about 70 wt.%, about 30 to about 50 wt.%, about 50 to about 99 wt.%, about 50 to about 95 wt.%, about 50 to about 90 wt.%, about 50 to about 70 wt.%, or about 70 to about 99 wt.%, about 70 to about 95 wt.%, about 70 to about 90 wt.%, including ranges and subranges therein, based on the total amount of protein in the pet food meal composition on a dry matter basis.

**[00120]** Protein may be supplied by any of a variety of sources known by those of ordinary skill in the art including plant sources, animal sources, microbial sources or a combination of these. For example, animal sources may include meat, meat-by products, seafood, dairy, eggs, etc. Meats, for example, may include animal flesh such as poultry, fish, and mammals including cattle, pigs, sheep, goats, and the like. Meat by-products may include, for example, lungs, kidneys, brain, livers, stomachs and intestines. Plant protein includes, for example, soybean, cottonseed, and peanuts. Microbial sources may be used to synthesize amino acids (e.g., lysine, threonine, tryptophan, methionine) or intact protein such as protein from sources listed below.

**[00121]** Examples of protein or protein ingredients may comprise chicken meals, chicken, chicken by-product meals, lamb, lamb meals, turkey, turkey meals, beef, beef by-products, viscera, fish meal, enterals, kangaroo, white fish, venison, soybean meal, soy protein isolate, soy protein concentrate, corn gluten meal, corn protein concentrate, distillers dried grains, and/or distillers dried grain solubles and single-cell proteins, for example yeast, algae, and/or bacteria cultures.

**[00122]** The protein can be intact, completely hydrolyzed, or partially hydrolyzed. The protein content of foods may be determined by any number of methods known by those of skill in the art, for example, as published by the Association of Official Analytical Chemists in Official Methods of Analysis (“OMA”), method 988.05. The amount of protein in a composition disclosed herein may be determined based on the amount of nitrogen in the composition according to methods familiar to one of skill in the art.

**[00123]** The pet food meal composition may further comprise ash. As described herein, ash consists of compounds that are not organic or water, generally produced by combustion of biological materials. The ash may be present in the pet food meal composition in an amount ranging from about 1 to about 10 wt.%, based on the total weight of the food composition on a dry

weight basis, including all amounts and sub-ranges there-between. In some embodiment, the ash may be present in the food composition in an amount ranging from about 1 to about 8 wt.%, about 1 to about 6 wt.%, about 1 to about 5 wt.%, about 1 to about 4 wt.%, about 1 to about 3 wt.%, about 1 to about 2 wt.%, from about 2 to about 10 wt.%, about 2 to about 8 wt.%, about 2 to about 6 wt.%, about 2 to about 5 wt.%, about 2 to about 4 wt.%, from about 3 to about 10 wt.%, about 3 to about 8 wt.%, about 3 to about 6 wt.%, about 3 to about 5 wt.%, from about 4 to about 10 wt.%, about 4 to about 8 wt.%, about 4 to about 6 wt.%, from about 5 to about 10 wt.%, about 5 to about 8 wt.%, or any range or subrange thereof, based on the total weight of the food composition on a dry weight basis.

**[00124]** In certain embodiments, the pet food meal composition comprises moisture. The moisture may be present at various amounts or concentrations. In one embodiment, moisture may be present in an amount of from about 3 to about 20 wt.%, based on the total weight of the pet food meal composition. For example, moisture may be present in an amount of about 3 wt.%, about 5 wt.%, about 5.5 wt.%, about 6 wt.%, about 6.5 wt.%, about 7 wt.%, about 7.5 wt.%, about 8 wt.%, about 8.5 wt.%, about 9 wt.%, about 9.5 wt.%, about 10 wt.%, about 10.5 wt.%, about 11 wt.%, about 11.5 wt.%, about 12 wt.%, about 12.5 wt.%, about 13 wt.%, about 13.5 wt.%, about 14 wt.%, about 14.5 wt.%, or about 15 wt.%, based on the total weight of the pet food meal composition. In another example, moisture may be present in an amount of from about 6% to about 12%, about 9% to about 13%, about 9% to about 11%, or about 9% to about 13%, based on the total weight of the pet food meal composition. In certain embodiments, moisture is present in an amount of about 5% to about 12%, about 6% to about 11%, or about 7% to about 10.0%, based on the total weight of the pet food meal composition. In further embodiments, moisture is present in an amount of about 65% to about 85%, about 60% to about 80%, or about 60% to about 75%, based on the total weight of the pet food meal composition.

**[00125]** The pet food meal compositions may include one or more ingredients and/or sources of glucose mimetic, carotenoids, and/or arginine and derivatives thereof. Sources of glucose mimetics may comprise glucose anti-metabolites including 2-deoxy-D-glucose, 5-thio-D-glucose, 3-O-methylglucose, anhydrosugars including 1,5-anhydro-D-glucitol, 2,5-anhydro-D-glucitol, and 2,5-anhydro-D-mannitol, mannoheptulose, and/or avocado extract comprising mannoheptulose. Sources of carotenoids may include lutein, astaxanthin, zeaxanthin, bixin, lycopene, and/or beta-carotene. Sources of antioxidant ingredients may comprise tocopherols (vitamin E), vitamin C,

vitamin A, plant-derived materials, carotenoids (described above), selenium, and/or CoQ10 (Co-enzyme Q10). In a preferred embodiment, the pet food meal composition contains high levels of arginine and derivatives thereof. The amount of arginine present in the composition may be about 0.01 to about 10.0 wt.%, about 0.01 to about 5.0 wt.%, about 0.01 to about 2.0 wt.%, about 0.1 to about 10.0 wt.%, about 0.1 to about 5.0 wt.%, about 0.1 to about 2.0 wt.%, about 0.5 to about 5.0 wt.%, about 0.5 to about 2.0 wt.%, about 1.5 to about 5.0 wt.%, about 1.5 to about 2.0 wt.%, about 0.5 wt.%, about 1.0 wt.%, about 1.4 weight%, about 1.44 wt.%, about 1.8 wt.%, or about 2.0 wt.%, based on the total weight of the composition on a dry matter basis. The arginine present in the composition may be L-arginine, D-arginine, or a mixture thereof.

**[00126]** The pet food meal compositions disclosed herein may be wet or dry compositions, and the ingredients can be either incorporated into the food composition and/or on the surface of any composition component, such as, for example, by spraying, agglomerating, dusting, or precipitating on the surface. Additionally, the pet food meal compositions may be formulated and produced to be in various forms and/or consistencies. For instance, the pet food meal compositions may, for example, be a dry, moist or semi-moist animal food composition. "Semi-moist" refers to a food composition containing from about 25 to about 35% moisture. "Moist" food refers to a food composition that has a moisture content of about 60 to 90% or greater. "Dry" food refers to a food composition with about 3 to about 12% moisture content and is often manufactured in the form of small bits or kibbles.

**[00127]** The pet food products may also include components of more than one consistency, for example, soft, chewy meat-like particles or pieces as well as kibble having an outer coating and an inner "core" component. In some embodiments, the pet food meal compositions may be in the form of a kibble or food kibble. As used herein, the term "kibble" or "food kibble" refers to a particulate pellet, e.g., a component of feline or canine feeds. In some embodiments, a food kibble has a moisture, or water, content of less than 15% by weight. Food kibbles may range in texture from hard to soft. Food kibbles may range in internal structure from expanded to dense. Food kibbles may be formed by an extrusion process or a baking process. In non-limiting examples, a food kibble may have a uniform internal structure or a varied internal structure. For example, a food kibble may include a core and a coating to form a coated kibble. It should be understood that when the term "kibble" or "food kibble" is used, it can refer to an uncoated kibble or a coated kibble.

**[00128]** The pet food meal composition of the present disclosure can additionally comprise other additives in amounts and combinations familiar to one of skill in the art. Such additives should be present in amounts that do not impair the purpose and effect provided by the invention. Examples of additives include substances with a stabilizing effect, organoleptic substances, processing aids, and substances that provide nutritional benefits.

**[00129]** Stabilizing substances may include, by way of example, substances that tend to increase the shelf life of the pet food meal composition. Other examples of other such additives potentially suitable for inclusion in the compositions of the invention include, for example, preservatives, antioxidants, synergists and sequestrants, packaging gases, stabilizers, emulsifiers, thickeners, gelling agents, and humectants. Examples of emulsifiers and/or thickening agents include gelatin, cellulose ethers, starch, starch esters, starch ethers, and modified starches. Additives for coloring, palatability, and nutritional purposes can include colorants, salts (including, but not limited to, sodium chloride, potassium citrate, potassium chloride, and other edible salts), vitamins, minerals, and flavoring. Other additives can include glucosamine, chondroitin sulfate, vegetable extracts, herbal extracts, etc.

**[00130]** The concentration of such additives in the pet food meal composition typically can be up to about 5 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. For example, the additives may be present in an amount from about 0.01 to about 5 wt.%, about 0.01 to about 4 wt.%, about 0.01 to about 4 wt.%, about 0.01 to about 3 wt.%, about 0.01 to about 2 wt.%, about 0.01 to about 1 wt.%, about 0.1 to about 5 wt.%, about 0.1 to about 4 wt.%, about 0.1 to about 4 wt.%, about 0.1 to about 3 wt.%, about 0.1 to about 2 wt.%, about 0.1 to about 1 wt.%, about 1 to about 5 wt.%, about 1 to about 4 wt.%, about 1 to about 4 wt.%, about 1 to about 3 wt.%, about 1 to about 2 wt.%, about 2 to about 5 wt.%, about 2 to about 4 wt.%, about 2 to about 4 wt.%, about 2 to about 3 wt.%, about 3 to about 5 wt.%, about 3 to about 4 wt.%, or about 4 to about 5 wt.%, based on the total weight of the pet food meal composition on a dry matter basis. In some embodiments, the concentration of such additives (particularly where such additives are primarily nutritional balancing agents, such as vitamins and minerals) is from about 0 to about 2.0% by weight, based on the total weight of the pet food meal composition on a dry matter basis. The amount of additives comprising vitamins may be in addition to the amount of vitamin B discussed above. In some embodiments, the concentration of such additives (again, particularly where such additives are primarily nutritional balancing agents) is from about 0 to about 1.0% by

weight, based on the total weight of the pet food meal composition on a dry matter basis. Although the list of foregoing additives may be potentially suitable in some embodiments, one or more of the foregoing additives may be excluded from other embodiments of the pet food meal composition.

**[00131]** In specific embodiments, the pet food meal compositions and food products are formulated to address specific nutritional differences between species and breeds of animals, as well as one or more of the attributes of the animal. For example, cat foods, for example, are typically formulated based upon the life stage, age, size, weight, body composition, and breed.

**[00132]** Sources of proteins, carbohydrates, fats, vitamins, minerals, balancing agents, and the like, suitable for inclusion in the pet food meal compositions, and particularly in the pet food products to be administered in methods provided herein, may be selected from among those conventional materials known to those of ordinary skill in the art.

**[00133]** The pet food meal compositions may include, or in some instance exclude, one or more ingredients selected from beef broth, brewers dried yeast, egg, egg product, flax meal, DL methionine, amino acids, leucine, lysine, arginine, cysteine, cystine, aspartic acid, polyphosphates, sodium pyrophosphate, sodium tripolyphosphate; zinc chloride, copper gluconate, stannous chloride, stannous fluoride, sodium fluoride, triclosan, glucosamine hydrochloride, chondroitin sulfate, green lipped mussel, blue lipped mussel, methyl sulfonyl methane (MSM), boron, boric acid, phytoestrogens, phytoandrogens, genistein, diadzein, Lcarnitine, chromium picolinate, chromium tripicolinate, chromium nicotinate, acid/base modifiers, potassium citrate, potassium chloride, calcium carbonate, calcium chloride, sodium bisulfate; eucalyptus, lavender, peppermint, plasticizers, colorants, flavorants, sweeteners, buffering agents, slip aids, carriers, pH adjusting agents, natural ingredients, stabilizers, biological additives such as enzymes (including proteases and lipases), chemical additives, coolants, chelants, denaturants, drug astringents, emulsifiers, external analgesics, fragrance compounds, humectants, opacifying agents (such as zinc oxide and titanium dioxide), antifoaming agents (such as silicone), preservatives (such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA), propyl gallate, benzalkonium chloride, EDTA, benzyl alcohol, potassium sorbate, parabens and mixtures thereof), reducing agents, solvents, hydrotropes, solubilizing agents, suspending agents (non-surfactant), solvents, viscosity increasing agents (aqueous and non-aqueous), sequestrants, keratolytics, egg shell membrane, ancient grain, and a combination of two or more thereof.

**[00134]** The pet food meal composition may be produced by various methods to achieve the desired pet food meal composition or desired form for the pet food meal composition. For example, dry food may be baked or extruded, then cut into individual shaped portions, such as kibbles. In some embodiments, the pet food meal composition may be prepared in a canned or wet form using conventional food preparation processes known to those of ordinary skill in the art. Typically, ground animal proteinaceous tissues are mixed with the other ingredients, such as cereal grains, suitable carbohydrate sources, fats, oils, and balancing ingredients, including special purpose additives such as vitamin and mineral mixtures, inorganic salts, cellulose, beet pulp and the like, and water in an amount sufficient for processing. The ingredients are mixed in a vessel suitable for heating while blending the components. Heating the mixture is carried out using any suitable manner, for example, direct steam injection or using a vessel fitted with a heat exchanger. Following addition of all of the ingredients of the formulation, the mixture may be heated to a temperature of from 50° F. to 212° F. Although temperatures outside this range can be used, they may be commercially impractical without the use of other processing aids. When heated to the appropriate temperature, the material will typically be in the form of thick liquid, which is dispensed into cans. A lid is applied, and the container is hermetically sealed. The sealed can is then placed in convention equipment designed for sterilization of the contents. Sterilization is usually accomplished by heating to temperatures of greater than 230° C for an appropriate time depending on the temperature used, the nature of the composition, and related factors. The pet food meal compositions and food products of the present disclosure can also be added to or combined with food compositions before, during, or after their preparation.

**[00135]** In some embodiments, the pet food products may be prepared in a dry form using convention processes known to those of ordinary skill in the art. Typically, dry ingredients, including dried animal protein, plant protein, grains and the like are ground and mixed together. Liquid or moist ingredients, including fats, oils water, animal protein, water, and the like are added combined with the dry materials. The specific formulation, order of addition, combination, and methods and equipment used to combine the various ingredients can be selected from those known in the art. For example, in certain embodiments, the resulting mixture is process into kibbles or similar dry pieces, which are formed using an extrusion process in which the mixture of dry and wet ingredients is subjected to mechanical work at high pressure and temperature, forced through small openings or apertures, and cut off into the kibbles, e.g., with a rotating knife. The resulting

kibble can be dried and optionally coated with one or more topical coatings comprising, e.g., flavors, fats, oils, powdered ingredients, and the like. Kibbles may also be prepared from dough by baking, rather than extrusion, in which the dough is placed into a mold before dry-heat processing.

**[00136]** In preparing a composition, any ingredient generally may be incorporated into the composition during the processing of the formulation, e.g., during and/or after mixing of the other components of the composition. Distribution of these components into the composition can be accomplished by conventional means. In certain embodiments, ground animal and/or poultry proteinaceous tissues are mixed with other ingredients, including nutritional balancing agents, inorganic salts, and may further include cellulose, beet pulp, bulking agents and the like, along with sufficient water for processing.

**[00137]** In accordance with an aspect of the invention, provided is a method comprising providing an animal a pet food meal comprising a first portion and second portion by first providing the first portion in a first period of time and subsequently providing the second portion in a second period of time, wherein the first portion has a having distinct macronutrient profile from the second portion.

**[00138]** In some embodiments, provided is a method comprising feeding an animal a pet food meal comprising a first portion and a second portion by providing the animal a first portion of the pet food meal; and providing the animal a second portion of the pet food meal subsequently to the first portion. The second portion typically has a different composition and/or macronutrient value from the first portion of the pet food meal.

**[00139]** The method may comprise providing the pet food meal once a day. In some embodiments, the pet food meal composition is provided to animal once in, for example, 24 hours, 23 hours, 22 hours, 21 hours, 20 hours, 19 hours, 18 hours, 17 hours, 16 hours, 15 hours, 14 hours, or 13 hours.

**[00140]** The first portion of the pet food meal is typically provided (e.g., made available for feeding by the animal) for a first period of time, and the second portion of the pet food meal is provided (e.g., made available for feeding by the animal) for a second period of time subsequently to the first portion of the pet food meal.

**[00141]** The first period of time may be from about 5 to about 20 minutes. The first period time may be, for example, from about 6 to about 19 minutes, from about 7 to about 18 minutes, from

about 6 to about 17 minutes, from about 5 to about 16 minutes, from about 5 to about 17 minutes, from about 5 to about 18 minutes, from about 5 to about 17 minutes, from about 6 to about 16 minutes, from about 6 to about 15 minutes, from about 7 to about 17 minutes, from about 7 to about 16 minutes, from about 7 to about 15 minutes, from about 8 to about 17 minutes, from about 8 to about 16 minutes, from about 8 to about 15 minutes, from about 9 to about 17 minutes, from about 8 to about 17 minutes, from about 9 to about 16 minutes, from about 9 to about 15 minutes, from about 10 to about 20 minutes, from about 10 to about 19 minutes, from about 10 to about 18 minutes, from about 10 to about 17 minutes, from about 10 to about 16 minutes, from about 10 to about 15 minutes, from about 11 to about 19 minutes, from about 11 to about 18 minutes, from about 11 to about 17 minutes, from about 11 to about 16 minutes, from about 11 to about 15 minutes, from about 12 to about 15 minutes, from about 13 to about 16 minutes, from about 14 to about 17 minutes, or 15 minutes, or any range or subrange thereof.

**[00142]** In some embodiments, the method comprises removing any remaining amount of the first portion of the pet food meal composition after conclusion of the first period. For example, if the animal does not finish eating all the first portion of the pet food meal in the first period of time, the remaining first portion of the pet food meal composition is taken away in some embodiments.

**[00143]** The second period of time is typically from about 5 to about 20 minutes. The second period time may be, for example, from about 6 to about 19 minutes, from about 7 to about 18 minutes, from about 6 to about 17 minutes, from about 5 to about 16 minutes, from about 5 to about 17 minutes, from about 5 to about 18 minutes, from about 5 to about 17 minutes, from about 6 to about 16 minutes, from about 6 to about 15 minutes, from about 7 to about 17 minutes, from about 7 to about 16 minutes, from about 7 to about 15 minutes, from about 8 to about 17 minutes, from about 8 to about 16 minutes, from about 8 to about 15 minutes, from about 9 to about 17 minutes, from about 8 to about 17 minutes, from about 9 to about 16 minutes, from about 9 to about 15 minutes, from about 10 to about 20 minutes, from about 10 to about 19 minutes, from about 10 to about 18 minutes, from about 10 to about 17 minutes, from about 10 to about 16 minutes, from about 10 to about 15 minutes, from about 11 to about 19 minutes, from about 11 to about 18 minutes, from about 11 to about 17 minutes, from about 11 to about 16 minutes, from about 11 to about 15 minutes, from about 12 to about 15 minutes, from about 13 to about 16 minutes, from about 14 to about 17 minutes, or 15 minutes, or any range or subrange thereof.

**[00144]** In some embodiments, the method comprises removing any remaining amount of the

second portion of the pet food meal after conclusion of the second period. For example, if the animals do not finish eating all the second portion of the pet food meal in the second period of time, the remaining second portion of the pet food meal is going to be taken away.

**[00145]** Preferably, the method comprises providing the second portion of the pet food meal composition subsequent to the first portion of the pet food meal composition. The amount of time between the end of the first period of time and/or the conclusion of feeding the animal the first portion of pet food meal composition and the start of the second period of time for the second portion of the pet food meal composition may be from about 1 minute to about 60 minutes, such as, e.g., from about 1 minute to about 60 minutes, about 1 minute to about 50 minutes, about 1 minute to about 40 minutes, about 1 minute to about 35 minutes, about 1 minute to about 30 minutes, about 1 minute to about 25 minutes, about 1 minute to about 20 minutes, about 1 minute to about 18 minutes, about 1 minute to about 15 minutes, about 1 minute to about 12 minutes, about 1 minute to about 10 minutes, about 1 minute to about 7 minutes, about 1 minute to about 5 minutes, about 1 minute to about 3 minutes; from about 3 minutes to about 60 minutes, about 3 minutes to about 50 minutes, about 3 minutes to about 40 minutes, about 3 minutes to about 35 minutes, about 3 minutes to about 30 minutes, about 3 minutes to about 25 minutes, about 3 minutes to about 20 minutes, about 3 minutes to about 18 minutes, about 3 minutes to about 15 minutes, about 3 minutes to about 12 minutes, about 3 minutes to about 10 minutes, about 3 minutes to about 7 minutes, about 3 minutes to about 5 minutes; from about 5 minutes to about 60 minutes, about 5 minutes to about 50 minutes, about 5 minutes to about 40 minutes, about 5 minutes to about 35 minutes, about 5 minutes to about 30 minutes, about 5 minutes to about 25 minutes, about 5 minutes to about 20 minutes, about 5 minutes to about 18 minutes, about 5 minutes to about 15 minutes, about 5 minutes to about 12 minutes, about 5 minutes to about 10 minutes; from about 10 minutes to about 60 minutes, about 10 minutes to about 50 minutes, about 10 minutes to about 40 minutes, about 10 minutes to about 35 minutes, about 10 minutes to about 30 minutes, about 10 minutes to about 25 minutes, about 10 minutes to about 20 minutes, about 10 minutes to about 18 minutes, about 10 minutes to about 15 minutes; from about 15 minutes to about 60 minutes, about 15 minutes to about 50 minutes, about 15 minutes to about 40 minutes, about 15 minutes to about 35 minutes, about 15 minutes to about 30 minutes, about 15 minutes to about 25 minutes, about 15 minutes to about 20 minutes; from about 20 minutes to about 60 minutes, about 20 minutes to about 50 minutes, about 20 minutes to about 40 minutes, about 20

minutes to about 35 minutes, about 20 minutes to about 30 minutes, about 20 minutes to about 25 minutes; from about 25 minutes to about 60 minutes, about 25 minutes to about 50 minutes, about 25 minutes to about 40 minutes, about 25 minutes to about 35 minutes, about 25 minutes to about 30 minutes; from about 30 minutes to about 60 minutes, about 30 minutes to about 50 minutes, about 30 minutes to about 40 minutes, about 30 minutes to about 35 minutes; from about 40 minutes to about 60 minutes, about 40 minutes to about 50 minutes, about 45 minutes to about 60 minutes, or any range or subrange thereof. In some embodiments, The amount of time between the end of the first period of time and/or the conclusion of feeding the animal the first portion of pet food meal composition and the start of the second period of time for the second portion of the pet food meal composition may be about 1 minute, about 2 minutes, about 3 minutes, about 4 minutes, about 5 minutes, about 6 minutes, about 7 minutes, about 8 minutes, about 9 minutes, about 10 minutes, about 15 minutes, about 20 minutes, about 25 minutes, about 30 minutes, about 35 minutes, about 40 minutes, about 45 minutes, about 50 minutes, about 55 minutes, about 60 minutes, or any range formed therefrom. In some embodiments, however, the animals are not given any “break” between the first period of time and the second period of time.

## EXAMPLES

### Example 1

**[00146]** A non-limiting pet food meal (Example Meal) was prepared in the form of two portions. The formula of the two portions (Example Portion A and Example Portion B) of the Example Meal is provided in Tables 1 and 2.

Table 1 – Example Portion A

|                 | <b>Example Portion A (wt.%)</b> |
|-----------------|---------------------------------|
| Protein         | 25.8                            |
| Fat             | 8                               |
| Starch          | 43.6                            |
| Soluble Fiber   | 1.9                             |
| Insoluble Fiber | 4.7                             |

Table 2 – Example Portion B

|                 | <b>Example Portion B (wt. %)</b> |
|-----------------|----------------------------------|
| Protein         | 34.8                             |
| Fat             | 35.3                             |
| Starch          | 2.3                              |
| Soluble Fiber   | 2.1                              |
| Insoluble Fiber | 12.7                             |

**[00147]** The Example Meal was evaluated in comparison to a Comparative Meal, which was in the form of two portions having the same composition and macronutrient value. The macronutrient value of the two portions of the Comparative Meal is provided in Table 3.

Table 3 – Comparative Meal

|                 | <b>Comparative Meal (wt. %)</b> |
|-----------------|---------------------------------|
| Protein         | 29.6                            |
| Fat             | 19.6                            |
| Starch          | 26.1                            |
| Soluble Fiber   | 2                               |
| Insoluble Fiber | 8.1                             |

**[00148]** Example Portion B contained a predominant amount of fat and fiber and provided about half of the calories received by the dog each day. Example Portion A contained a majority of the dietary carbohydrate received by the dog each day. The Comparative Meal was a eucaloric mixture of the two portions of Example Portion A and Example Portion B, which provided a complete allotment of the macronutritional value in one day. Thus, at the completion of eating either the Example Meal or the Comparative Meal, the canines receiving the Example Meal or the Comparative Meal received the same amount and type of macronutrients. The amount of the respective meal fed to the canines was based on the weight and/or caloric need of each canine.

#### Example 2

**[00149]** Thirty-six healthy canines were evaluated to assess the effects of the Example Meal as compared to the Comparative Meal. All thirty-six canines consumed the two portions of the Comparative Meal only once each day for a five-week pre-feed regimen. Specifically, during the pre-feed regimen, the canines received a first portion of the Comparative Meal during the first feeding for 15 minutes and a second portion of the Comparative Meal during the second feeding for 15 minutes. The second feeding period occurred about 1 minute after the conclusion of the 15 minutes of the first feeding period.

**[00121]** After the five-week pre-feed period, the canines were randomized into two groups as part of a first feeding regimen with the first group being fed the two portions of Example Meal in

sequential order for 5 weeks. For instance, the first group of canines received Example Portion A during the first feeding period for 15 minutes and received Example Portion B during the second feeding period for 15 minutes. The second group of canines received Example Portion B during the first feeding period for 15 minutes and received Example Portion A during the second feeding period for 15 minutes. The second feeding period occurred about 1 minute after the conclusion of the 15 minutes of the first feeding period.

**[00150]** After the conclusion of the first feeding regimen, the second group of canines then received the two portions of Example Meal in a sequential order for 5 weeks as the second feed regimen. Specifically, during the second feeding regimen, the second group of canines received Example Portion A during the first feeding period for 15 minutes and received Example Portion B during the second feeding period for 15 minutes. The second feeding period occurred about 1 minute after the conclusion of the 15 minutes of the first feeding period.

**[00151]** All canines were pair-housed in spacious indoor rooms with natural light. Canines received behavioral enrichment by interacting with each other, as well as through play time with caretakers, daily opportunities to run outside, and access to toys. Canines were fed once daily and had ad libitum access to water. All canines were immunized against canine distemper, adenovirus, parvovirus, Bordetella, and rabies, were monitored for parasites, and received routine heartworm preventative. All of the canines were deemed healthy after the evaluation with no adverse reactions.

**[00152]** Blood samples were taken and assessed from the canines after the pre-feed regimen, after the first feed regimen, and after the second feed regimen. To evaluate the Example Meal and the method of providing the Example Meal in sequential order, the Example Meal and the method of providing the Example Meal in sequential order were assessed in comparison to the canines after receiving the Comparative Meal during the pre-feed regimen or the canines after receiving the two portions of Example Meal in an opposite sequential order during the first feeding regimen. Data was analyzed by dependent samples t-test, with statistical criteria for significance for endpoints being  $p = 0.05$ .

**[00153]** Specifically, in the fifth week of the first feeding regimen, blood was drawn at 2 hours post meal (Fed/postprandial; after the Example Meal or Comparative Meal). A portion of whole blood-derived serum (no EDTA) was used for blood chemistry that included bilirubin, ALT, and BUN. The postprandial circulating blood chemistry analyses were conducted by using Roche

Hitachi Cobas 6000. Example 3

**[00154]** The blood samples from the canines receiving the Example Meal and those receiving the Comparative Meal were tested, as described in Example 2, to assess the difference in postprandial rise in blood urea nitrogen (BUN) in the canines.

**[00155]** The Example Meal reduced postprandial rise in BUN when compared to the Comparative Meal, as seen in FIG. 1. Example Meal achieved an about 25% reduction in BUN. A reduction in BUN indicates improved nitrogen and protein processing in canines and reduced risk for CKD. This was unexpected as the protein content in the Example Meal and the Comparative Meal were identical.

#### Example 4

**[00156]** The blood samples from the canines receiving the Example Meal and those receiving the Comparative Meal were tested, as described in Example 2, to assess the difference in postprandial rise in creatinine in the canines. The Example Meal reduced postprandial rise in creatinine when compared to Comparative Meal, as seen in FIG. 2. Example Meal achieved an about 70% reduction in creatinine. A reduction in creatinine indicates improved dietary and cellular protein processing in canines and reduced risk of CKD. This was unexpected as the protein content in the Example Meal and the Comparative Meal were identical.

#### Example 5

**[00157]** The blood samples from the canines receiving the Example Meal and those receiving the Comparative Meal were tested, as described in Example 2, to assess the differences in postprandial rise in triglyceride and lipemia in the canines.

**[00158]** The Example Meal reduced postprandial rise in triglyceride and lipemia when compared to Comparative Meal, as seen in FIGS. 3A and 3B. Example Meal achieved an about 50% reduction in triglyceride and an about 40% reduction in lipemia. A reduction in triglyceride and lipemia indicates improved dietary fat processing in canines. This was unexpected as the total fat content in the Example Meal and the Comparative Meal were identical.

#### Example 6

**[00159]** The blood samples from the canines receiving the Example Meal and those receiving the Comparative Meal were tested, as described in Example 2, to assess the difference in postprandial rise in phosphorus in the canines.

**[00160]** The Example Meal reduced postprandial rise in phosphorus when compared to the

Comparative Meal, as seen in FIG. 4, the Example Meal completely abrogated the increase in phosphorus that was observed when the Comparative Meal was fed, which indicates improved processing and less burden from dietary phosphorus with regards to kidney health.

**[00161]** In Example Meal, the overall calories and nutrients provided to canines were not perturbed, but the time-ordered provision of individual nutrients particularly pertinent to the markers to CKD and the sarcopenic loss of lean muscle in canine were manipulated to maintain the desirable protein, fat, and fiber consumption.

**[00162]** Desirably, the Example Meal maximized the effect of relatively high levels of protein fed to canines while the diet-induced rise in BUN, creatinine, and phosphorus are reduced. Also, the Example Meal maximized the effect of relatively high levels of dietary fiber provided with the relatively high levels of protein without compromising the nutrient digestibility. Further, the Example Meal maximized the effect of relatively high levels of dietary fat to maintain the fat energy calories without the detriments.

**[00163]** A summary of the results of the evaluation of the canines is provided in Table 4.

Table 4

| Analyte       | Comparative Example | Example Composition | P Value from Dependent Sample T-Test (Wilcoxon) |
|---------------|---------------------|---------------------|-------------------------------------------------|
| BUN           | 5.15 ± 0.28         | 3.85 ± 0.3          | 5.3E-06                                         |
| Creatinine    | 0.073 ± 0.008       | 0.024 ± 0.009       | 3.1E-06                                         |
| Triglycerides | 119.03 ± 10.08      | 62.28 ± 11.94       | 4.8E-05                                         |
| Lipemic       | 52.39 ± 4.94        | 32.03 ± 5.94        | 7.3E-04                                         |
| Phosphorus    | 0.289 ± 0.091       | -0.003 ± 0.097      | 0.019                                           |

## CLAIMS

*What Is Claimed Is:*

1. A method of feeding an animal, the method comprising:  
feeding an animal a pet food meal comprising a first portion and a second portion by  
providing the animal a first portion of the pet food meal; and  
providing the animal a second portion of the pet food meal subsequently to the first portion,  
wherein the second portion has a different macronutrient value from the first portion of the  
pet food meal.
2. The method according to claim 1, wherein the second portion of the pet food meal is  
provided after the animal finishes eating the first portion of the pet food meal.
3. The method according to claim 1 or claim 2, wherein the second portion of the pet food  
meal is provided after a period of time of about 1 minute or more.
4. The method according to any foregoing claim, wherein the second portion of the pet food  
meal is provided after a period of time ranging from about 1 minute to about 60 minutes from  
providing the first portion of the pet food meal.
5. The method according to any foregoing claim, wherein the first portion of the pet food  
meal comprises starch in an amount of about 51 to about 100 wt.%, based on the total weight of  
the pet food meal on a dry matter basis.
6. The method according to any foregoing claim, wherein the pet food meal has a weight ratio  
of an amount of starch in the first portion to an amount of starch in the second portion that is from  
about 35:1 to about 15:1, optionally, from about 30:1 to about 20:1, or about 25:1.
7. The method according to any foregoing claim, wherein the second portion of the pet food  
meal comprises starch in an amount of about 2 wt.% to about 49 wt.%, based on the total weight  
of the pet food meal on a dry matter basis.

8. The method according to any foregoing claim, wherein the first portion of the pet food meal comprises fat in an amount that is less than half of a total amount of fat in the pet food meal.
9. The method according to any foregoing claim, wherein the pet food meal has a weight ratio of the amount of the fat in the first portion to the amount of the fat in the second portion of about 1:1.5 to about 1:7.
10. The method according to claim 9, wherein the weight ratio of the amount of the fat in the first portion to the amount of the fat in the second portion is from about 1:2 to about 1:6, optionally, about 1:2 to about 1:5 or about 1:2 to about 1:4.
11. The method according to any foregoing claim, wherein the second portion of the pet food meal comprises fat in an amount that is greater than half of the total amount of the fat in the pet food meal.
12. The method according to any foregoing claim, wherein the first portion of the pet food meal comprises fiber in an amount that is less than half of the total amount of the fiber in the pet food meal.
13. The method according to any foregoing claim, wherein the pet food meal has a weight ratio of the amount of the fiber in the first portion of the pet food meal to the amount of the fiber in the second portion of the pet food meal of about 1:5 to about 1:1.
14. The method according to claim 13, wherein the weight ratio of the amount of the fiber in the first portion to the amount of the fiber in the second portion is about 1:3 to about 1:1.
15. The method according to any foregoing claim, wherein the second portion of the pet food meal comprises an amount of fiber that is 2 times greater than the amount of fiber in the first portion.

16. The method according to any foregoing claim, wherein the first portion of the pet food meal comprises protein in an amount that is about equal to the amount of protein in the second portion of the pet food meal.
17. The method according to any foregoing claim, wherein the pet food meal has a macronutrient value comprising:
  - from about 20 to about 60 kcal%, based on the total amount of kcal, of protein,
  - from about 8 to about 25 kcal%, based on the total amount of kcal, of fat, and
  - from about 30 to about 60 kcal%, based on the total amount of kcal, of dietary starch.
18. The method according to any foregoing claim, wherein the animal is a pet.
19. The method according to any foregoing claim, wherein the pet is a canine.
20. The method according to any foregoing claim, wherein the method comprises feeding the animal the pet food meal only once in one day.
21. The method according to any foregoing claim, wherein the animal has access to the first portion of the pet food meal for a period of about 5 to about 15 minutes.
22. The method according to any foregoing claim, wherein the animal has access to the second portion of the pet food meal for a period of about 5 to about 15 minutes.
23. A pet food meal in the form of a first portion and a second portion, the pet food meal composition comprising:
  - a macronutrient value comprising:
    - from about 20 to about 60 kcal%, based on the total amount of kcal, of protein,
    - from about 8 to about 25 kcal%, based on the total amount of kcal, of fat, and
    - from about 30 to about 60 kcal%, based on the total amount of kcal, of dietary starch,

wherein the first portion of the first portion of the pet food meal comprises at least 50 kcal%, based on the total amount of kcal, of the fat in the pet food meal and at least 50 kcal%, based on the total amount of kcal, of the fiber in the pet food meal.

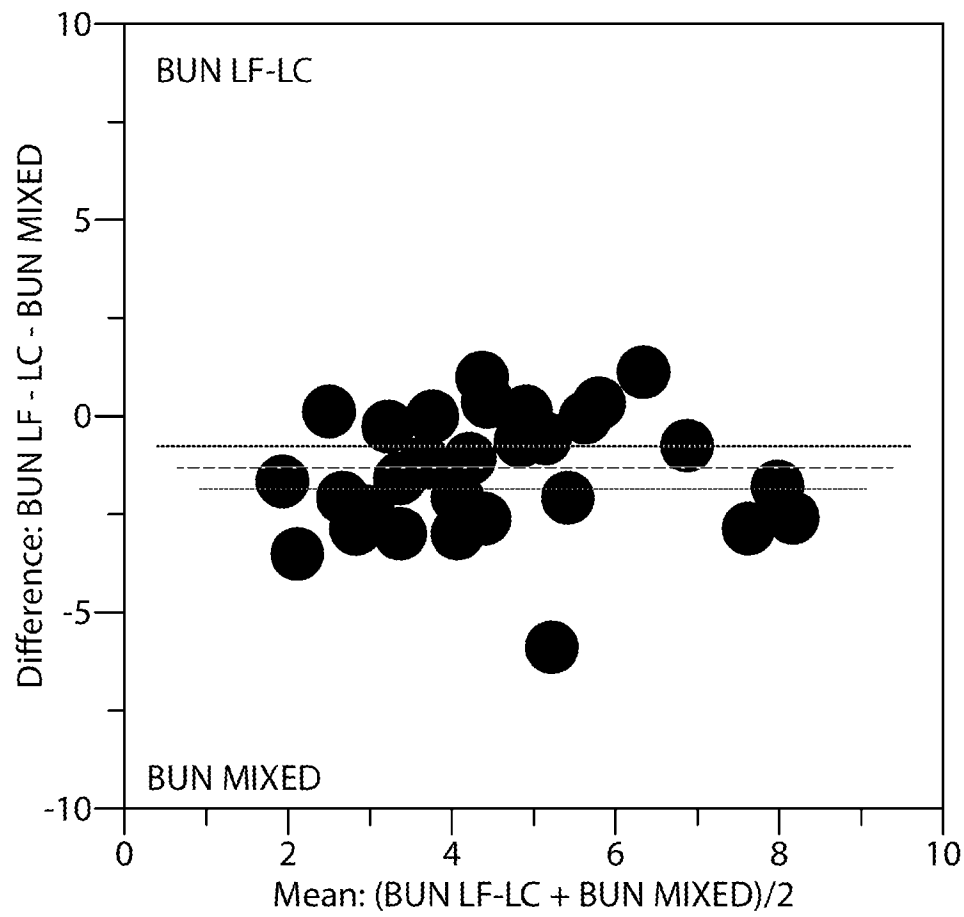
24. The pet food meal according to claim 23, wherein the pet food meal is adapted to reduce chronic kidney disease markers relative to when the animal eats the first portion and the second portion of the pet food meal together.

25. The pet food meal according to claim 23 or claim 24, wherein the chronic kidney disease markers comprise blood urea nitrogen, creatinine, phosphorus, triglycerides, and a combination thereof.

26. The pet food meal according to one of claim 23 to claim 26, wherein the animal is *Canis familiaris*.

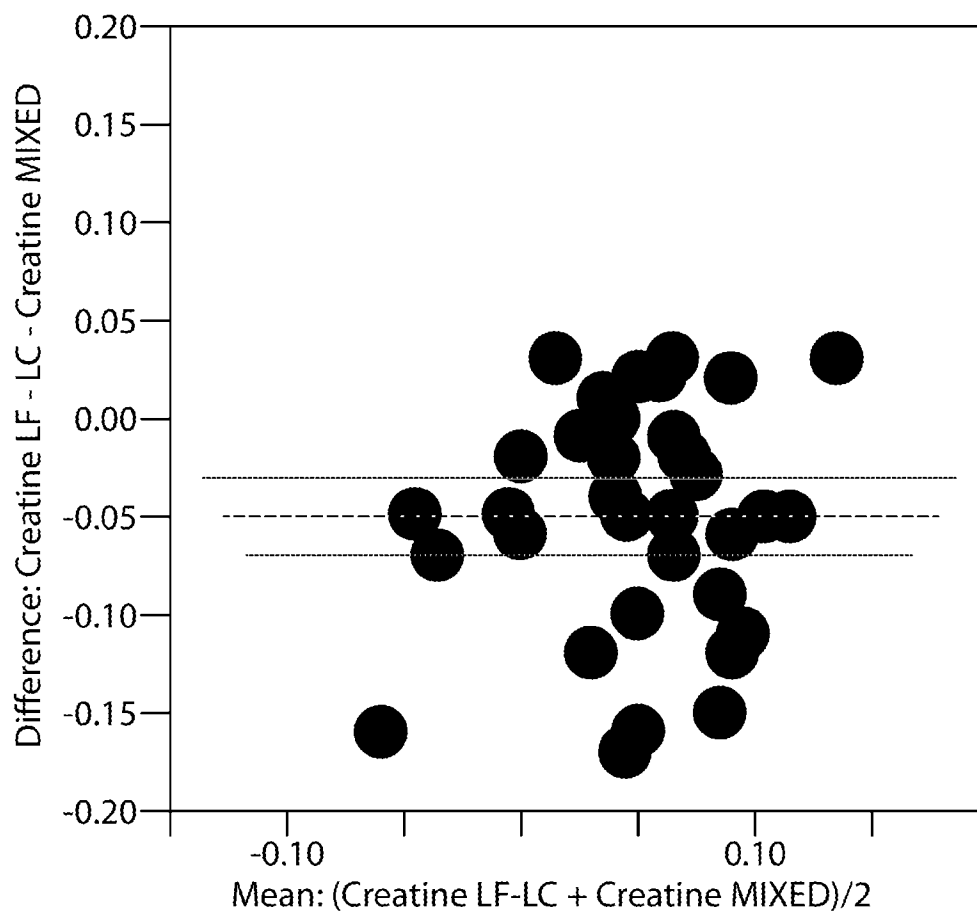
27. The pet food meal according to one of claim 23 to claim 25, wherein the animal is *Felis domesticus*.

28. A method of feeding an animal to improve renal health in the animal, comprising:  
feeding an animal a pet food meal comprising a first portion and a second portion by  
providing the animal a first portion of the pet food meal; and  
providing the animal a second portion of the pet food meal subsequently to the first portion,  
wherein the second portion has a different macronutrient value from the first portion of the  
pet food meal.



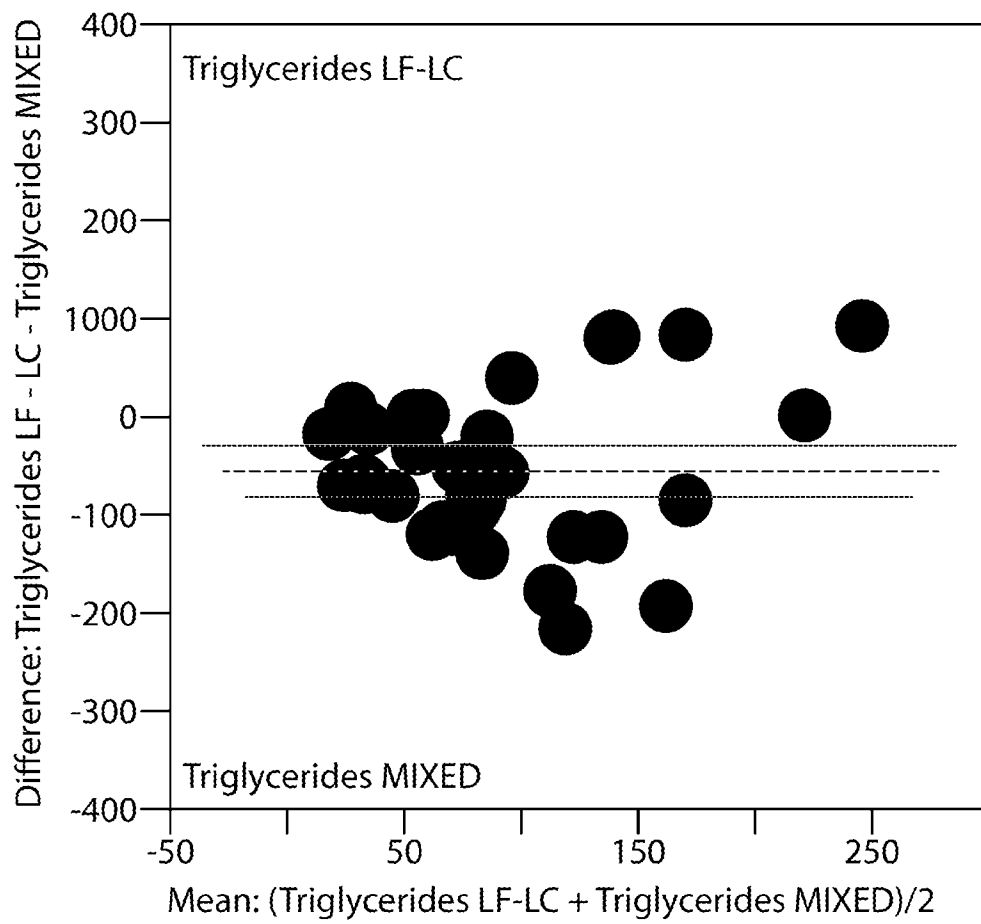
|                 |         |           |          |
|-----------------|---------|-----------|----------|
| TEST            | 3.85278 | t-Ratio   | -5.15074 |
| Control         | 5.14722 | DF        | 35       |
| Mean Difference | -1.2944 | Prob >  t | <0.0001* |
| Std Error       | 0.25131 | Prob > t  | 1.0000   |
| Upper 95%       | -0.7843 | Prob < t  | <.0001*  |
| Lower 95%       | -1.8046 |           |          |
| N               | 36      |           |          |
| Correlation     | 0.62802 |           |          |

FIG. 1



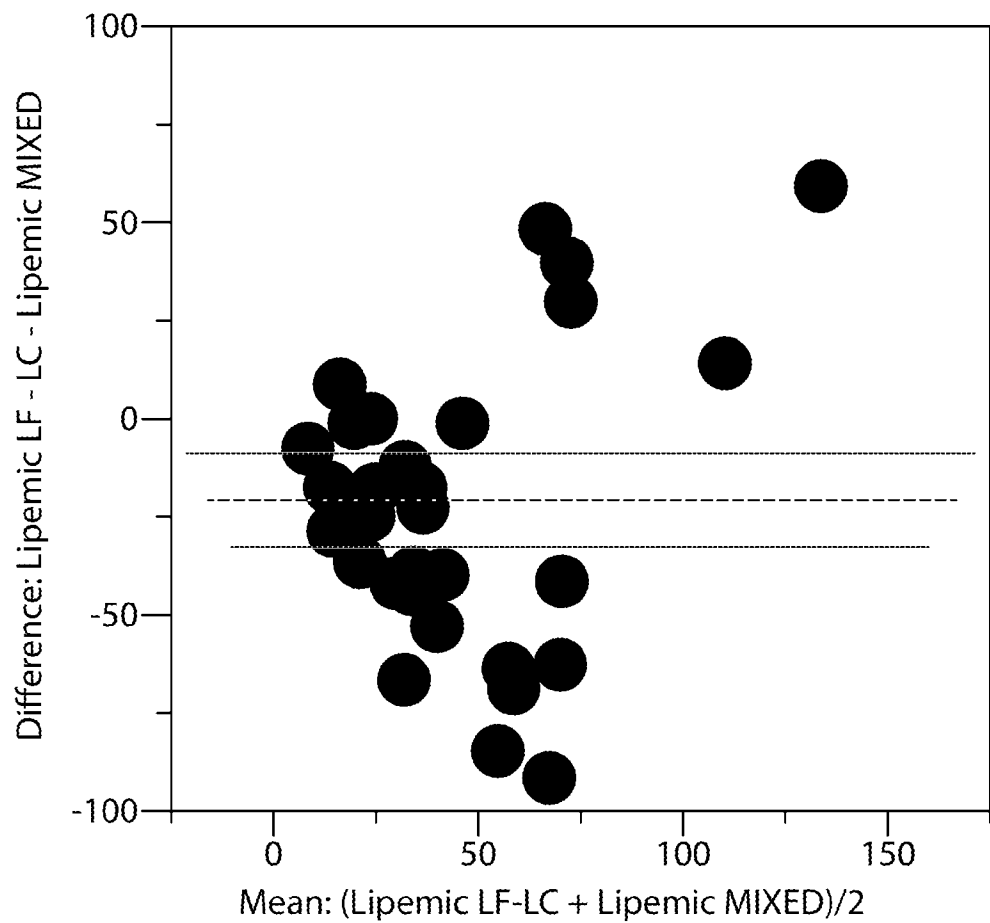
|                 |         |           |          |
|-----------------|---------|-----------|----------|
| TEST            | 0.02417 | t-Ratio   | -5.1403  |
| Control         | 0.07333 | DF        | 35       |
| Mean Difference | -0.0492 | Prob >  t | <0.0001* |
| Std Error       | 0.00956 | Prob > t  | 1.0000   |
| Upper 95%       | 0.0297  | Prob < t  | <.0001*  |
| Lower 95%       | -0.0686 |           |          |
| N               | 36      |           |          |
| Correlation     | 0.38898 |           |          |

FIG. 2



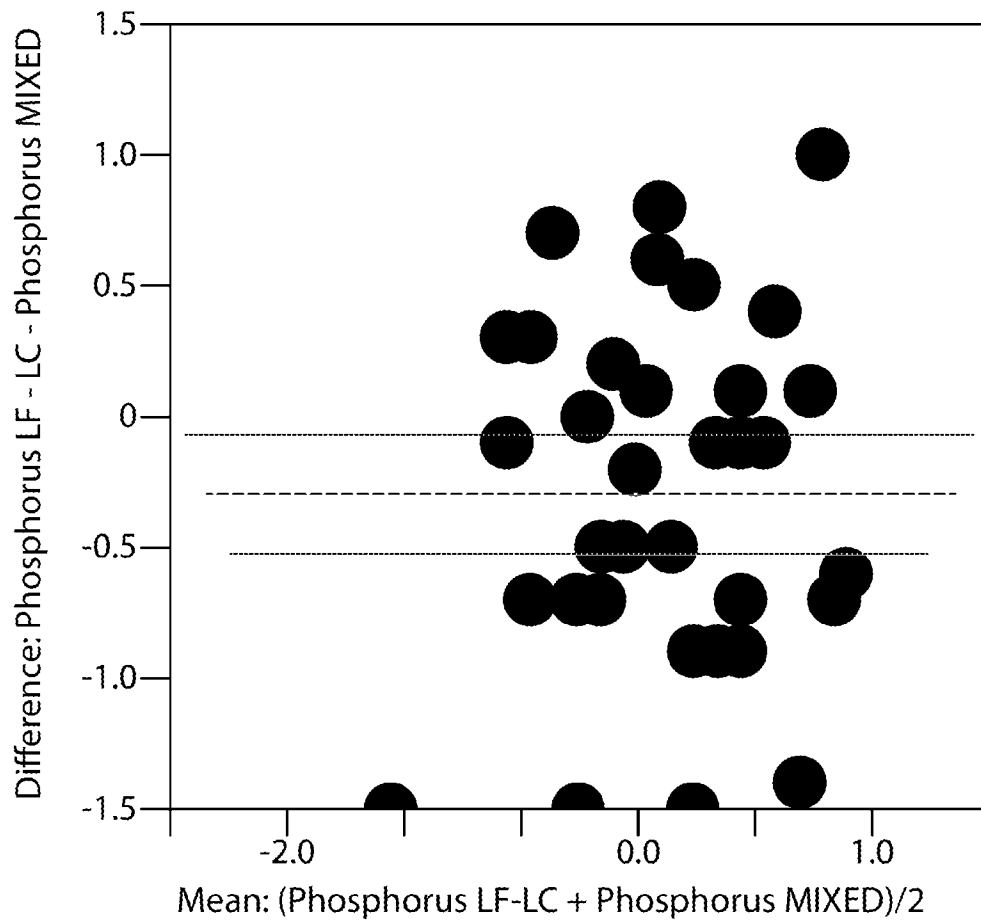
|                 |         |           |          |
|-----------------|---------|-----------|----------|
| TEST            | 62.2778 | t-Ratio   | -4.50022 |
| Control         | 119.028 | DF        | 35       |
| Mean Difference | -56.75  | Prob >  t | <0.0001* |
| Std Error       | 12.6105 | Prob > t  | 1.0000   |
| Upper 95%       | -31.149 | Prob < t  | <.0001*  |
| Lower 95%       | -82.351 |           |          |
| N               | 36      |           |          |
| Correlation     | 0.35372 |           |          |

FIG. 3A



|                 |         |           |          |
|-----------------|---------|-----------|----------|
| TEST            | 32.0378 | t-Ratio   | -3.46474 |
| Control         | 52.3889 | DF        | 35       |
| Mean Difference | -20.361 | Prob >  t | 0.0014*  |
| Std Error       | 5.87666 | Prob > t  | 0.9993   |
| Upper 95%       | -8.4309 | Prob < t  | 0.0007*  |
| Lower 95%       | -32.291 |           |          |
| N               | 36      |           |          |
| Correlation     | 0.42873 |           |          |

FIG. 3B



|                 |         |           |          |
|-----------------|---------|-----------|----------|
| TEST            | -0.0028 | t-Ratio   | -2.64101 |
| Control         | 0.28889 | DF        | 35       |
| Mean Difference | -0.2917 | Prob >  t | 0.0123*  |
| Std Error       | 0.11044 | Prob > t  | 0.9939   |
| Upper 95%       | -0.0675 | Prob < t  | 0.0061*  |
| Lower 95%       | -0.5159 |           |          |
| N               | 36      |           |          |
| Correlation     | 0.31112 |           |          |

FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2024/035772

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                           |                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                           |                                                                      |
| INV. A23K20/147 A23K20/158 A23K20/163 A23K50/40 A23L33/20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                           |                                                                      |
| ADD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                           |                                                                      |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                           |                                                                      |
| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                           |                                                                      |
| Minimum documentation searched (classification system followed by classification symbols)<br>A23K A23L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                           |                                                                      |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                           |                                                                      |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br>EPO-Internal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                           |                                                                      |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                           |                                                                      |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                        | Relevant to claim No.                                                |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2015/010669 A1 (KIMURA SEIJI [JP])<br>8 January 2015 (2015-01-08)<br>paragraph [0033] - paragraph [0034]; claim<br>3; tables 1,2<br>paragraphs [0002], [0024]<br>----- | 1-20,23,<br>24,26-28                                                 |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | US 2011/052752 A1 (SAXE LUCAS [US] ET AL)<br>3 March 2011 (2011-03-03)<br>claim 1; figure 1<br>-----                                                                      | 1,28                                                                 |
| <input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                           |                                                                      |
| <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |                                                                                                                                                                           |                                                                      |
| Date of the actual completion of the international search<br><br>11 October 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                           | Date of mailing of the international search report<br><br>24/10/2024 |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                           | Authorized officer<br><br>Steiner Ribeiro G.                         |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No  
PCT/US2024/035772

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2015010669 A1                          | 08-01-2015          | JP 6124407 B2              | 10-05-2017          |
|                                           |                     | JP 2015012809 A            | 22-01-2015          |
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| US 2011052752 A1                          | 03-03-2011          | NONE                       |                     |