Understanding Pet Food Consumers with Various Sensory Analysis Methods

by

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B.S., National Taiwan University, 2016

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Food Science
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2019

Approved by:

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Abstract

The pet food industry has been fast-growing over the past decades, which makes the pet food market very competitive. Understanding pet food consumers plays an important role in this competition to investigate purchase decisions. There are two aspects of pet food consumers, which includes pets that consume products, and pet owners who buy products. This research focused on two factors, palatability and emotion, that may affect purchase decisions from the perspectives of pet and pet owner. The objective of the first study was to investigate dog preference for various meats using the preference ranking test. Twelve beagle dogs performed the preference ranking procedure to rank five different meats: beef, chicken, lamb, pork, and turkey. Dog preference for cooked and raw meats were both tested during the study. In addition, a descriptive analysis of cooked meat aroma characteristics was conducted with four highly trained panelists to profile the meats. The results showed that dog preference for cooked and raw meats was similar, in which beef was preferred over chicken and pork. Specific cooked meat aroma characteristics such as meaty overall and brown/roasted might be intrinsic drivers of liking in dogs. The goals of the second study were to generate emotion terminology from both pets and pet owners and to investigate body languages and signs perceived by pet owners related to pet emotion. Four focus group sessions were conducted to gather insights from pet owners according to emotions they and their pets experienced. Lists of 38 and 55 emotion terms were generated for dogs and cats, respectively. In addition, lists of 33 and 62 emotion terms were created for dog owners and cat owners, respectively. Examples of emotion terms generated for pets and pet owners included excited, happy, anxious, and fearful. The validation of these emotion terms was conducted in the third study. The objective of the third study was to understand consumer (dog and dog owner) acceptance of granola-bar-like dog treats made with various sources of crisp and binder. Fifteen

different kinds of treats were baked with three sources of crisp (rice crisp, white sorghum crisp, and red sorghum crisp) and five sources of binder (corn syrup, spray dried plasma, gelatin, albumin, and egg white). A home-use-test was conducted with 39 dog owners and their pets to evaluate the treats for overall liking, dog's liking, appearance, aroma, and texture. In addition, emotion terms were probed during the test. The results showed that there was no significant difference for the owner's overall liking and the dog's liking among the treats. Positive emotions such as content/satisfied and happy were experienced frequently by the owners when dogs consumed the treats. Conversely, dogs were reported excited, happy, and eager when eating the treats. These studies demonstrated that a combination of palatability test and sensory analysis provided insights from both and pet and pet owners, which may be helpful for the pet food industry to understand the pet food consumers further.

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Chapter 1 - Literature Review

Pet Food Industry

Pet ownership has been growing significantly over the last ten years. More than 80 million households own at least one pet in the U.S. alone (APPA, 2018). These pet owners spent approximately US$33 billion on pet food and treat in 2018, and the sale of pet food is still growing (Wall, 2018). Pet owners often considered their pets as family members that they share their lives with. This humanization trend has influenced pet food product development to parallel human food trends. Trends toward natural, healthy, and functional diet can be found in both human and pet food (Sprinkle, 2018; Beaton, 2018; Carrozza, 2019). Understanding pet food consumers (both pet owners and pets) plays an important role in product development, as the products need to meet consumers' expectations. Palatability tests are often used to understand pets' enjoyment of a food (Aldrich and Koppel, 2015; Tobie et al., 2015; Griffin, 2003), while consumer study is often conducted to investigate owner's attitudes toward a product (Di Donfrancesco et al., 2018; Boya, Dotson &Hyatt, 2015; Tesfom & Birch, 2010).

Palatability Test

Palatability is commonly recognized as the pleasantness of taste or willingness of animals to eat the feed in preference to others. The more palatable the food is, the more possible the food would be consumed by pets. In addition, Boya et al. (2015) found that palatability is one of the most critical factors that affect dog owners' purchase decision for dog food. Therefore, palatability is a crucial element in the pet food industry for pet food and treats. Several methods have been developed to study palatability, which can be broken down into two categories: non-consumption and consumption tests (Griffin, 2003). The non-consumption tests include conditioned responses

tests (e.g. the Pavlovian response) and instrumental conditioning tests (e.g. the Skinner box test). The consumption tests are the most commonly used tests in the industry, in which the tests measure the intake of food that indicates acceptance or by the preference of one food over another (Aldrich & Koppel, 2015; Tobie et al., 2015). Examples for the consumption tests are the single-bowl test and the two-bowl test.

Single-Bowl Test

In a single-bowl test, animals are provided with one food at a time as their meal, the weight difference of the food been consumed in a certain period is recorded. The amount of food consumed indicates the acceptance/ palatability of the food (Griffin, 2003). In the modified single-bowl test, the liking test, other indicators are evaluated as well. For example, the percentage of finished and refused bowls, the speed of consumption, and consumption rate difference between the provided food and pets' food intake history (Tobie et al., 2015). The single-bowl method is easy to conduct as the animals do not need to be trained beforehand (Tobie et al., 2015); besides, it is similar to the setting of regular daily feeding most pet owners would have at home. However, it does not show the liking or preference of food (Aldrich & Koppel, 2015). The animals may be "forced" to eat the food provided to keep themselves from being hungry.

Two-Bowl Test

The two-bowl test is the common method to understand whether animals have a preference toward a diet. In a two-bowl test, two foods are served to the animals at the same time. The amount of consumption for each food is measured after a predetermined time (usually 15 to 30 minutes), (Aldrich & Koppel, 2015). The food that has been consumed more over the other is indicated to be the preferred sample. The ratio of the food intake [food A/ (food A+ food B)] is an important parameter in a two-bowl test, where the ratio represents the preference for the sample. The first

choice, the first food being tasted, can be used as an indicator as well, which indicated the olfactory liking for foods. The two-bowl test should be conducted at least two times, in which the position (left or right) of the bowls should be switched. The reason for switching is to avoid position bias during the test.

There are some variations of the two-bowl tests; for example, the operant lever-press test (Rashotte et al., 1984) and the false-bottom method (Pétel et al., 2017). In the operant lever-press test, animals are trained to press the lever of the food they want more based on the aroma cues. This test requires the animals to be trained for a long period of time, and the results were not always the same as the two-bowl test (Rashotte et al., 1984). In the false-bottom method, two bowls of kibble are presented to dogs simultaneously; besides, olfactory stimuli (e.g. palatant) were placed under each bowl. The first choice and the intake of the food were recorded as parameters for food preference. This method helps to understand the odor effect on food preference in dogs.

The two-bowl test is useful for evaluating the preference for one food over another. Nevertheless, it fails to reflect the actual preference when both foods are not desirable for the dogs, since a dog may force to eat one of the least undesirable foods. In addition, the preference for the foods is uncertain when the two foods were consumed at the same level. It is possible that the foods were both preferred by the animals or both not preferred by the animals. The two-bowl test also fails to illustrate what specific aspects of the food are liked by the animals (Aldrich and Koppel, 2015).

Preference Ranking Test

The preference ranking test relies on the motivation of dogs to extract food from a puzzle-toy by aroma/flavor preference was proposed by Li et al. (2017). This method provides an alternative for studying dogs' food preference with more sample tested at once compared to the

one- bowl and two-bowl tests. In the preference ranking test, five foods, each food hidden in a puzzle toy, are presented to the dogs at once. The dogs are allowed to sniff the samples before the test, and they extract the foods from the toys based on the aroma cues. The first extracted food is considered to be the most preferred among the five samples. This method enables the researchers to investigate the preference ranking of foods tested. However, the dogs participate in the test need to be trained beforehand. Li et al. (2017) showed that dogs were able to compare their preference simultaneously with five different treats in a preliminary test. However, the reliability of the results was still unclear.

Sensory Analysis and Pet Food

Sensory Analysis

Sensory Analysis has been defined as a class of methods that identify and quantify the perceived intensities of the sensory characteristics of a product (Lawless and Heymann, 2010). There are three types of testing in sensory analysis: the discrimination test, the descriptive test, and the affective test. The discrimination test is used to test if the samples are different/ similar from each other. The descriptive test is conducted with a number of trained panelists to describe and quantify the intensities of the sensory characteristics. The affective test is conducted with consumers to investigate whether a product is liked or disliked, and the data is commonly collected through questionnaires.

Application of Sensory Analysis in Pet Food

Studying pet food can sometimes be difficult, as animals cannot talk to describe why a specific food is preferred over another or what specific attributes they perceive in the food. Sensory analysis with a human descriptive panel is often used to decipher sensory properties that determine

pet food acceptance/ preference. Descriptive lexicon for dry dog food (Di Donfrancesco et al., 2012) and retorted cat food (Koppel &Koppel, 2018) had been developed, in which more than 70 sensory attributes and 25 aroma attributes were generated to describe the sensory characteristics of dog food and cat food, respectively. These terms help to describe the appearance, texture, aroma, and flavor of pet foods, and they served as a language to communicate for product development and marketing. In addition, some studies used descriptive analysis to profile the pet foods manufactured with different ingredients (Di Donfrancesco & Koppel, 2017; Di Donfrancesco et al., 2014; Koppel et al., 2015). Descriptive analysis was also used in previous studies to understand changes in sensory characteristics throughout shelf-life (Chanadang et al., 2016), and to investigate processing conditions in extruded pet food (Lin et al., 1998).

Several studies have used affective testing to understand pet owners' acceptance of pet foods. When testing overall liking of a product, the liking of appearance, aroma, and texture are often evaluated as well (Di Donfrancesco et al., 2014; Chanadang et al., 2016; Baquero et al., 2018; Koppel et al., 2018). In order to find out drivers of liking for a product, data association can be used to analyze the relationship between descriptive analysis data sand affective analysis results. For example, Chanadang et al. (2016) associated the sensory attributes to the overall liking of pet food and found out that consumers preferred pet foods with higher intensity of off-notes (stale and cardboard) than pet foods with not much aroma.

Consumer Studies and Pet Food

Consumer studies in pet food usually collect data form both pet owners and pets to understand how the products are perceived. Based on the location of the test conducted, consumer studies can be separated into two categories: Central Location Test (CLT) and Home Use Test (HUT). The location of the test occurred may not affect the pet owner significantly; however, it

affected the pet performance with the test. Griffin et al. (1984) reported that food preference between home dogs and kennel dogs was different when testing dry dog food and semi-moist food. More studies related to pet food have found to use the central location test to study the acceptability of products (Koppel et al., 2018, Baquero et al., 2018; Chanadang et al., 2016; Di Donfrancesco et al., 2014). Pet food studies that used home use tests seem to be limited. Di Donfrancesco et al. (2018) conducted a home use test in which a diet with sorghum addition was tested with the one-bowl test for dogs. The result showed that there is no difference in consumption between sorghum-included diet and corn-based (control) sample.

Compared to a CLT, the results from a home use test is often considered less precise because the control of the testing conditions is low. Tobie et al. (2015) suggested that more animals should be included when conducting the HUT to enhance reliability. Though there is less control for a HUT, a home use test can collect feedback from both pet owners and pets with daily experiences (Di Donfrancesco et al.,2018; Tobie et al., 2015). In addition, dogs may be more consistent with their preference for food when a home use test is conducted (Griffin et al., 1984).

Pet Emotion

Definition of Emotion

To date, there is no universal definition of emotion among scientists. The complexity of defining emotion was shown in a previous study conducted by Kleinginna & Kleinginna (1981). After reviewing more than 90 definitions of emotion, they found that each definition accentuates different aspects of emotion. From an evolution standpoint, emotion can be seen as a process for animals to respond to stimuli, which helps to avoid harm or obtain resources (Boissey et al., 2007; Rolls, 2000; Panksepp, 1994). This is known as basic emotion theory, in which these basic

emotions, also called “primary” emotions or “fundamental” emotions, contributed to survival (Matsumoto & Ekman, 2009; Boissey et al., 2007; Plutchik, 1980) and existed across a wide range of vertebrate species (Panksepp, 1982; Ekman, 1992; LeDoux, 1996; Boissy et al., 2007). Examples of basic (primary) emotions included fear, disgust, anger, sadness, surprise, enjoyment, etc. (Prinz, 2004; Ortony & Tuner, 1990). Other emotions which are not directly related to survival can be classified as secondary or complex emotions; for example, guilt, shame, and jealousy. Self-conscious or self- evaluative was believed to be a key element of secondary emotions, which also leads to the argument of whether non-human animals have secondary emotions (Lewis, 2002; Morris et al., 2008). Several secondary emotions in animals were reported by their owners in previous studies (Harris & Prouvost, 2014; Morris et al., 2008; Parr, 2001).

Methodology

Since animals cannot talk, understanding pet emotions can be challenging. The behavioral investigation, physiological measurement, and collection of owners’ perceptions are the common methods used to understand pet emotion. Leyhausen (1979) displayed nine different facial expressions of cats when being in an offensive or a defensive mood. On top of that, these facial expressions were later correlated to emotions such as fear, frustration, and relaxed with a facial action coding system developed for cats (Bennett et al., 2017). Facial action coding system for dogs was also developed to investigate how dogs reacted to emotional stimuli (Caeiro et al., 2017). Other research has illustrated relationship between behavioral cues (e.g. tail movement, body movement, vocalization) and observed emotion including jealousy in dogs (Harris & Prouvoust, 2014; Abdai et al., 2018), fear in dogs (Döring et al., 2009; Tami & Gallagher, 2009), and general emotions in cats and dogs (Arahori et al., 2017; Crowell-Davis, 2007). Observations of animal’s behavior provide a straightforward understanding of pet emotions; however, some behaviors may

be observed in two different emotions and would be hard to interpret. For example, moving actively can be observed in being joyful or angry (Konok et al., 2015).

Physiological measurement such as heart rate can be an indicator for pet emotion as well (Kuhne et al., 2014), yet, similar to behavioral observation, the result could be ambivalent. For instance, an increase in heart rate could be a sign for positive emotion (e.g., excited) and negative emotion (e.g., angry). Another alternative method to study pet emotions is collecting information from pet owners, who share their lives with pets. This method not only helps to investigate pet emotions but also examines how humans attribute emotions to their pets (Arahori et al., 2017; Martens et al., 2016; Konok et al., 2015; Tami & Gallagher, 2009; Morris et al., 2008). When collecting information about pet emotion from owners, most studies provided a pre-determined list of emotions, including primary and secondary emotions, and asked the owners to report if the provided emotions have been observed (Su et al., 2018; Arahori et al., 2017; Martens et al., 2016; Konok et al., 2015; Morris et al., 2008). Providing a pre-determined list of emotions to the research participants helps to define the scope of a study, but may limit the range of emotions being excavated at the same time. Since all the methods mentioned above merely focus on a specific aspect, a combination of different methods is often adopted by researchers to gain a more comprehensive overview of pet emotion.

Research Objectives

When considering the factors that influence pet food purchase decision, palatability is one of the most critical. The preference ranking test is one of the recently proposed methods that allow five foods to be tested simultaneously. The method has previously only been tested on baked treats. No study was found to use the preference ranking procedure to test the ingredients in pet food.

Thus, the first objective of this research is to investigate dogs' preference for various meats using the preference ranking procedure.

Emotion is another factor that affects pet owners' purchase decision. Pet emotion towards food may play an important role in the decision making of pet owners. However, there have been limited studies discussing the emotions of pet owners and pets (as perceived by their owners). Therefore, the second objective is to generate emotions terminology from both pets and pet owners. The results of the emotion terms generated in the second study will be validated in the third study. In the third study, dog treats manufactured with an innovative ingredient, sorghum, were tested. The third objective is to understand consumer acceptance and emotion responses of dog treats made with sorghum crisps and binder.

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Chapter 2 - Ranking of Dog Preference for Various Meats

ABSTRACT

An innovative dog preference ranking procedure, which relies on the motivation of dogs to extract food from a puzzle-toy by aroma/flavor preference was recently proposed (Li et al., 2017). The method previously has only been tested on baked treats. This study was aimed to investigate dogs' preference for various meats using the preference ranking procedure. Twelve beagle dogs were used in the study. Two treatments of meat were tested: raw and cooked meats. In both treatments, each dog was served with five different meat cubes: beef, chicken, lamb, pork, and turkey in coded puzzle-toys for five consecutive days. The rank orders were recorded during the test, and the ranked data were analyzed by Friedman test to understand the preference among meats. Descriptive analysis of raw and cooked meat aroma characteristics was conducted with five highly trained panelists to profile the meats. The preference for raw and cooked meats was similar, in which beef was preferred over chicken and pork by dogs. This result was consistent with the previous study (Lohse, 1974), where canned beef was preferred over canned chicken. Beef had higher intensity scores in the attributes of meaty overall and bloody/serumy in the raw treatment, and brown/roasted aroma in the cooked treatment. These results indicated that specific meat aroma characteristics such as meaty overall and brown/roasted might be intrinsic drivers of liking in dogs. This study showed that dogs previously naïve to raw and cooked meat cubes were able to rank their meat preferences based on aroma by this preference ranking procedure.

INTRODUCTION

More than 65% of U.S. households have at least one pet in which dog ownership is leading, followed by cats, freshwater fish, and birds (APPA, 2018). These pet owners spent approximately US$33 billion on pet food and treat in the year 2018, and the pet food market is still growing (Wall, 2018). A national survey done by the American Pet Products Association showed that pet food is one of the categories that dog owners spent the most in pet-related expense. Palatability is one of the most critical factors that affect dog owners' purchase decision for dog food (Boya, Dotson &Hyatt, 2015).

Palatability is commonly recognized as the pleasantness of taste of feed or willingness of animals to eat the feed in preference to others. It can be measured by the intake of food that indicates acceptance or by the preference of one food over another (Aldrich and Koppel, 2015). To understand the palatability of pet food, several methods have been developed. The single-bowl or monadic test and the two-bowl test are the common techniques used in the industry (Aldrich and Koppel, 2015; Tobie et al., 2015; Griffin, 2003). In a single-bowl test, animals are provided with one food at a time as their meal, the weight difference of the food been consumed in a certain time period is recorded. The amount of food consumed indicates the acceptance/ palatability of the food (Griffin, 2003). This method is easy to conduct as the animals do not need to be trained beforehand, besides, it is similar to the setting of regular daily feeding most pet owners would have at home. However, the results from a single-bowl test cannot entirely speak for the acceptance/ palatability of the food. This is because the animals may eat the one sample provided merely because of hunger but not acceptance, since there are no other food choices presented. On the contrary, two foods are presented to the animals simultaneously (usually as their meals) in a two-bowl test, where the food that is consumed more will be considered as the preferred one by the

animals. The two-bowl test is useful for evaluating the preference for one food over another. Nevertheless, it fails to reflect the actual preference when both foods are not desirable for the dogs, since a dog may be forced to eat one of the least desirable foods.

The limitation of one-bowl test and two-bowl tests lie on that the animals could be "forced" to make their selection of food so that they will not feel hungry. Furthermore, only a small number of samples can be evaluated at once, which makes the test time and cost consuming. An innovative dog preference ranking method, which relies on the motivation of dogs to extract food from a puzzle-toy by aroma/flavor preference was proposed (Li et al. 2017). The method could enhance the efficiency of palatability preference test because it enables up to 5 samples to be served simultaneously to a dog. Namely, the dogs have more options to evaluate before making their preference, which could provide a more genuine understanding of food palatability. The preference ranking procedure has only been tested on baked treats previously (Li et al. 2017). Thus, the reliability of the method in different food categories was unknown.

Food preference of dogs for ingredients effect has been researched in the past, for example, soybean inclusion in the diet (Felix *et al*., 2012), fiber inclusion in the kibbles (Koppel *et al*., 2015), and vegetable ingredient-based diet (Callon et al., 2017). However, a limited number of studies can be found with a focus on food preference of dogs for ingredients themselves. Works in this field were done by Lohse (1974) and Houpt *et al*. (1978) in which meat preferences of dogs were investigated. Lohse found that dogs preferred beef> lamb> chicken> horsemeat when fresh meat cubes were served, while Houpt *et al*. found that beef and pork was preferred over lamb, chicken, and horsemeat when ground cooked meats were presented. The preference test for meats has not been revisited over the years. Meats may have changed over the times and horsemeat is not

available in any grocery store nowadays. It is necessary to re-evaluate dogs' preference for meats with new approaches to see whether the dogs still have the same preference after decades.

Studying food preferences for dogs can sometimes be difficult as animals cannot talk to describe why a food is preferred over another. Even though pet owners/ researchers may be able to perceive and interpret the enjoyment of food intake from the dogs, the interpretation can be subjective and not specific. Physical indicators, such as heart rate, activity level, eating rate, and body movement were used to further understand dogs' food preference (Aldrich and Koppel, 2015). This information may be useful as a general understanding, but are not able to find out the characteristics that drive the dog's preference. Sensory analysis with a human descriptive panel is often used to decipher sensory properties that determine pet food acceptance/preference. Examples of human descriptive panel used in previous studies include rendered protein meal in extruded pet food (Chanadang *et al*., 2016), fiber inclusion in pet food (Koppel *et al*., 2015), descriptive lexicon for dry dog food (Di Donfrancesco *et al*., 2012), and lipids and processing conditions in extruded pet food (Lin *et al*., 1998). This technique combined with a palatability test could enable researchers to take a deeper look at drivers of liking for pet food preferences.

Meat is one of the essential ingredients in pet food. However, whether or not dogs have an inherence to like meats and their preference for meats were not fully investigated. The inherence of meat-liking was studied in free-ranging dogs (scavenge for food) previously (Bhadra &Bhadra, 2014), but not in dogs kept indoors (fed by people). In addition, the last work to understand dogs' preference for meats was published 45 years ago with the operant testing (Lohse, 1974) and has not been revisited over the years. In order to explore dogs' preference for various meats, preference ranking method and sensory descriptive analysis were used in this study. This study was aimed 1) to understand dogs' inherence of meat-liking with laboratory dogs, 2) to validate dogs' preference

for meats using the preference ranking test, and 3) to investigate possible aroma characteristics that affect dogs liking for meats (if dogs do prefer specific meats).

MATERIALS AND METHODS

Subjects

Twelve beagle dogs (four female dogs and eight male dogs) housed at the Large Animal Research Center at Kansas State University were used in the study. The dogs were kept in pairs in a 7.8 square meter indoor kennel. A standard diet of grain-based (poultry flavor) kibbles was provided to the dogs twice a day at 7:00 a.m. and 11:00 a.m. The tests were conducted between 4:00 p.m. and 6:00 p.m. daily during the study. To conduct the preference ranking test, each dog was chosen randomly on the test day and was brought to the testing room near their pens individually. Before entering the testing room, each dog had a 3-5 mins walk/run to ensure there were no abnormal behaviors that refrain the dog from the test. The testing room was neutral and smell-free, the noise outside the room was insulated. The dogs performed the ranking procedure in a testing area separated with two metal fences to form a 1.5 square meter space in the testing room. The research was approved by the Institutional Animal Care and Use Committee (IACUC #3722).

Meat Samples

Raw meats

Five types of fresh meat were purchased in local grocery stores in Manhattan, KS, which included beef, lamb, pork, chicken, and turkey. Since the fat content might affect the dogs' food selection (Li *et al*.,2017), different parts were used for each meat to avoid the source of fat bias in this study. Thus, the least-fat meats that were available in the market were chosen, which included

diced boneless beef, lamb leg steak, diced lean pork, chicken tenderloin, and turkey breast. The meats were frozen after purchased, and the frozen portions were moved to a refrigerator around 4.4°C the night before testing to thaw. All the meats were used within the best-before date suggested on the package.

On each testing day, the meats were pulled from the refrigerator, connective tissues and fat portion of the meat were trimmed and removed. After trimming, the meats were cut into ½ inch cubes, each type of meat cubes were kept in a resealable bag (Ziploc, S.C.Johnson & Son, WI, U.S.A.) and brought to the testing facility after the preparation.

Cooked meats

The meat types and their storage condition used for cooked meat samples were the same as raw meats. After trimming and cutting, the meats were broiled at 260°C and flipped once during the cooking. Broiling time for white meats and red meats were different in order to make sure the meats were cooked but not overcooked. White meats (chicken and turkey) took 7 min and red meats (beef, lamb, and pork) took approximately 9-10 min for broiling. All the meat cubes were cooled down to room temperature and packed into resealable bag (Ziploc, S.C.Johnson & Son, WI, U.S.A.) for the ranking test.

Preference Ranking Test

Test Design

The preference ranking test for this study was composed of four experiments- adaptation, raw meat treatment, cooked meat treatment, revisit of raw meat treatment. A three-day adaptation experiment was conducted with five different commercial dog treats purchased in a local grocery store in Manhattan, Kansas. As the dogs had done the preference ranking test before, the purpose of the adaptation was to help the dogs re-familiarize with the preference ranking procedure. All

the dogs were able to perform the preference ranking test with the provided treats after the adaptation. The experiment for the raw meat treatment started right after the adaptation. This experiment was initially expected to be done for five consecutive days; however, it was terminated after 1 day of testing and switched to the cooked meat treatment. The reason for the termination was because less than half of the dogs (only 2 out of 12 dogs) were able to finish the procedure with raw meats. We would like to know whether the dogs were not able to finish the test because of the raw meats or the ranking process with meats; thus, the cooked meat treatment was conducted. More than half of the dogs completed the experiment of the cooked meat treatment for five consecutive days (see the Results and Discussion). This indicated that the dogs were able to finish the ranking procedure with meats. Therefore, we revisit the raw meat treatment after conducting the cooked meat treatment. Overall, these experiments were conducted back-to-back for 14 days (Figure 2.1). The results of the revisit raw meat treatment and the cooked meat treatment will be discussed in the following sections.

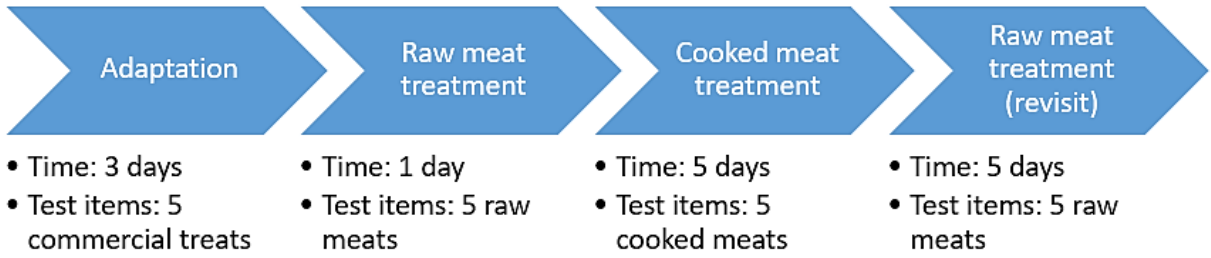

Figure 2.1 Flowchart of the preference ranking test design.

Procedure

Dogs' preference for meats was determined using the preference ranking procedure, which relied on the motivation of dogs to extract food from a puzzle-toy "Kong" by aroma/flavor (Li *et al*., 2017). The puzzle-toy (Kong; Kong, Golden, CO) was made of rigid rubber with a hollow cone-shaped cylinder where a small piece of food can be hidden inside the hole. Sixty toys were

used in this study, each of them was labeled with a code from 1 to 60 for recording purpose. These toys were cleaned every day after the testing with non-fragrant soap and warm water twice and then air-dried overnight. The cleaning assured that the toys used in daily testing were residual-free (no leftover food pieces, hair or odor, etc.).

In each testing day, the order of dogs participated in everyday testing was completely randomized. One cube of each type of meat was put into separated puzzle-toys, toys with meat cubes were then presented to the dogs. Before the testing, the dog sniffed the toys with meats in random order with assistance from the researchers. The sniffing allowed the dog to memorize and familiarize with the aroma of each meat samples. After sniffing the meats, the dog was brought to the testing space and was contained at a start-point by one researcher. The toys with meat cubes were placed in random order in a row approximately 2m away from the start point by the other researcher. When the test started, the dog was released from the start-point to access and grab the meats in the toys. The order and time for the dog to extract and consume each meat sample were recorded. The order of the meats being extracted and eaten was defined as preference ranking order for the dog. To be specific, rank order 1 stood for the first picked and consumed meat and indicated the meat was the most preferred, while rank order 5 was the last picked and consumed meat with an implication of the least preferred. Once the dog obtained and consumed the meat from the toy, the empty toy was removed by the researchers to avoid any confusion and/or distraction for the dog. The endpoint of the ranking procedure was the completion of all the five meats been extracted and consumed by the dog. If the dogs did not select/ consume/ or were not interested in any of the toys, the test would be terminated after 3.5 min which was the endpoint for incompletion ranking test. When the dog finished the test, the researcher led the dog back to its pen and another dog was brought to the same testing space to

perform the ranking procedure. The test was conducted for five consecutive days for each raw meat and cooked meat treatment.

Descriptive Analysis- Aroma Profiling

The raw and cooked meats- beef, lamb, pork, chicken and turkey were evaluated by five, highly trained panelists from the Center for Sensory Analysis and Consumer Behavior at Kansas State University (Manhattan, KS, U.SA). All the panelists received a minimum of 120 h of general descriptive sensory analysis training prior to completing this panel.

Table 2.1 Raw and cooked meat aroma attributes, definitions, and references with intensities on a 0-15 scale.

Attribute	Definition	Reference with intensity
Meaty overall	A measure of how much a sample is recognized as distinctly muscle tissue, including poultry, seafood/fish, and beef.	USDA choice Strip Steak (cooked) = 4.5
Meaty beef	A measure of how much a sample is recognized as distinctly beef muscle tissue.	Swanson's Beef Broth = 5.0 80% Lean Ground Chuck (cooked) = 7.0
Meaty Poultry	A measure of how much a sample is recognized as distinctly poultry muscle tissue.	Boneless chicken thigh (cooked) = 4.5
Brown/Roasted	A round, full aromatic generally associated with beef suet that has been broiled.	80% Lean Ground Chuck (cooked) = 10.0
Bloody/Serumy	An aromatic associated with blood on cooked meat products. Closely related to metallic aromatic.	USDA choice Strip Steak (cooked) = 5.5
Liver	Aromatics associated with cooked organ meat/liver.	Grilled beef liver = 6.0
Metallic	The impression of slightly oxidized metal, such as iron, copper, and silver spoons.	The Lid of Dole Canned Pineapple Juice Can = 6.0
Stale	The aromatics characterized by lack of freshness.	Quaker Quick Oats (cooked) = 4.0 Mama Mary's Pizza Crust = 4.5
Brothy	A general term for aromatics associated with juices from cooked seafoods, meat and/or vegetables.	Unsalted Swanson Chicken Broth = 3.5
Butyric	Aromatics reminiscent of baby vomit; is sour and cheesy.	Kraft Shredded Parmesan Cheese = 5.5

*****Definitions and references listed were modified from *Adhikari et al. (2011).*

For this study, the first day of the panel was a 90-minute orientation session to introduce the panelists with different raw or cooked meat samples. List of aroma attributes perceived by the panelists was generated as well. Then, the panel completed 1-2 days of evaluation, in which the consensus method was used. The panelists smelled and evaluated the meat samples individually, and then the panel leader guided a discussion to come out a consensus score for each attribute perceived in the meats. Ten aroma attributes were evaluated, including meaty overall, meaty beef, meaty poultry, brown/roasted, bloody/serumy, liver, metallic, stale, brothy, and butyric (Table 2.1). A 0-15 scale with 0.5 increments was used where 0 means no intensity and 15 means extremely high intensity.

The preparation of the cooked meat samples was the same as in the preference ranking test. For each meat sample, three ½ inch cubes were served in a covered medium snifter at room temperature. All of the samples were labeled with random, three-digit blinding codes.

RESULTS AND DISCUSSION

First Trial of the Raw Meats Preference Ranking Test

Most dogs did not finish the preference ranking test with the raw meat treatment in the first trial. Two out of twelve dogs extracted the raw meats from the puzzle toys, and only one dog consumed the meats. The rest of the dogs showed low or no interest in the raw meats. Some dogs turned their backs on the puzzle toys with meats right after sniffing all the meats. Others sniffed around the testing space or the researcher for the whole time. Still others sat at the corner or hid behind the researcher after the first sniff of the raw meats, and did not go back to sniff or explore the meats again. When the researchers took out the raw meats from the puzzle toys and handed them to the dogs, most dogs moved their heads away from the meats.

This result was surprising as opposed to the myth that dogs inherited carnivorous traits from their ancestor wolfs. The dogs participated in this study were naïve with meats. They were only fed with kibbles and have never tried any meats before the test. If the preference for meat is innate in dogs, the dogs would have eaten the raw meats at the first time they were exposed to meats. However, most dogs were indifferent to raw meats and did not eat the raw meats in the first trial of this study. Our result suggested that dogs were not genetically inherent to prefer eating meats.

Completion of Preference Ranking Procedure

The preference ranking procedure was viewed as complete when a dog picked and consumed the meat in a puzzle toy for all of the five meat samples. More than half of the dogs were able to complete the preference ranking procedure for both raw meat (second trial) and cooked meat treatments (Figure 2.2).

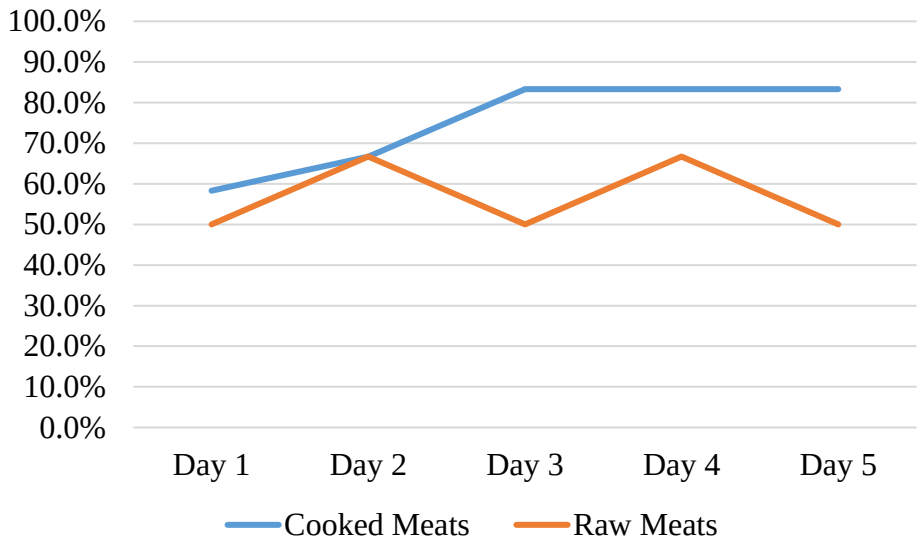

Figure 2.2 Completion rate of preference ranking test for raw meat and cooked meat treatments. Twelve beagle dogs were used during the test.

Over the 5-day period of testing, the completion rate showed an increasing trend and reached the highest of 83.3% for the cooked meat treatment, while the competition rate of the raw meat treatment fluctuated between 50% and 66% (Figure 2.2). All of the dogs sniffed five different meat samples in the toys before making their preference ranking. Some dogs made their five choices right after sniffing the toys for the five consecutive days of testing. Others only picked and ate two or three meats out of the five samples for several days. The others showed no interest in all of the five types of meat.

The increasing completion rate for the cooked meat treatment may result from how the dogs adapted to and processed the ranking procedure. The dogs relied merely on the aroma of meats to make their preference ranking for the first time (day 1). However, the dogs could count on their experience and memory of meat aromas and flavors afterward, if they ate the meat samples on the first day of the study. Their interests in meat samples may have increased because of the pleasant aromas or flavors they had on the first day. Thus, the dogs would be more willing to pick and eat the meat samples. This was observed in the current study wherein some dogs only consumed two out of five cooked meats on the first two days, but they consumed all of the five cooked meats for the last three days.

Some dogs showed low or no interest in meats and did not complete the test. Dogs not completing the test may have been distracted by the test environment, food neophobia, and/or sensory properties of meats. Distraction behaviors were observed during the study, which included sniffing and circling around the testing space, and jumping and climbing to play with the researchers. Sometimes, male dogs were distracted by the scents that other dogs left in the room. In that case, the dogs would sniff around the area and urinate during the test. The behavior of

urination was not surprising; previous research proposed that urine marking happened when dogs were exposed to new or unfamiliar places or objects (Kleiman, 1966).

Some dogs may have neophobia as they refused to try new food compared to their regular diet. Neophobia is the fear or avoidance of new things or new objects presented, also called "fixation of food habits" (Bourgeois et al., 2006). Dogs that participated in this study consumed kibbles as their main diet every day; therefore, the introduction of various meats was new to the dogs and could result in neophobia. Although some studies illustrated that dogs ate the same diet for a long time often display enhanced preferences for other diets (Ferrell, 1984; Griffin et al., 1984), other research reported the fixation of foods in puppies (Kuo, 1967), and long hesitation when first introduced to a new diet as adult dogs (Callon et al., 2017). Neophobia in animals could be overcome if they were exposed to new food repeatedly. A study of cats found that neophobia disappeared after presenting a novel food for three days (Bradshaw, 1986). This may also explain the results mentioned before, where some dogs could not complete the ranking test but were able to consume all five meats on the last three days of the study.

Dogs, that were naïve to meats, did not show a strong interest in either raw or cooked meats at the first day the meats were presented. However, when comparing the first trial and the second trial for the raw meat treatment, more dogs were able to complete the test and eat the meats. The increasing rate of completion was also observed in the cooked meat treatment over the five consecutive days. These results indicated that meat-eating is not genetically inherent in dogs but is learned after frequent exposure of meats. Bhadra &Bhadra (2014) reported a similar result with free-ranging dogs, where the preference for meat was not found in pups but in adult dogs. Their suggested that dogs' preference for meat is not innate and needs to be learned as well.

Sensory properties exerted an important role in food preference for dogs, and thus the properties of meats might affect the completion rate in this study. Houpt *et al*. found that aroma and flavor together influenced canine preferences for meats in a two-bowl test. Furthermore, anosmic dogs (dogs without the sense of smell) had a reduced ability to discern different meats (Houpt *et al*., 1978). Given that raw meats had weaker aromatics than cooked meats, dogs might find raw meats less attractive and diminish interest in selecting/eating the meats. This could explain the lower completion rate of raw meat treatment compared to the cooked meat treatment (Figure 2.1). However, aroma should not be the only sensory factors that affected the completion rate, flavor and texture may have an impact as well.

Length of Preference Ranking Procedure

Generally, all of the dogs spent less than 5 minutes to complete the ranking procedure for both raw meats and cooked meats. This result was consistent with a previous study with dog treats preference ranking (Li *et al*., 2017). In the cooked meat treatment, the total time taking decreased considerably throughout the 5-day testing (Figure 2.3). In contrast to the time dogs spent on the first day, the dogs took 1/3 to 1/5 the time on their last day for the cooked meats ranking procedure.

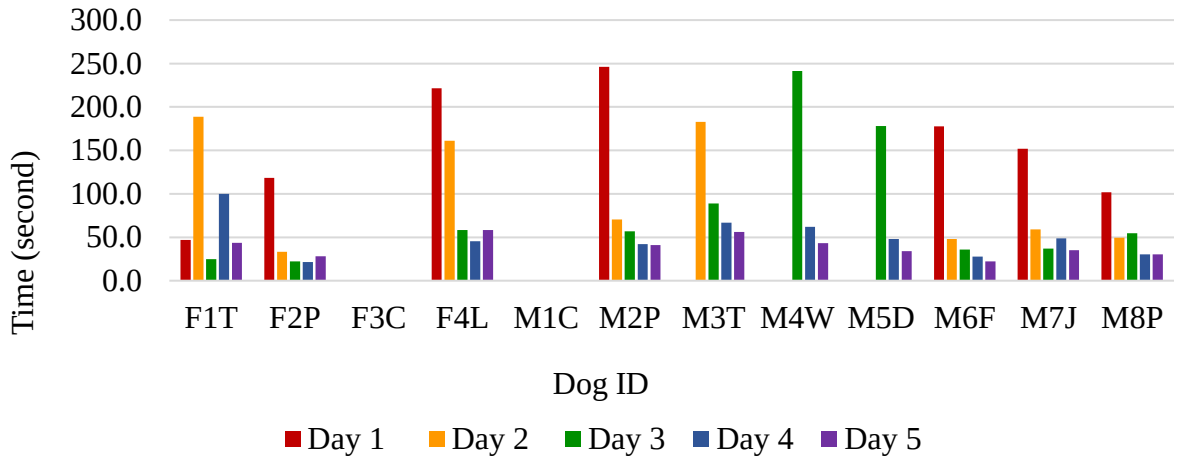

Figure 2.3 Total time taken for the dogs to complete the ranking procedure for cooked meats. Zero second of total time indicates that the dog did not complete the test.

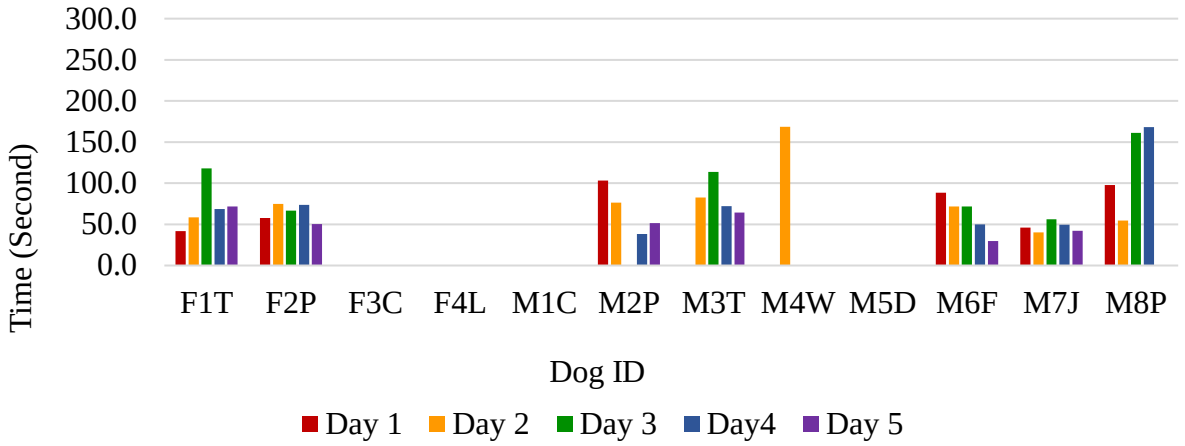

Figure 2.4 Total time taken for the dogs to complete the ranking procedure for raw meats. Zero second of total time indicates that the dog did not complete the test.

The decrease in time could be contributed to adaptation, skills development, and experiences. After the first two testing days, the dogs were adapted to the testing environment and the testing process. Fewer exploratory behaviors such as sniffing and looking around the test area were observed. In addition, the dogs reacted faster to the cues (for example, point to the toys) from the researchers to start the ranking process. On the other hand, the dogs developed their own skills to extract the meats from the toys. This is not surprising as the development of skills was seen in a previous study, where some dogs flipped the toys upside down to remove the foods in the toys, and the others grabbed the toys with their mouth then dropped them onto the floor to force the food fallen out (Li *et al., 2017).* Both of the above actions were seen in this study, in addition, rolling/tumbling the toys back and forth to fall the meats out was observed as well. Last, the more characteristics the dogs were exposed to, the faster they could complete the test. On the first day of the study, the dogs completed the ranking procedure based on limited aroma information. However, after the dogs tasted the meats on the first day, flavor and texture of the meats were recognized. The

abundance of sensory hints, aroma, flavor together with texture, may help the dog to identify different meats easily and thus make their ranking decisions faster.

The reduction of time taken was not obvious in the raw meat treatment (Figure 2.4). The different pattern of total time taken between two treatments was expected, since the cooked meat ranking test was conducted first followed by the raw meat treatment. The dogs were more comfortable with the testing space and the procedure; therefore, they did not spend much time exploring the test environment nor interacting with the researchers. Most dogs were able to focus on the ranking procedure whenever the testing started for the raw meat treatment.

Preference Ranking Order

Dogs showed a preference for beef over chicken and pork for both cooked and raw meats (Table 2.2). Lamb was intermediate and was not significantly preferred over other meats. This result was similar to previous studies where dogs preferred fresh beef over lamb, chicken and horsemeat (Lohse, 1974), and cooked beef was preferred in comparison to lamb, and horse (Houpt *et al*., 1978).

Table 2.2 The rank order of dog preference for raw and cooked meat (1- the most preferred, 5- the least preferred).

Treatment	Types of Meat				
Raw (n=34)	Beef	Chicken	Lamb	Pork	Turkey
	2.4[a]	3.5[b]	2.8[ab]	3.9[b]	2.4[ab]
Cooked (n=45)	Beef	Chicken	Lamb	Pork	Turkey
	2.3[a]	3.3[b]	3.0[ab]	3.5[b]	3.0[a]

** Within a row, samples with different letters were significantly different ($p<0.05$).*
*** n: number of dogs completed the preference ranking test*

The slight preference difference compared to the previous research could be due to the methodology and the breed of dogs. Most studies used a two-bowl test as preference testing method,

and failed to test all the sample combinations. The preference ranking procedure adopted in this study was able to show more comprehensive results, where dogs' preferences for five different meats were all included and without conformity effect of time. The preference for meats may be different because of the breeds of dog, Zanatta et al., (2017) illustrated Basset Hounds were the most selective and Labradors were the least selective in food preference tests. It is important to note that our study was conducted with a small number of laboratory dogs, the preference ranking results may be different for household dogs because of a more complex dietary history for each dog and versatile testing room settings.

Descriptive Analysis for Meats

The trained panelists perceived seven and nine aroma attributes for the raw and cooked meat samples, relatively (Figure 2.5). Raw beef and raw lamb had similar aroma profiles, in which meaty overall, meaty beef, bloody/serumy, and metallic were detected by the panelists. Raw lamb received the highest intensity scores of bloody/serumy and metallic among the meats. Raw chicken had a similar aroma profile to raw turkey but the intensities for the attributes were lower. Raw pork differed from other meats with the presence of stale and butyric aroma but the absence of bloody/serumy aroma.

Cooked beef had the most complex aroma profile with the highest scores of meaty overall, meaty beef and brown/roasted, and slight aromas of liver and metallic. Cooked lamb had a similar aroma profile to cooked beef but the intensities for the attributes were lower. In addition, a stale aroma was detected in cooked lamb. Cooked chicken, turkey, and pork displayed a less complicated aroma profile with low intensity of all the attributes detected. The complexity of the aroma profile could be one of the factors that affect dogs' preference toward cooked meats. Cooked

beef with the most complex aroma profile was preferred more by dogs, while cooked chicken and pork had a less complex aroma profile were the least preferred meats.

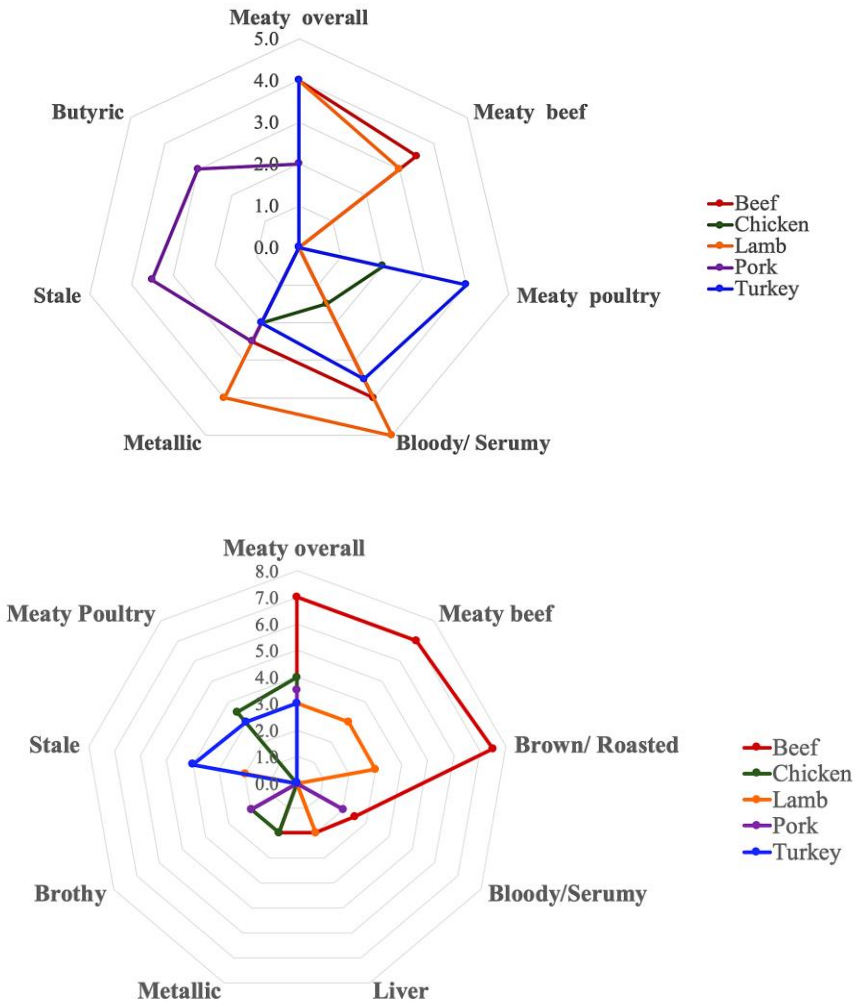

Figure 2.5 The aroma profiles of different raw meats (top) and cooked meats (bottom). A 0-15 point scale with 0.5 increments was used where 0: no intensity and 15: the highest intensity score.

Aroma intensities of the meats may affect the dogs' preference for meats. In both raw and cooked meat treatment, beef with higher intensity scores for aroma attributes was the most preferred meat. It is possible that the higher intensity of aroma may be a stronger trigger for food

preference selection comparing to the meats with weaker aroma. However, the previous study showed that the differences in intensity among odors did not affect how dogs differentiate foods (Basque et al., 2019). That is, dogs did not make their decision for preference merely by aroma intensity; other factors probably aroma characteristics play an important role in their preference

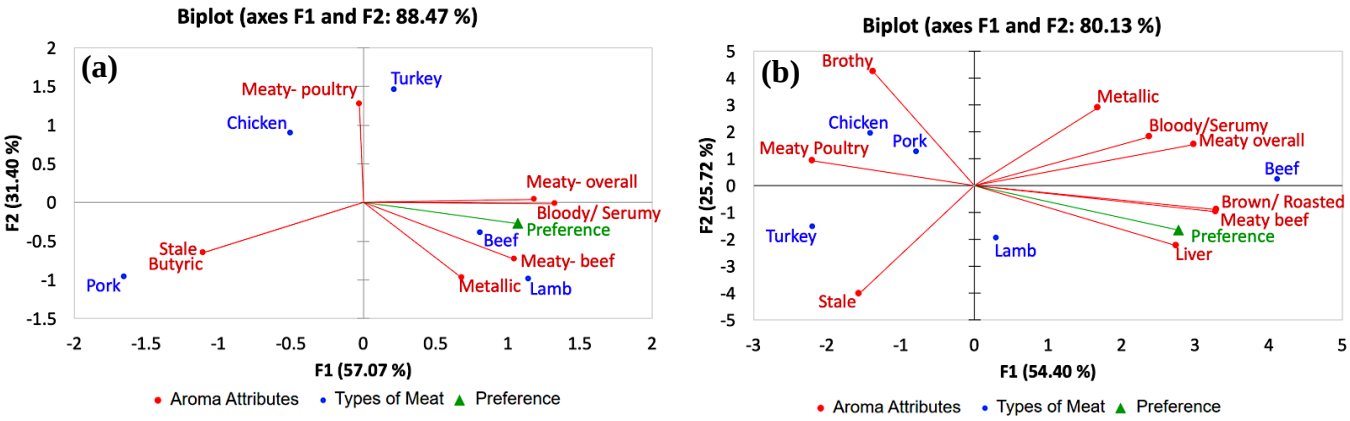

Figure 2.6 Principal component analysis (PCA) of aroma attributes for raw meats (a) and cooked meats (b). Dog preferences for meats was included as supplementary variables.

Principal component analysis (PCA) was conducted in order to understand the relationship between meat samples and their aroma characteristics, and how the results related to dog preference for meats (Figure 2.6). The PCA bi-plots showed that the meat samples were separated into different quadrants. In the plot for raw meats, chicken and turkey clustered on the top and were highly correlated to meaty poultry aroma. Beef and lamb were located on the bottom right quadrant and were correlated with the aroma of meaty overall, bloody/serumy, meaty beef, and metallic. Pork was distinct from other meats and characterized by stale and butyric aroma. The distribution of cooked meats on the PCA bi-plot was different from the raw meats, beef located on the top right quadrant was highly correlated to meaty overall, brown/roasted, and liver aroma. Chicken and pork, lay on the left side of the plot, were characterized by brothy and meaty poultry aroma. Turkey was positioned close to chicken and pork but separated by stale aroma. Lamb lay

near the center of the bi-plot which indicated that it did not strongly related to any aroma attributes, this was because lamb received lower intensity scores for most attributes.

Dogs' preference toward meats was added to the PCA bi-plots as supplementary variables. The preference for raw meat was driven by bloody/serumy, meaty overall, meaty beef, and metallic aroma, while the preference for cooked meat was driven by brown/ roasted, meaty overall, meaty beef and liver aroma (Figure 2.6). The drivers of liking toward the meats were slightly different between the raw and cooked treatment. It is interesting to note that bloody/serumy and metallic aroma were not highly associated with the dogs' preference for cooked meats but in raw meats. Brown/roasted aroma in the cooked meats was probably resulted from the Maillard reaction, in which the products from the reaction may induce dogs' liking for meats. In general, meaty overall was highly correlated to dogs' liking for both raw and cooked meats, and could be the driver of dogs' preference for meats.

Our results suggested that dogs preferred meats with higher meaty overall and meaty beef aroma. In contrast, meats with stale, butyric, broth, and meaty poultry aroma were less preferred. The technique of associating dog preference data with sensory characteristics had been seen in a previous study (Koppel *et al*., 2015) to examine dog preference for fiber inclusion kibbles. This technique has not been used frequently because most research used a paired preference test to measure pet preference; wherein, the cost of comparing multiple combinations may be a limitation (Di Donfrancesco *et al*., 2018). The preference ranking procedure was able to provide preference information for more samples at a time (comparing to traditional two-bowl test), by associating with descriptive data, drivers of liking for the preference could also be interpreted which may be a useful tool to explore food preference from pets.

CONCLUSION

The preference ranking method proposed by Li *et al*. (2017) was used in this study to validate dog preference for meats. More than 50% of the dogs were able to complete the preference ranking procedure with initial guidance from researchers. Dogs preferred beef over chicken and pork regardless of raw or cooked meats were served. This was in accord with the previous research (Lohse, 1974) where beef was preferred over chicken, lamb, and horsemeat (when served with fresh meat cubes). The consistency of the results proved that the preference ranking method was reliable in testing various meats with different forms. Aromatics of raw and cooked meats were evaluated with a human descriptive panel, in which high intensities of meaty overall and meaty beef aroma were found in both raw and cooked beef. In addition, bloody/serumy and brown/ roasted aroma were characterized in raw and cooked meats, respectively. These attributes may be the intrinsic factors that affect dog choices for meats. Overall, this study showed that dogs' preference for meat was not innate but may be acquired through learning. In addition, the study validated the preference ranking method using various meats and found out that meaty overall, bloody/serumy, and brown/roasted aroma could be drivers of liking for dog preference toward meats.

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Chapter 3 - Generating Consumer Terminology to Describe Emotions in Pet Owners and Their Pets

ABSTRACT

Emotions are one of the factors that affect consumers' choices and behaviors toward products. However, there have been limited studies discussing the emotions of pet owners and pets (as perceived by their owners). The objectives of this study were to generate emotions terminology from both pets and pet owners and to investigate body languages and signs perceived by pet owners related to pet emotion. Four focus group sessions were conducted. Two focus groups were designed for dog owners and two for cat owners. Each group was consistent of 5-7 participants. During each session, the participants were asked to provide activities that they share with their pets. Next, the participants voted on two positive and two negative activities to serve as situational backgrounds for providing how they and their pets feel when sharing specific activities. These collected emotions were sorted and classified to form lists of emotions terminology. Lists of 38 and 55 emotion terms were generated for dogs and cats, respectively. In addition, lists of 33 and 62 emotion terms were created for dog owners and cat owners, respectively. Examples of emotion terms for dogs included excited, happy, anxious, and embarrassed. For cats, calm, happy, angry, and fearful were some examples of the emotion terms. Further studies are needed to validate the generated lists of emotions and to explore these words in terms of pet food consumption and during other situations to understand acceptance/rejection behaviors. Overall, this study provided a general view of emotions experienced by pet owners and their pets, which may be helpful for the pet food industry to understand the pet food consumers further.

INTRODUCTION

According to the American Pet Products Association, $72.56 billion was spent on pets in the U.S within the year 2018, in which pet food was the largest category accounted for 42% of the expenditure. The pet food market is growing, with an estimated 4.5% annual rate (APPA, 2018), which makes this market very competitive. Therefore, understanding pet food consumers becomes key to the competition. There are two aspects of pet food consumers- pets that consume the products, and pet owners who make the purchase decision. Palatability tests are often used to understand pets as pet food consumers (Aldrich and Koppel, 2015; Tobie et al., 2015; Griffin, 2003). Consumer research has investigated factors that affect pet owners' perception of a product and their purchase decision (Di Donfrancesco et al., 2018; Koppel et al., 2017; Boya, Dotson &Hyatt, 2015; Tesfom &Birch, 2010). However, consumer research focused on pet owner and pet emotions was not found.

Mood/emotion is one of the most important personal factors that affect purchase decision for food (Khan & Hackler, 1981). This may apply to the factors that affect pet owner's purchase decision for pet food as well. Consumers often base their purchase decision unconsciously on emotions (Lehrer, 2006). Therefore, understanding pet owners' and pets' emotions would be helpful to decipher those unconscious purchase decisions in pet food. It is important to note that pets' emotions should not be ignored, as pets can use body language and vocalization to express their emotions (Turner, 2017; Konok et al., 2015). This may further affect how pet owners make their decisions. Research that addressed pet emotions focused two issues: the definition of emotion and the existence of emotion in animals.

To date, there is no universal definition of emotion among scientists. From an evolution standpoint, emotion can be seen as a process for animals to respond to stimuli, which helps to

avoid harm or obtain resources (Boissey et al., 2007; Rolls, 2000; Panksepp, 1994). This is known as basic emotion theory, in which these basic emotions, also called "primary" emotions or "fundamental" emotions, contributed to survival (Matsumoto & Ekman, 2009; Boissey et al., 2007; Plutchik, 1980) and existed across a wide range of vertebrate species (Panksepp, 1982; Ekman, 1992; LeDoux, 1996; Boissy et al., 2007). Examples of basic (primary) emotions included, fear, disgust, anger, sadness, surprise, enjoyment, etc. (Prinz, 2004; Ortony & Tuner, 1990). Other emotions which are not directly related to survival can be classified as secondary or complex emotions; for example, guilt, shame, and jealousy. Several secondary emotions in animals were reported by their owners in previous studies (Harris & Prouvost, 2014; Morris et al., 2008; Parr, 2001).

Since animals cannot talk, understanding pet emotions can be challenging. The behavioral investigation, physiological measurement, and collection of owners' perceptions are the common methods used to understand pet emotion. Facial action coding system for dogs and cats were developed to investigate how they reacted to emotional stimuli (Bennett et al., 2017; Caeiro et al., 2017). Other research has illustrated the relationship between behavioral cues (e.g. tail movement, body movement, vocalization) and observed emotion including jealousy in dogs (Harris & Prouvoust, 2014; Abdai et al., 2018),and general emotions in cats and dogs (Arahori et al., 2017; Crowell-Davis, 2007). Physiological measurement such as heart rate can be an indicator of pet emotion as well (Kuhne et al., 2014). Another alternative method to study pet emotions is collecting information from pet owners, who share their lives with pets. This method not only helps to investigate pet emotions but also examines how human attributes emotions to their pets (Arahori et al., 2017; Martens et al., 2016; Konok et al., 2015; Tami & Gallagher, 2009; Morris et al., 2008). Since all the methods mentioned above merely focus on a specific aspect, a combination

of different methods is often adopted by researchers to gain a more comprehensive overview of pet emotion. In order to understand pet emotions to a broader extent, focus group sessions were conducted to gather insights of pet emotions from the owners in this study. The objectives of the study were (a) to generate emotions terminology from both pets and pet owners, and (b) to investigate body languages and signs perceived by pet owners related to pet emotions.

MATERIALS AND METHODS

Recruitment

The recruitment for this study included two steps: online screening and phone-call screening. An online screening questionnaire was designed to target male and female pet owners over 18 years old, who own dogs/cats, feed them, are close to them from an emotional standpoint, and are confident about their knowledge to their pets. Consumers in the Center for Sensory Analysis and Consumer Behavior (Manhattan, KS, U.S.A.) database were contacted via email and asked to complete the online screening through RedJade software (RedJade ®, Redwood Shores, CA, U.S.A.). Respondents who qualified in the online screening, and were willing to participate in the study, received a phone call for further screening regarding language and communication skills. Eligible participants were asked to briefly describe a typical day in their pet's life during an approximate 5-minute phone-call to ensure people are comfortable speaking, and have a general understanding of their pets. Respondents who could not clearly express about their pets were disqualified at this point. Once the respondents passed both online and phone-call screening, they were qualified to participate in a 90-min focus group. Eleven dog owners and thirteen cat owners were qualified and participated in this study (Table 3.1)

Table 3.1 Focus group participant Demographics

Number of Participants	N=24	
	Dog owners (n=11)	Cat owners (n=13)
Gender		
Male	4	4
Female	7	9
Age		
18-35	4	4
36-50	4	3
51 or older	3	6
Pet Ownership		
Have only one dog/cat	7	3
Have two or more dogs /cats	4	10

Homework

All of the pet owners were asked to complete an assignment before the session. Participants were asked to form a collage with at least seven pictures and at most four words, which represented how they feel when spending time with their pets. Drawing and sketching of pictures were also encouraged in this homework. The purpose of the homework was to prepare participants for the focus group session by thinking and working on the given subjects related to the focus group topic (Henderson & Hairston, 2014). Additionally, for this particular research, the homework also helped to visualize emotions, feelings, and mindsets, which were usually too abstract to be expressed. On the day of the focus group session, the pet owners brought their homework and shared their collages as part of the interaction in the study.

Focus group

In order to generate emotion terms from pet owners and their pets, four 90-min focus group sessions were conducted- two for dog owners, and two for cat owners. The intention of the focus group was to collect pet owners' insights, and understand how they interpret pet emotion by pet's body languages. The 90-minute focus groups took place in a conference room at the Center for

Sensory Analysis and Consumer Behavior at Kansas State University (Manhattan, KS, U.S.A.). Each of the group consisted of 5-7 participants, a moderator, and an observer. The moderator was highly trained to do focus group discussions. The role of the moderator was to led the focus group discussions and guided the participants to complete the activities in the study. The observer took notes of the discussions and helped in the logistics, such as providing materials for activities and recording the discussions. There were four phases in each focus group session, which included an introduction, a warm-up, and two discussions (Figure 3.1).

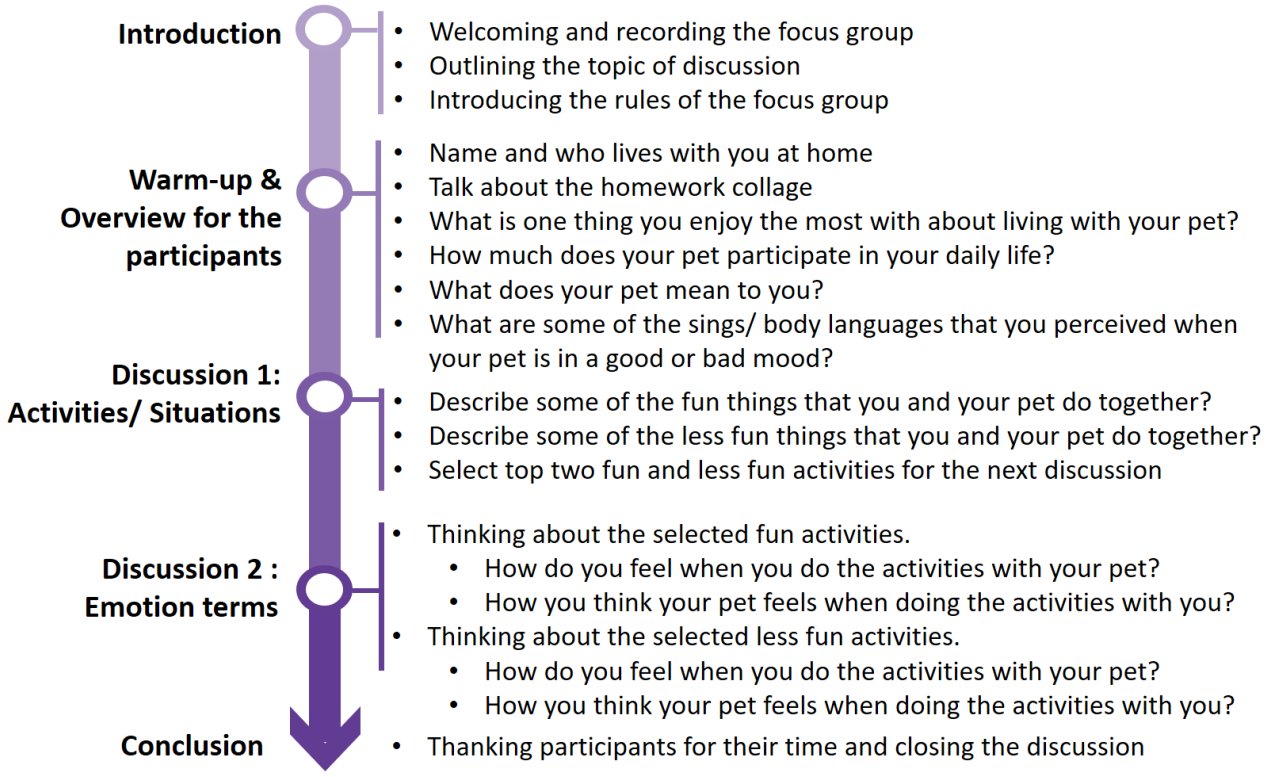

Figure 3.1 Flowchart of the focus group session

The session was initiated with an introduction and a warm-up, in which the homework was discussed. In the introduction phase, the participants were informed about the facility setting that the session was video recorded, the objective of the discussion, and rules for the focus group. The rules were set to make the discussion fluent and to enable all the participants to express their

opinions without interruptions. Some examples of the rules included “Avoid any side conversations.” “There are no wrong answers.” “Please talk one at a time.”. Participants introduced themselves and talked about their homework in the warm-up phase. Other questions were asked after the introduction, such as “What is one thing that you/your pets enjoy the most about living with your pets/you?” and “What does your pet mean to you?” Body languages and signs which pet owners perceived as indicators for pet’s emotions were also discussed in this phase. After giving each participant a sufficient time to express his or her opinion, the moderator organized the group discussion along with two exercises and several predesigned topics.

In the first exercise, participants were asked to provide some of the fun/positive things that they and their pets do together; and on the other side, some not so fun/ negative things that they and their pets have to do together. After a decent number of activities were generated and listed, the moderator consolidated the list on an easel pad. For example, “take pets to the vet” and “give medication” were combined as “vet/medication”, since these two activities shared a similar concept. The pet owners then voted for two positive and two negative activities that resonated the best for them. The top two voted positive and negative activities were selected and used as “situational” backgrounds for the second exercise.

The second exercise was the main process of emotion terminology generation. Based on the first exercise, the moderator wrote down each of the voted positive/negative activity on separate easel pads, then asked the participants to think about how they feel and what do they think their pets feel when doing the certain activity together. The participants would need to write down 8-10 emotions for themselves and for their pets according to the selected activities on sticky notes (one emotion term per sticky note). The sticky notes with emotion terms were then attached to the easel pad with the corresponding activity. Once the terminology generation process for both pet

and pet owner were done for one activity, the moderator went through the emotion terms with the participants to review and clarify some ambiguous ones. At the same time, the participants could explain further on the terms and provide examples to make the terms clear. For example, one cat owner said he feels "Zen" when sitting and relaxing with his cat. The definitions of "Zen" as an adjective are "suggestive of the teachings or practice of Zen Buddhism" and "having or showing qualities (such as meditative calmness and an attitude of acceptance) popularly associated with practitioners of Zen Buddhism" (Merriam-Webster Dictionary, 2019). Neither of the definitions was directly related to emotion. However, when the owner explained the "Zen" he experienced was related to calming, harmony, and peaceful, the Zen emotion could then be understood as calm or peaceful. The clarification of the emotion terms was crucial for this study to ensure the terms were well comprehended, and to serve as a reference for further data analysis. During the discussion, the moderator also asked the participants about the body languages that made them believed their pets have a particular emotion.

Data Analysis

After the sessions, data collected from the homework, group notes, and activities were compiled to further investigate emotion terms for pet owners and their pets. Video recordings were also reviewed to gather the information that may have been omitted from the notes. These data were sorted into four categories: dog owners, dogs, cat owners, and cats. Emotion terms were identified through the review of notes and recordings, and were then refined if needed. During the refining, negative emotion terms mentioned in fun/positive activities were excluded, and vice versa. The exclusion ensured that the terms were related to the activities straightforwardly, since a conjecture of the terms could be misleading as not all the terms got clarified during the focus group discussions. Another criterium used in the refining process was that the terms have to meet

the definition of emotion. A definition discussed by Coppin & Sander (2016) was adopted in this study, where an emotion is an "event-focused, two-step, fast process consisting of (1) relevance-based emotion elicitation mechanisms that (2) shape a multiple emotional response (i.e., action tendency, automatic reaction, expression, and feeling)". For example, "lazy" was excluded as an emotion since it is a condition of unwilling to work or use the energy rather than an emotional response. The definition (Coppin & Sander, 2016) was selected because it fit the generation of emotion terms in this study, assuming that shared activities between pet owners and pets created a relevance-based emotion elicitation mechanism and that the focus group discussions could obtain the aspect of the multiple emotional response. Other terms that were removed from emotion terms could be discourse marker, exclamation, or incomplete sentence; for example, "wow", "yuck", "oh-no", and "why me?".

In order to visualize and analyze the refined emotion terms for pet owners and pets, word clouds were generated (WordItOut.com, Enideo, Bristol, UK). Word clouds of the positive and negative emotion terms from pet owners and pets were created, respectively. For each word cloud, word size varied with frequency of the terms. Word clouds have been used as a research tool for preliminary analysis for qualitative data (Shahid et al.,2017; Jemison et al., 2014; McNaught & Lam, 2010). This technique enabled the researchers to highlight general patterns quickly and to grasp common themes in large text content (McNaught & Lam, 2010).

A consolidation of the refined emotion terms was done to generate lists of emotion terms for dog owners, dogs, cat owners, and cats. To begin the process, terms with higher frequency, according to the word cloud, were picked out as the "mother terms", and the rest of the terms were viewed as "daughter terms". If the daughter terms had a similar meaning to a mother term, the daughter terms would be integrated into the mother term. For example, "joy" and "pleasure",

sharing the same meaning with “happy”, were combined into “happy” because happy was more frequently mentioned by dog owners. If a term did not share similar meaning to others, the particular term would be its own mother term. The benchmark of the similarity between the terms was based on not only the definition of the words in the dictionary (e.g. Merriam-Webster.com), but also the explanations/ clarifications within a focus group discussion. For example, “care-free” was defined as *having no worries or troubles* in Merriam-Webster.com, while the participant mentioned that she did not need to worry about things and could relax while sitting with her cats. Therefore, “carefree” was consolidated into “relaxed” in this study. Even though the definitions from dictionaries and focus group discussions were both used during emotion terms consolidation, discussions in the focus group carried more weight as they brought out the participants’ insights behind the terms.

RESULTS AND DISCUSSION

How owners feel when spending time with their pets

During the homework discussion, positive and negative emotions were experienced by both cat and dog owners when spending time with their pets. Positive emotions such as happy, loved, companioned, comfortable, and relaxed were experienced a lot when the owners spend time with their pets. One cat owner said, “My cats make me feel warm and happy.” Another dog owner mentioned, “They bring us happiness for sure!” Most owners felt that their pets always try to make them, and their family feel comfortable. One cat owner shared her experience “When my daughter had a toothache, our cat was the first one to cheer her up and to comfort her.” Pet owners felt loved and companioned because they considered their pets as family members. Arahori et al. (2017) showed that more than 60% cat and dog owners view their pets as family members, in which cat

owners considered it less often than dog owners. The different perception was not found in this study; however, how owners anthropomorphized their pets was consistent with the previous study. It is interesting to note that "secured/safe" was only mentioned by dog owners but not cat owners. One dog owner mentioned, "In the sense of family, my dogs make me feel secure." Others said their dog makes them feel safe. One possible reason that "secured/safe" was not mentioned by any cat owners may be the different domestication of cats and dogs. Dogs were domesticated as guards and as hunters for the hunting-gatherers, while cats were domesticated as mousers (Driscoll et al., 2009). The ability of dogs to guard for human may provide their owner with a sense of security, which the cat owners may not experience.

Negative emotions were experienced by both cat and dog owners, but were less mentioned than positive emotions in all the focus group sessions. Annoyed, irritated, angry, and worried were reported with different situations the pet owners had. One cat owner with several farm cats felt irritated and frustrated "When you left them for a few seconds, you will get a new pile of kittens." Another cat owner felt irritated and annoyed when her cat was loud and vocal; others agreed that it was sometimes annoying when their cats were constantly meowing. On the other hand, dog owners felt worried, annoyed, and angry, mainly because of their dogs being naughty and playful. One dog owner said "I have to keep my finger crossed when I come home, hoping my dog did not make a mess. And if I found out he did something he should not do, I felt annoyed." Overall, most owners did have some negative emotions when spending time with their pets, but only a few of them put those elements in their collage homework. Positive feelings and experiences may be long-lasting in pet owners' mind compared to the negative feelings. When probing pet owner's feelings toward their pets, it is important to keep in mind that the gathered emotions might be skewed toward positive emotions. This could be overcome with specifying subtopics for the participants

to focus when working on the homework and the guidance of moderator during discussions. The purpose of the homework was to prepare the participants to be familiarized with the focus group topic prior to the sessions in this study. Therefore, the skewness was acceptable because the homework already initiated the pet owners to think about the topic.

Other feelings that pet owners brought up frequently during the discussion were responsible, connected, and healthy. One cat owner with two cats said, “They have increased my sense of responsibility. I have to make sure they are comfy, and they have food and clean water. They almost feel like my kids!” On the other hand, the connected feelings for the owners were more than the connection between pets and their owners. A cat owner mentioned, “I am not a very social person, but my cats is a connection for me with other cat owners and society.” The feelings of responsibility and connection could be contributed to the role pets play in owners’ lives. When the owners viewed their pets as family members, to be specific, as their kids, the owners may feel responsible as they have to take care of their pet children. Previous research suggested pets could be social lubricant for owners because they help the owners to interact with other people (Veevers, 1985). This may explain the feeling of external connections for the pet owner.

Emotion Terms for Pet Owners

In general, cat owners provided more emotion terms than dog owners did (Figure 3.2 and Figure 3.3). Positive emotion terms frequently mentioned by both cat and dog owners were happy, joy, and relaxed, while the negative emotion terms were anxious, worried, annoyed, and nervous.

Figure 3.2 Emotion word clouds of dog owners including positive emotion terms (left) and negative emotion terms (right). The larger the word is, the more frequent it was mentioned.

Figure 3.3 Emotion word clouds of cat owners including positive emotion terms (left) and negative emotion terms (right). The larger the word is, the more frequent it was mentioned.

Some positive emotions were only discussed by the dog owners, these included proud and surprised. One dog owner shared, “I feel proud when people say my dogs are cute!” The surprised emotion has resulted from perceptions of the ability dogs have. “I am always surprised and amazed by how high my dog can jump onto the counter.” stated from one of the dog owners. Conversely, there were some terms discussed by the cat owners only; for example, warm, peaceful, and serene. It is interesting to note that some emotions were mentioned by both cat and dog owners; however the relative frequency of the terms in each cloud was quite different. For instance, cat owners seemed to experience more “calm” emotion than dog owners, while dog owners tended to have more “excited” emotion than cat owners.

The different property of the terms may be explained by the activities pet owners shared with their pets. The generation of emotion terms in this study was based on the situational background selected in the first exercise of focus group discussions. Fun/ positive activities for cat owners and their pets were mostly static, such as relaxing and napping. Nevertheless, dog owners shared more lively activities with their dogs, such as running and hiking. This may indicate that emotions of the owner are somewhat related to the activities they shared with their pets, and the interaction between pet and pet owner.

Regarding the negative emotions the pet owner experienced, the terms generated were more consistent between cat and dog owners compared to the positive emotion terms. This could be contributed to the fact that not so fun/negative activity “going to the veterinarian/medication” was widely experienced among all of the cat and dog owners. Going to the veterinarian/medication worked well as an elicitation for generating negative emotion terms, as this cue produced a great amount of terms. Most owners were anxious, nervous, and worried when going to the veterinarian with their pets, guilty and sympathetic were also experienced by the owners as well. It may be

worth mentioning that guilty was reported more by cat owners than dog owners, and similar emotion "sorry" was only brought up by cat owners. One cat owner said, "I feel bad and sorry bring my cat to the vet because she does not like that". One should not jump to the conclusion that dog owners felt less guilty for bring their pet to the veterinarian, since the frequency of the word mentioned did not wholly equal to how much or how strong the emotion was experienced.

Other negative emotions that were mentioned a lot by the cat owners were sad, annoyed, stressed, and frustrated, which were mostly resulted from going to the veterinarian, except annoyed. Annoyed was experienced by cat owners when they have to vacuum/clean their house. An owner with two cats stated, "It is annoying when you have to vacuum the room with their constant meowing." On the other hand, dog owners mentioned additional negative emotions such as angry, frustrated, and sad as well. Exhausted and tired were only mentioned by dog owners, which were mainly due to the activity "grooming/bathing". One dog owner said "It was exhausting when my dog does not want to bathe, getting him to bathe is a 3-hour process." This result was not surprising because cats usually could groom themselves, and cat owners do not need to bathe their pets as often as dog owners do, in which they might not experience much exhausted/tired emotions as frequently as dog owners.

Emotion Terms for Dogs and Cats

Similar to the results of the pet owner's emotion terms, cat owners generated more terms than dog owners did (Figure 3.4 and Figure 3.5). Several positive and negative emotions mentioned by both cat and dog owners were happy, excited, loved, energetic, anxious, scared, and confused. All the owners believed that they could interpret emotions from their pets through facial expression, sign, and body languages. These signs and body languages mentioned by the owners will be discussed in the later section.

Figure 3.4 Emotion word clouds of dogs including positive emotion terms (left) and negative emotion terms (right) perceived by the owners. The larger the word is, the more frequent it was mentioned.

Figure 3.5 Emotion word clouds of cats including positive emotion terms (left) and negative emotion terms (right) perceived by the owners. The larger the word is, the more frequent it was mentioned.

Most owners thought their pets were happy, excited, and energetic when running, walking or playing. One dog owner described her dog as being excited and energetic as "He is always ready to be a part of it, whether it is hiking, running, or anything." Negative emotions, anxious and scared, were mostly coming from the experience of going to the veterinarian. One cat owner said "My cat is scared when going to the vet because she will try her best to hide or sneak under the table." Another dog owner mentioned, "She is shaky when we go to the vet so I know she is scared or anxious." The owners observed confused emotion in all sorts of activities, such as going to the veterinarian, clipping nails/ bathing (for dogs), and house cleaning/ vacuuming (for cats). Confused emotion could result from communication between pet owners and their pets. One dog owner thought her dog might be confused because she offered treats to her dog when doing things, the dog did not like (e.g., clipping nails). Another cat owner mentioned, "My cats were probably confused why I ignored their meowing and kept doing things they do not like (vacuuming)." Other emotions that were frequently perceived in dogs were eager, comfort, joy, nervous, fear, and shame. Conversely, relaxed, content, warm, irritated, sad, and stressed were frequently recognized in cats. Most of these emotions share the same concept as other terms mentioned earlier. For example, joy and happiness shared the same concept of a pleasant feeling. It is worth noting that owners who owned two or more cats reported jealous as negative emotion they observed, while jealous was not mentioned by any dog owners in this study. "When I put my face closer to one of my cats, the other one will scoop him off from my face." stated by one cat owner. This result was different from a previous study, in which more dog owners than cat owners reported jealous emotion (Morris et al., 2008). The demographic difference (Table 3.1) may account for the result. Since there were more cat owners with two or more cats compared to the dog owners; jealousy between two animals may be easier to spot, and thus being reported more frequently.

Pet owners created various emotion terms for pets based on their interpretation. The most frequently noticed and mentioned emotions were similar between cat and dog owners, including happy, excited, loved, energetic, anxious, scared, and confused. Happy, loved (affection), anxious and scared (fear) have been perceived in dogs and cats by their owners in previous studies (Morris et al., 2008; Konok et al., 2015; Martens et al., 2016; Arahori et al., 2017), and were classified as primary emotions based on Morris et al. (2008). Other primary emotions reported in Morris et al. (2008) research were sadness, curiosity, interest, surprise, anger, and disgust, in which sadness, curiosity, and anger were found in our study as well with a lower frequency. Comparing to other previous studies, pet owners in this study did not mention interest, surprise, and disgust as pet emotions they perceived. This could be explained by the difference in methodology. Most studies provided a list of predetermined emotions with yes/no questions in a questionnaire for owners to evaluate if the pets ever have a specific emotion (Morris et al., 2008; Konok et al., 2015; Martens et al., 2016). By doing so, the owners will have to focus on particular emotions that the researchers are interested in, and are forced to think/evaluate every listed emotion. However, for the purpose of generating emotion terminology, focus group discussions with open-ended questions were used to provoke extensive thinking. This method helps to understand pet emotions as a whole view, but specific emotions may not be evaluated. In addition, the given situational cues may affect the emotion terms mentioned by the owners. Activities shared between pet owners, and their pets were served as situational cues when generating emotion terms. These cues aided the owners to come up with emotions they perceived in their pets, yet the cues could limit the terminology generation as some emotions may not be observed in a particular activity.

Most of the less frequent mentioned pet emotions were secondary emotions, for example, pride, cozy, embarrassed, and guilt (based on the classification from Morris et al., 2008). This was

consistent to the previous studies, in which cat and dog owners perceived more primary emotions than secondary emotions in their pets (Konok et al., 2015; Morris et al., 2008). Though secondary emotions were not mentioned as frequently as primary emotions in this study, the generated terms supported the existence of secondary emotions in non-primate species (Buck, 1999; Morris et al., 2008)- specifically cats and dogs. Jealousy was reported as the most frequent perceived secondary emotion in several species, including dogs, horses, birds, and cats (Morris et al., 2008). However, there was not much peered-review literature focusing on jealous emotion in cats; while some studies have shown that dogs exhibit jealous emotion and behavior toward different subjects (Abdai et al., 2018; Harris & Prouvost, 2014; Morris et al., 2008). Our results indicated that jealousy emotion might exist in cats, in which further study is needed for justification. Overall, several secondary emotions were recognized in cats and dogs in our study; nevertheless, additional researches perhaps behavioral investigation and neurological study are required to validate the existence of these emotions in cats and dogs.

Conceptual Emotion Terms for Pet Owners and Their Pets

The collected emotion terms discussed in the previous sections were consolidated based on the definition of emotion (Coppin & Sander, 2016) and descriptions from focus group sessions. Terms with a similar meaning were combined, and lists of conceptual emotion terms for dog owners, cat owners, dogs, and cats were created (Table 3.2-Table 3.5). There were 33 and 62 conceptual emotion terms listed for dog owners and cat owners, respectively. Cat owners might have experienced more emotions in contrast to dog owners. However, this result could result from the different number of participants as there were more cat owners than dog owners in this study.

Table 3.2 Conceptual emotion terms of dog owners

Positive	Negative
amazed	ambivalent
amused	angry
calm	anxious/nervous
content/satisfied	concerned
energetic	disappointed
excited	fearful/scared
fun	embarrassed
happy	exhausted/tired
interested	frustrated
loved/loving	guilty
nurturing	impatient
playful	protective
proud	sympathetic
relaxed	sad
surprised	stressed
	unhappy
	unnerved
	worried

In regards to the property of emotion, cat owners reported more positive than negative emotions (Table 3.3), while dog owners had more negative than positive emotions (Table 3.2). Regarding pet emotions, 38 and 55 conceptual emotion terms were perceived in cats and dogs, respectively (Table 3.4 and Table 3.5). Assuming all the pet owners had the same ability to perceive and express emotions in their pets, the result may indicate that cats showed more emotions than dogs. Considering the property of emotions, similar amount of positive and negative emotions was observed in cats, while more negative emotions were interpreted in dogs.

Table 3.3 Conceptual emotion terms of cat owners

Positive	Negative
amazed	afraid/fearful
amused	alone
appreciative	angry
calm/harmony	anxious/nervous
careful	cautious
caring	confused
close	discouraged
comfortable	doubtful
companioned	embarrassed
complete	empathetic
connected	frustrated
content/satisfied	guilty
curious	hopeless
energetic	hurt/painful
excited	indifferent
fun	jealous
free	mean
focused	regretful
friendly	reluctant
generous	sad
giddy	scared
goofy	sorry
happy	stressed
humorous	sympathetic
important	uncomfortable
interested	upset
intrigued	worried
loved/loving	
nurturing	
mindful	
playful	
quiet	
refreshed	
relaxed	
safe	
warm	

Table 3.4 Conceptual emotion terms of dogs

Positive	Negative
competitive	aggressive
content/satisfied	annoyed
curious	anxious/nervous
determined	confused
eager	disappointed
energetic	discomfort
excited	distrustful
free	dominant
goofy	embarrassed
happy	fearful/scared
inquisitive	frustrated
loved	guilty
proud	horrible
relieved	impatient
trust	lonely
	painful
	possessive
	sad
	sorry
	stressed
	unhappy
	unnerved
	worried

When comparing the conceptual emotions between pet owners and their pets, several emotion terms existed in both humans and animals. For example, content/satisfied, energetic, excited, happy, anxious, embarrassed, frustrated, fearful...etc. were reported for both dogs and dog owners. To be specific, most of these common emotions found in pet owners and pets were primary emotion. This was in line with a general agreement that primary emotions (e.g., joy, fear, sadness) can be found across a wide range of vertebrates (Panksepp, 1982; Ekman, 1992; LeDoux, 1996;

Boissy et al., 2007). The resemblance of the emotion terms between owners and their pets may be contributed to the method of terms generation, anthropomorphism, and emotional attunement.

Table 3.5 Conceptual emotion terms of cats

Positive	Negative
calm	alert
comfortable	angry
companioned	anxious/nervous
competitive	bored
confident	cold/indifferent
content/satisfied	combative
crazy	confused
curious	defensive
dependent	desperate
determined	distrustful
energetic	exhausted
engaged	fearful/scared
entertained	homesick
excited	hostile
fascinated	hurt/painful
focused	impatient
free-spirited	panicked
fun	resistant/reluctant
happy	sad
loved/loving	shamed
loyal	sick
peaceful	stressed
playful	unaware
proud	uncomfortable
relaxed	unnerved
safe/secure	upset
warm	worried

As for whether or not cats and dogs have the same emotion cognition as humans do is debatable, different assumptions are needed before discussing the resemblance of the emotion terms found in the study. Assuming cats and dogs have same emotion cognition as their owners do; then it would be reasonable that similar emotion terms were reported, since the situational cues used during terms generation are the same for owners and pets. This suggested that pets and their owners may have experienced similar emotions when being exposed to the same situation. In addition, when sharing the same activity, behavior and emotion of the owners could affect their pets' emotion. Previous researches have shown that dogs can recognize and discriminate human emotions (Albuquerque et al., 2016; Turcsán et al., 2014; Ruffman & Morris-Trainor, 2011), however, how they attune their emotion to human emotion was not clearly investigated. Martens et al. (2016) suggested that attunement of emotions occurred mutually between pets and their owner. Specifically, emotional attunement between pet owners and their pets is positively correlated to the attachment bonding (Martens et al., 2016; Hare &Woods, 2013). As the participants in this study were all screened for being close to their pets, the resemblance of the emotions resulted from attunement between owners and pets should not be surprising.

If we assume cats and dogs do not have a comparable emotion cognition as human do, some of the emotions observed may be the result of human projection. The process of the projection and how people attribute human traits to animals was often called anthropomorphism (Wynne, 2007). A great number of owners anthropomorphized their cats or dogs as family members, especially as kids. It is possible that the owners projected their own emotions to their pets, as they viewed the pets as kids that were able to experience the same emotions they had. Previous studies have shown that pet owners attributed emotions to their pets (Morris et al., 2008; Martens et al., 2016; Konok et al., 2015; Arahori et al., 2017; Su et al., 2018). To be specific,

primary emotions were more commonly attributed to pets comparing to secondary emotions (Morris et al., 2008; Martens et al., 2016; Konok et al., 2015; Su et al., 2018). This may explain the result where the common emotion terms found in pet owners and pets were primary emotions, probably through anthropomorphism. Also, cat and dog owners who had stronger bonding with their pets attributed emotions to companion animals more frequently; these emotions included joy, sadness, surprise, shame, jealousy, compassion and disappointment (Martens et al., 2016). In general, our study was in line with previous studies in which pet owners tended to attribute emotions to their pets, and it could result in anthropomorphism.

Vocalization and Body Language Related to Pet Emotion

Several signs relating to emotions from cats and dogs were collected (Table 3.6 and Table 3.7). In general, body movements, tail movements, facial expression, and vocalization were the signs mentioned the most by pet owners. When cats were in a good mood, purring, kneading (paws moving against something), and napping were often perceived by the owner. Cats purred in all sorts of situations, and this may be interpreted by the owners differently (Yeon et al., 2011; Tuner, 2017). A great number of owners said that their cats purred when being relaxed. Additionally, cats were more willing to expose their belly and to get close to their owner when being in a good mood. Nuzzling/ rubbing was reported as a body language for positive mood. Previous studies suggested that cats rubbed against their owners' leg to show friendly greeting (Crowell-Davis, 2007; Turner, 2017). It is possible that the owners took the act of friendly greeting as an expression of cats being in a good mood. However, other research illustrated that cats rubbed against objects for scent marking (Feldman, 1994). How the cat owners interpreted signs/ body languages was somewhat similar to the previous studies, but the owners may also anthropomorphize some body languages, which probably has little to do with emotion.

Table 3.6 Emotion-related signs/body languages of cats

Positive emotion	Negative emotion
Purring	High pitch meowing
Kneading (paws moving)	Do not allow people to get close/ hold
Napping	Nipping (biting)
Being close to the owner	Arched back
Walking and rubbing against people	Hiding from owner
Making couples of turn	Being clingy
Belly exposed	Being aggressive
Nuzzling/ rubbing	Tail switching
Wide-eyed	Walking away
Tail language	Wide-eyed

On the other hand, high pitch meowing, back arching, and nipping were reported as signs for negative emotions in cats. Interestingly, tail movement and wide-eyed facial expression were observed in cats, no matter they were in positive or negative emotions. Some owners mentioned that their cats widen their eyes whenever they were scared, excited, happy, or surprised. Most cat owners have seen their cats moving their tail to express their emotions; however, the owners did not specify how different the tail languages were between various emotions. Crowell-Davis (2007) stated that cats straight up their tail in a "tail-up" position when approaching to human as a friendly fashion. Nonetheless, it seemed like no research had discussed the association between the tail language of cats and cat's emotion.

Dogs tended to behave more active when they are in a good mood; signs such as tail wagging, jumping/ bouncing, whole body wagging, licking, and cuddling were observed by their owners (Table 3.7). On the contrary, dogs were less active when having a negative emotion, laying down, sitting in the corner, and hiding were some of the frequently perceived signs. The

relationship between the active levels and the emotions of dogs was discussed by Konok et al. (2015), where joy and anger entailed the highest activity. Tail wagging was generally reported as a sign of excitement (Tami & Gallagher, 2009) which was agreed by the dog owners in this study. Ears movement was also mentioned as emotion-related body languages (Table 3.p). Using ear movements as a cue was not frequent (Goodwin et al., 1997; Tami & Gallagher, 2009) because some dog breeds have floppy ears, which leads to difficulty for observation. Albeit the possible difficulty mentioned, the owners reported that dogs perked up their ears as they were in a good mood, while their ears went down when being in a bad mood.

Table 3.7 Emotion-related signs/body languages of dogs

Positive emotion	Negative emotion
Tail wagging	Ears going down
Ears perking up	No ears movement
Facial expression	Hiding
Jumping/ bouncing	Looking away/ looking down
Barking	Slinking away
Pacing in a funny way	Sitting in the corner
Whole body wagging	Pouting
Yoga position (stretching)	Hiding their face in the corner
Whining & jumping	Laying down
Waving the paw/pawing at you	Tailing down
Parading	
Picking up favorite toys	
Walking around the owner	
Licking	
Cuddling	

Barking was recognized by the owners as a vocalization sign of their dogs being in a good mood. Barking was usually viewed as an element of aggression (Tami & Gallagher, 2009), yet it was not

mentioned as a sign for negative emotion (aggressive) in this study. Perhaps other body languages for negative emotion occurred more often than barking, thus the owners did not bring up the sign during discussions.

To sum up, pet owners were able to perceive several behaviors from their pets, and the results were generally consistent with previous studies. However, these behaviors were discussed under the aspects of positive and negative pet emotions only, specific emotions corresponding to the behaviors were still not fully explored. Further studies using physiological and psychological approaches, with the involvement of pet owners and animal behaviorists/ veterinarians, are needed for validation.

Limitations of the Study

This study generated lists of initial emotion terminology from both cat and dog owners, and investigated behaviors related to emotion through owners' perception. The results provided a basic idea of what emotions had pet owners and their pets experienced in daily situations. However, several limitations of the study should not be ignored. First, the number of participants included in the study was small. How the pet owners experienced emotions and the interpretation of pet emotions vary from people to people. The results from these participants may not be representative enough for a large population nationwide or worldwide. Second, the background of the participants may have an impact on the results. As mentioned in the methodology, the pet owners who participated in the study were screened of: being close to their pets. It is possible that some emotion terms were not discussed because of the exclusion. In addition, the effect of anthropomorphism from the owners who are not so close to their pets may be less, and thus how they perceive pet emotions could be different. There was also a time limitation for focus group discussion, which may limit the information collected. Furthermore, the information of pets collected in focus group

discussions was reported by the pet owners. Comparing to a laboratory observational study with pets, the owners may not observe every emotions and signs of their pets. To solve the limitations mentioned above, nationwide and worldwide surveys should be conducted. By doing so, more participants will be included in which a broader range of information could be collected. Additionally, a nationwide survey can serve as a tool to validate the preliminary results in this study.

CONCLUSION

Emotion terms to describe pet owners and their pets were generated in this study Lists of 38 and 55 emotion terms were generated for dogs and cats, respectively. Furthermore, lists of 33 and 62 emotion terms were created for dog owners and cat owners, respectively. These emotion terms may be the ones to communicate the best with pet owners because they resonate among the owners. A resemblance of the terms between pet owners and pets was found in this study, which could be a result of anthropomorphism as discussed in other studies (Morris et al., 2008; Martens et al., 2016; Konok et al., 2015; Arahori et al., 2017; Su et al., 2018). Pet owners were able to read signs/body languages of their cats and dogs related to positive/negative emotions, in which the interpretation was consistent with previous studies (Crowell-Davis, 2007; Tami & Gallagher, 2009; Turner, 2017). Overall, this study provided a general view of emotions experienced by pet owners and their pets, which may be helpful for the pet food industry to understand the consumer further. More research is needed to validate the emotion terms generated.

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Chapter 4 - Acceptance and Emotion Response of Dog Treats Manufactured with Sorghum and Different Sources of Binders

ABSTRACT

The pet food industry is vigorously growing and constantly testing different ingredients to meet the needs of consumers. Trends toward healthy and functional food were rising in the pet food industry. Sorghum has the potential to be a novel ingredient in pet food because of its health properties. A previous study showed that acceptance of sorghum in dry dog food was similar to the control sample made with rice, corn, and wheat (Di Donfrancesco et al., 2018). However, there was no published research focused on the application of sorghum in pet treats. The objective of this study was to understand consumer acceptance and emotion responses of dog treats. Fifteen different kinds of treats were baked with three sources of crisps (rice crisp, white sorghum crisp, and red sorghum crisp) and five sources of binders (corn syrup, spray dried plasma, gelatin, albumin, and egg white). A home-use-test was conducted with 39 dog owners and their pets to evaluate overall acceptability and acceptance of appearance, aroma, and texture. In addition, emotion responses from pet owners and their pets to the treats were collected. The results showed that there was no significant difference for the owner's overall liking and the dog's liking among the treatments. Positive emotions such as content/satisfied and happy were experienced frequently by the owners when dogs consumed the treats. Dogs were eager, excited, and happy when being offered the treats. Happy and loved emotions in dogs were found to be correlated to dog's liking to the treats. Overall, treats made with sorghum exhibited similar acceptability to rice-based treats, which supported the use of sorghum in pet treats. In addition, dog owners and their dogs experienced more positive emotions than negative emotions to the sorghum-added treats.

INTRODUCTION

The pet food industry is growing rapidly within recent years, in which the estimated sales in 2018 were $30 billion dollars and a billion-dollar growth is expected in 2019 (APPA, 2018). As pets are often considered as family members, a great number of owners treat their pets as human (more accurately as kids). The humanization of pets plays an important role in pet food product development, in which human food trends are being applied to pet foods. Trends in healthy and natural have become popular in both human food and pet food. A rising trend of functional pet foods is also observed as an echo of human food trends (Beaton, 2018).

Sorghum originates from Northeastern Africa and is the fifth most important grain in the world where the U.S. is the largest producer (Sorghum Checkoff Program, 2016). The sorghum plant is known for its resistance to harsh climate and low water usage; thus it is considered as a sustainable crop (Medeiros et al., 2011). Previous studies have shown that sorghum is rich in anthocyanins, tannins, and vitamins that may impact human health (Awika & Rooney, 2004; Vázquez-Araújo et al., 2012). Even though these health properties were not investigated in pets, other research showed that pet foods made with sorghum had comparable nutritional quality to corn-based, rice-based, and wheat-based pet food (Alvarenga et al., 2018). In addition, the flavor profile of the sorghum-added dry dog foods was close to the control sample made with rice, corn and wheat (Di Donfrancesco & Koppel, 2017). These studies demonstrated the potential of sorghum utilization in the pet food industry.

To increase market success for sorghum included pet foods, it is essential to understand consumer's perception of the products. Consumer research focusing on sorghum-added pet food is very limited. Di Donfrancesco et al. (2018) showed that extruded dry dog food manufactured with sorghum was accepted by pet and pet owner at the same level of the control sample made

with rice, corn, and wheat. This study provides insights of acceptability in sorghum-included pet food. However, recent studies have pointed out the insufficiency to understand consumers' product experience by using merely hedonic measurement (Gibson, 2006; King & Meilselman, 2010; Ng et al., 2013). Investigating consumers' emotional responses may provide information in addition to hedonic responses (Gutjar et al., 2015; Cardello et al., 2012; Thomson et al., 2010). Several studies have demonstrated the use of emotion responses to differentiate the products and to understand consumers' perception in human food and beverage (Nijman et al., 2019; Gutjar et al., 2015; Ng et al., 2013; Thomson et al., 2010). Nevertheless, no research has been published on using emotion responses from consumers in pet food.

In order to explore consumers' perception of using sorghum as an ingredient in pet treats, a consumer study with a home-use-test setting was conducted with dog owners and their dogs. The objective of this study was to understand consumer (dog and dog owner) acceptance and emotion responses of dog treats made with various sources of crisps and binders. In addition, this study was performed to validate the emotion terminology generated in the previous chapter.

MATERIALS AND METHODS

Samples

Fifteen different treatments of dog treat were manufactured in the Grain Science and Industry laboratories at Kansas State University. These treats were made with combinations of three sources of crisp (rice, R (Cereal Ingredients Inc., Leavenworth, KS, U.S.A.); white sorghum, WS (HRFM, Kansas State University, Manhattan, KS, U.S.A.); and red sorghum, RS (HRFM, Kansas State University, Manhattan, KS, U.S.A.), five sources of binder (corn syrup, CS; spray dried plasma, SDP; gelatin, GL; albumin, AB; and egg white, EW), and other human-grade

ingredients included oatmeal (Quaker Oats Quick 1 - Minute Oatmeal, The Quaker Oats Company, IL, U.S.A.), coconut flakes (Great Value Organic Unsweetened Coconut Flakes, Wal-Mart Stores, Inc, AR, U.S.A.), corn starch (Rumford Corn Starch, Clabber Girl Corporation, IN, U.S.A.), dried blueberry (People's Grocery Dried Blueberry, People's Grocery, Manhattan, KS, U.S.A.), flaxseed (Great Value Organic Ground Flax Seed, Wal-Mart Stores, Inc, AR, U.S.A.), pepitas seeds (Hy-Vee Bulk Food Pepitas Roasted & Unsalted, Hy-Vee, Inc, IA, U.S.A.) , wheat germ (Kretschmer®,Continental Mills, WA, U.S.A.), salt (Great Value Plain Salt, Wal-Mart Stores, Inc, AR, U.S.A.), and palatant. The SDP (Innomax Porcine Plasma), GL (Pro-Bind Plus 50), and AL (Innomax MPI) were obtained from Sonac ® 76 (Maquoketa, IA, U.S.A.), and the EP (Ovabind - RSD 80) was acquired from IsoNova ® (Springfield, MO, U.S.A.). Last, CS (Light Corn Syrup, Kroger ®, OH, U.S.A.) was bought from a local grocery market. The formula and the preparations of the treats were adopted from Pezzali et al. (2019). White sorghum and red sorghum were grounded to generate smaller particle sizes prior to the production. Oatmeal, crisp, coconut flakes, corn starch, dried blueberry, flaxseed, pepitas seeds, wheat germ, salt, and palatant were mixed in a bowl, in which the binder was later added. Except CS, other binders, SDP, GL, AB, and EW, were hydrated to form syrup before usage. The combination of the dry ingredients and the binder was stirred and mixed until evenly combined. The mixture was transferred to a baking pan, pressed into a 1-inch thick sheet, and baked at 163°C for 20 minutes in a convection oven (MEA 21-93-E; Garland Commercial Industries, PA, U.S.A.). The sheet of granola was cut approximately into 2x2 cm square pieces after baking. These treats were cooled and stored in Ziploc bags (S.C. Johnson & Son, Inc.Racine, WI, U.S.A.) in a freezer at -18°C.

Subjects

Participants were recruited through the database of Center for Sensory Analysis and Consumer Behavior (Manhattan, KS, U.S.A.) via email, and were asked to complete the online screening through RedJade software (RedJade ®, Redwood Shores, CA, U.S.A.). The participants had to meet the criteria that they are dog owners above 18 years old, and their dogs do not have health problem or food allergy and are offered treats on a regular basis.

Table 4.1 Home-use-test participant demographics.

Dog owner characteristics	frequency	%
Gender		
Male	12	30.8%
Female	27	69.2%
Age		
18-34	9	23.1%
35-50	7	17.9%
51+	23	59.0%
Treat offering frequency		
Twice or more than twice every day	15	38.5%
Once every day	15	38.5%
Once every week	2	5.1%
More than two times a week	6	15.4%
2-3 times a month	1	2.6%
Dog characteristics	**frequency**	**%**
Age range		
1 year or under	3	7.7%
2-5 years	12	30.8%
6-10 years	17	43.6%
10 years or above	7	17.9%
Weight		
<10 lb.	2	5.1%
10-35 lb.	14	35.9%
35-75 lb.	17	43.6%
75-120 lb.	4	10.3%
>120 lb.	2	5.1%

Once qualified and interested in this study, the dog owners were required to attend a 15~20-minute orientation before conducting the test. During the orientation, the owners received a package of 30

three-digit coded bags of sample (in a one-gallon Ziploc bag marked with the owner's name), a questionnaire booklet, and an owner instruction packet. The owners were instructed on the testing procedures and the timeline of the study. Each participant was compensated ($75) after completing the 30-day testing when they turned in the questionnaires. Forty dog owners were qualified and included for the study, in which 39 owners completed the testing. The demographics of the participants and their dogs were shown in Table 4.1. The research was approved by the Institutional Review Board for Protection of Human Subjects (IRB #9617).

Home use test

The study was conducted in a home-use-test setting, in which the owners would need to offer the samples to their dogs in their household and answer questions regarding to the samples. The owners had to offer the designated sample to their dogs every day for 30 consecutive days, where the sample number corresponding to each day was annotated in the questionnaires. All of the 15 treatments were tested within the 30-day study, and each treatment was served for 2 consecutive days. The design of the experiment was not completely randomized, where 3 out of 15 treatments were randomly chosen to serve at the beginning (day 1 and 2), in the middle (day 14 and 15), and at the end (day 29 and 30) of the study. For example, suppose that A, B, and C were the randomly picked treatments, A, B, and C would be served to all the consumers at the beginning, in the middle, and at the end of the experiment, respectively. The reason of the design was to accommodate additional emotion questions included in the questionnaires for day 1, 15, and 30. Since the samples served on day 1, 15, and 30 were consistent among consumers, the emotion responses collected from day 1, 15, and 30 could be evaluated and compared across the consumers. The rest of the 12 treatments were randomly assigned to day 3~day13 and day 16~day 28 for each participant.

Questionnaires

Data was collected using hard copy questionnaires. Each owner would receive a questionnaire booklet with 30 days of the questionnaire. For each day of testing, questions of overall liking, dog's liking, appearance liking, aroma liking, and texture liking were included in the questionnaire. These questions were stated as "How much do you like or dislike this sample overall?", "How much do you think your dog likes or dislikes this sample?", "How much do you like or dislike the appearance of this sample?", "How much do you like or dislike the aroma of this sample?", and "How much do you like or dislike the texture of this sample?" The owners had to answer these questions on a 9-point hedonic scale, in which 1 indicated "dislike extremely" and 9 indicated "like extremely". In addition, open-ended questions were followed after the acceptance test to probe what do the owner like or dislike about the sample. Four emotion questions were included in the testing day 1, 15, and 30 to explore how the owners and their dogs feel when offering/ being offered the treats, and when the treats were consumed by the dogs.

The owners had to report emotion responses according to themselves and the dogs using check-that-all-apply (CATA) with the listed emotion terms. The listed emotions for the owner and the dog were shown in Table 4.2. There were 8-10 positive and negative emotion terms included for both dog owners and dogs. These terms were selected from the results of pet owner and pet emotion terminology (Chapter 3). The selected terms, related to pet feeding, were discussed in the focus group discussions from the previous study (Chapter 3). It is important to notice that "anticipated" was not considered as an emotion for dogs in the result of Chapter 3; however, this term was included in the questionnaire as it was mentioned frequently by the dog owners as a positive sign for dogs according to their feeding experience.

Table 4.2 Emotion terms for dog owners and dogs.

Dog owners		Dogs	
Positive	Negative	Positive	Negative
Amused	Angry	Anticipated	Afraid/ Fearful
Content/Satisfied	Anxious/ Nervous	Content/ Satisfied	Anxious/ Nervous
Excited	Concerned	Curious	Confused
Energetic	Disappointed	Eager	Disappointed
Happy	Fearful/ Scared	Energetic	Discomfort
Proud	Exhausted/ Tired	Excited	Unhappy
Relaxed	Frustrated	Happy	Sad
Surprised	Sad	Loved	Worried
	Unhappy	Proud	
	Worried	Relieved	

Statistical Analysis

All data analysis was conducted by XLSTAT version 2017.4.46756 (Addinsoft, New York, NY). Analysis of variance (ANOVA) with Tukey's HSD multiple comparison tests were used to determine statistically significant ($P < 0.05$) differences among treatments in terms of liking scores. The main effects of crisp and binder source, and their interaction were analyzed with ANOVA as well. Chi-squared tests were conducted to analyze the emotion responses from dogs and dog owners. The Chi-squared test helped to understand which emotions discriminated among the tested samples. Principal coordinate analysis was carried out to visualize the relationships among selected dog emotions and dog's liking. Dog emotions included in the principal coordinate analysis were selected if the accumulative frequency count of the terms were greater than 10, as the lower frequency count of the variables would skew the result.

RESULTS AND DISCUSSION

Acceptability of Sorghum Dog Treats with Different Binder Sources

The acceptance scores among the samples for overall liking, dog's liking, appearance, and aroma ranged approximately from 6.0 to 7.1, which indicated these samples were liked slightly to moderately by the dog owners (Table 4.3). The acceptance scores for texture were lower (5.8-6.5 average range) compared to other modalities among the samples.

Table 4.3 Mean scores of acceptability among fifteen treatments. (1: dislike extremely, 5: neither like or dislike, 9: like extremely)

Sample	Overall liking	Dog's liking	Appearance	Aroma	Texture
R+CS	6.42±1.52	7.10±1.25	6.49±1.52	6.62±1.41 [a]	6.15±1.64
R+SDP	6.53±1.74	7.15±1.66	6.36±1.52	6.19±1.42 [ab]	6.33±1.57
R+GL	6.06±1.65	6.68±1.98	6.13±1.51	5.76±1.59 [b]	5.91±1.63
R+AB	6.50±1.69	7.08±1.81	6.58±1.43	5.90±1.70 [ab]	6.55±1.50
R+EW	6.11±1.79	6.68±1.72	6.16±1.55	6.06±1.42 [ab]	5.87±1.68
WS+CS	6.60±1.56	7.16±1.58	6.56±1.45	6.56±1.40 [ab]	6.22±1.53
WS+SDP	6.59±1.38	7.15±1.46	6.13±1.59	6.44±1.41 [ab]	5.95±1.59
WS+GL	6.26±1.78	6.82±2.05	6.33±1.50	6.00±1.69 [ab]	6.24±1.51
WS+AB	6.32±1.71	6.92±1.83	6.42±1.53	6.03±1.71 [ab]	6.21±1.48
WS+EW	6.13±1.60	6.90±1.69	6.09±1.57	5.92±1.65 [ab]	5.85±1.78
RS+CS	6.19±1.65	6.77±1.85	6.23±1.58	6.33±1.48 [ab]	5.95±1.81
RS+SDP	6.50±1.36	7.14±1.20	6.29±1.49	6.16±1.47 [ab]	6.24±1.60
RS+GL	6.35±1.57	6.92±1.79	6.38±1.45	6.10±1.51 [ab]	6.14±1.68
RS+AB	6.33±1.45	7.09±1.63	6.46±1.49	5.88±1.66 [ab]	6.08±1.68
RS+EW	6.31±1.77	6.66±1.90	6.01±1.69	5.97±1.45 [ab]	5.92±1.67
Mean±STDEV	6.35±1.63	6.95±1.72	6.31±1.54	6.13±1.56	6.11±1.64

** Within a column, samples with different letters were significantly different ($p<0.05$).*
*** Sources of crisp: rice, R; white sorghum, WS; red sorghum, RS; sources of binder: corn syrup, CS; spray dried plasma, SDP; gelatin, GL; albumin, AB; and egg white, EW*

Most consumers disliked the crumbliness and the hardness among the samples, but the acceptance of the texture was still tended to be slightly liked by the owners. Consumer acceptance among samples was not significantly different for overall liking, dog's liking, appearance, and texture (Table 4.3). However, a significant difference was found in the acceptance of aroma, in which the treat made with rice crisp and corn syrup (R+CS) was the most liked. Though the interaction effect between crisp and binder on the acceptability was found not significant, main effect of the binders on appearance liking and aroma liking was significant (Table 4.4). The main effect of binder may indicate that the different acceptance of aroma for the treats was due to the source of binder but not the source of crisp. The effect of crisp and binder variables and their interaction on the overall liking and dog's liking was not significant. This can be explained by the inclusion of limited number of participants (small sample size) in this study.

Table 4.4 ANOVA results for the effect of crisp and binder variables and their interaction on acceptability.

Acceptability	Source	d.f.	SS	MS	F-*value*	*p-value*
Overall liking	Crisp	2	0.62	0.309	0.116	0.891
	Binder	4	19.62	4.906	1.842	0.118
	Crisp × Binder	8	12.87	1.609	0.604	0.775
Dog's liking	Crisp	2	1.09	0.543	0.183	0.832
	Binder	4	25.87	6.468	2.183	0.069
	Crisp × Binder	8	12.43	1.554	0.524	0.839
Appearance	Crisp	2	0.85	0.424	0.179	0.836
	Binder	4	22.95	5.737	2.430	**0.046***
	Crisp × Binder	8	10.61	1.327	0.562	0.810
Aroma	Crisp	2	2.16	1.080	0.452	0.636
	Binder	4	57.30	14.326	5.998	**< 0.0001****
	Crisp × Binder	8	11.58	1.447	0.606	0.773
Texture	Crisp	2	2.073	1.036	0.387	0.679
	Binder	4	19.874	4.968	1.853	0.116
	Crisp × Binder	8	21.652	2.706	1.009	0.427

Note: Factors with significant effect was highlighted (*: $P < 0.05$; **: $P < 0.01$).
d.f.: degrees of freedom, SS: sum of squares, MS: mean squares

Treats manufactured with corn syrup as a binder had higher acceptance of aroma compared to treats made with gelatin, while the difference was not significant in other samples made with sorghum crisp. It is worth noting that treats with lower aroma acceptance scores were not disliked but were slightly liked by the owners. Most owners commented "It smelled like rotten eggs", "odd smell", and "I don't like the smell", when being asked what they dislike about the treats made with rice crisp and gelatin. The lower aroma acceptance of treats made with gelatin could be explained by its origin from pork or beef skin and bones (Choi & Regenstein, 2000), which may generate an unpleasant animalic smell as mentioned by the consumers. On the other hand, a great number of consumers liked the aroma of treats made with rice crisp and corn syrup, examples of the comments included "smells great", "had a neutral smell", and "had a pleasant smell". These comments indicated that a neutral or pleasant smell of a treat plays an important role in leveraging consumers' acceptance in aroma.

Excluding the main effect of binder, the aroma liking between different crisp sources (white sorghum, red sorghum, and rice) was similar. This was not surprising as previous research showed that dry dog food with different sorghum fractions had a similar volatile profile (Di Donfrancesco & Koppel, 2017). Regarding the acceptance of dogs and dog owners, treats made with white sorghum crisp and red sorghum crisp had similar liking score. This result was consistent with a previous study where kibbles made with whole sorghum was accepted at the same level of the control sample made with corn, rice, and wheat (Di Donfrancesco et al., 2018). Overall, the result indicated that sorghum might be an alternative crisp source in dog treats. Moreover, this study supported the potential for increased use of sorghum in pet food industry as discussed by other studies (Alvarenga et al., 2018; Di Donfrancesco et al., 2018).

The overall liking of the treats was highly correlated with appearance liking (r= 0.77), dog's liking (r= 0.76), texture liking (r= 0.73), and was slightly correlated with aroma liking (r= 0.58) (Figure 4.1). This can be supported by the comments from the owners when being asked what they like about the samples. Most owners mentioned that they liked the size, the inclusion of fruit and nuts, wholesome/healthy ingredients, and similar to a human snack for treats with higher overall liking scores (7-9). The results were consistent with the previous study in which the appearance of dry dog food influenced dog owners' overall liking the most (Di Donfrancesco et al., 2014). Dog's liking also plays a vital role in pet owners' overall liking of a product. Some owners said that one of the reasons they like the treats was because their dogs liked/enjoyed the samples. Boya et al. (2015) found that palatability of pet food is one of the most critical choice criteria for the pet owners. Overall, consumer acceptance was correlated with the liking of sensory characteristics. This phenomenon was not only found in pet food studies but also human food and non-food studies (Di Donfrancesco et al., 2014; Sun et al., 2015; Herrera-Corredor et al., 2007)

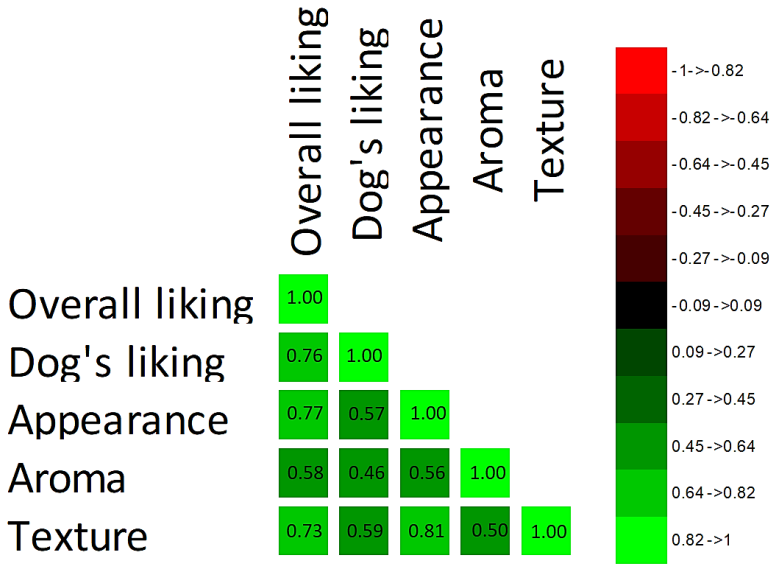

Figure 4.1 Pearson correlation matrix with correlation coefficient (r) of the acceptance for the pet treats. All of the values are different from 0 with a significance level alpha=0.05.

Emotion Responses of Dog Owners

The frequency of emotion checked by the dog owners when offering a sample to their dogs, and when their dogs ate the sample were displayed in Figure 4.2.

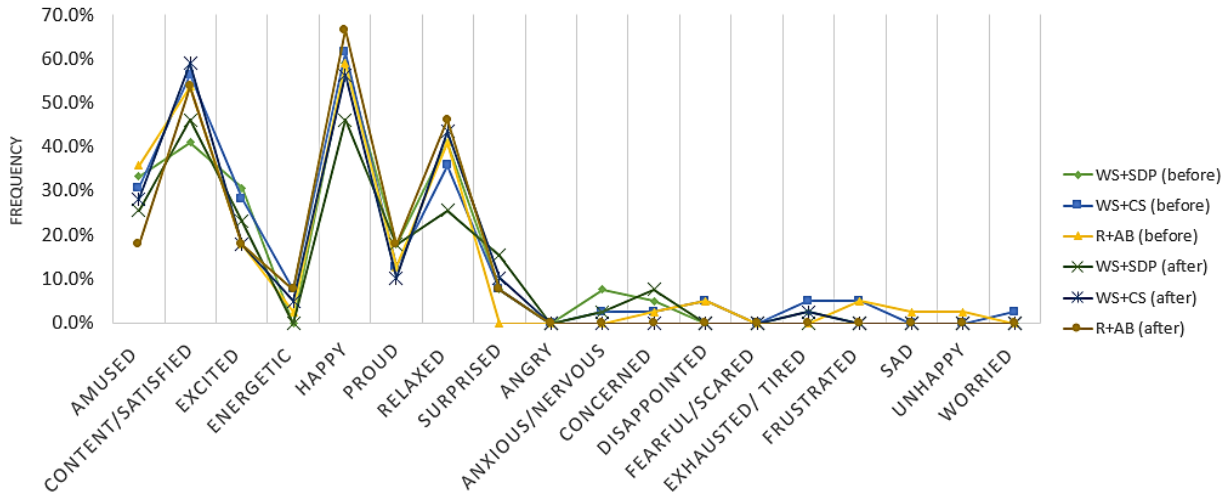

Figure 4.2 Frequency distributions of pet owners' emotions before and after the treats were consumed by their dogs. Treats evaluated were treatment with white sorghum and spray dried plasma (WS+SDP), white sorghum and corn syrup (WS+CS), and with rice and albumin (R+AB).

Lower frequency was reported for negative emotions compared to positive emotions. When offering treats to the pets, most owners felt happy, content/satisfied, or relaxed. These emotions were also experienced by the owners when their pets ate the treat. The owners felt less content/satisfied and more anxious/nervous, when they offered the sample made with white sorghum crisp and spray dried plasma (WS+SDP) to their dogs (Figure 4.2). This may have resulted from the testing order as sample WS+SDP was the first treat the owners gave to their dogs. It is possible that the owners were uncertain of the sample, which made the owner nervous about

giving the treat to their pets. The order effect could explain the lower frequency in relaxed and higher frequency of concerned as well, when the dogs ate the treat. The order effect was supported by the comments from the owners, some reported that their dogs were hesitant or unwilling to eat the first served treat (sample WS+SDP). Perhaps the hesitance of dogs to consume the treats was one of the reasons for the owners to feel concerned and anxious for a specific sample. Chi-square tests of independence showed that all of the listed emotions were independent to the samples tested, whenever these samples were offered to or were eaten by the dogs. The association between these emotions and the treats was not observed with a significant level of 0.05, when these treats were offered to the pets (χ^2 (30) = 25.49, p=0.70) and when the treats were eaten by the dogs (χ^2 (20) = 20.57, p=0.42). This indicated that the listed emotions could not discriminate the samples WS+SDP, WS+CS, and R+AB. This was reasonable as WS+SDP, WS+CS, and R+AB had similar acceptance levels for overall liking, appearance, aroma, and texture (Table 4.3), which may trigger similar emotional responses from the consumers.

Previous studies have shown the ability of emotion responses/ lexicons to differentiate samples under the same product category; for example, in beer (Nijman et al., 2019), breakfast drink (Gutjar et al., 2015), blackcurrant squash (Ng et al., 2013), and dark chocolate (Thomson et al., 2010). However, emotion responses from the dog owners were not able to discriminate dog treats tested in this study. This may be due to the similarity of overall liking among the samples, since acceptability scores were found to be correlated to emotion scores (Gutjar et al., 2015; Ng et al., 2013; Thomson et al., 2010). In addition, the emotion lexicons included in the study were limited, it is possible that these terms were insufficient to differentiate samples with similar liking. Furthermore, emotions were measured by check-all-that-apply (CATA) with regard to whether the emotions were present or not, which may neglect the extent of how strong one emotion was

experienced. The owners might have experienced different degree of each emotion that could possibly discriminate the samples. Ng et al. (2013) suggested that rate-that-all-apply (RATA) being an alternative method for measuring emotion response, to solve the limitation of qualitative data, in which the extent of emotion could be collected.

In general, the listed emotion terms were able to capture how the dog owners felt during the treats offering process. However, the treats tested were not differentiated by these emotions. Perhaps more emotion terms should be included and the degree of emotions being experienced should be investigated. Emotion responses from the consumers may provide extra information for the products, yet the extent could be limited when the products are close to each other.

Emotion Responses of Dogs

Dog's emotions of being offered and consuming different samples were shown in Figure 4.3. Positive emotions were perceived more frequently by the owners in contrast to the negative emotions. Eager, happy, and excited were observed in dogs frequently when the owners offered treats to them. The pattern of emotions experienced by dogs when being offered the sample WS+SDP was different to WS+CS and R+AB (Figure 4.3). Dogs were less anticipated, eager, excited, and happy but more curious and confused when received the sample WS+SDP. This may be due to the serving order as mentioned previously, in which WS+SDP was the first served treat. The owners commented that the dogs were curious when the first sample WS+SDP was served because the dogs have never seen those treats before. On the other hand, the dogs were reported to be confused whether they should take the sample WS+SDP or not. These comments were less mentioned by the owners on the other two samples.

In addition, most owners mentioned their dogs took longer time to explore the first treat given before actually eating it. Before consuming the first served treat (WS+SDP), some dogs

mouthed the treat and dropped it out several times; others play with the treats. These behaviors might be related to the emotion of curious as the dogs were trying to figure out what the treat was. The decreased frequency of curious and confused, and the increased frequency of anticipated, eager, excited, and happy may result from the dog's tasting experience of the first sample. It is possible that the dogs had a good experience with the treats, which made them eager and excited about the later samples WS+CS and R+AB. This indication could be supported by the comments from the owners where their dogs ate the samples, WS+CS and R+AB, quicker than the first sample WS+SDP.

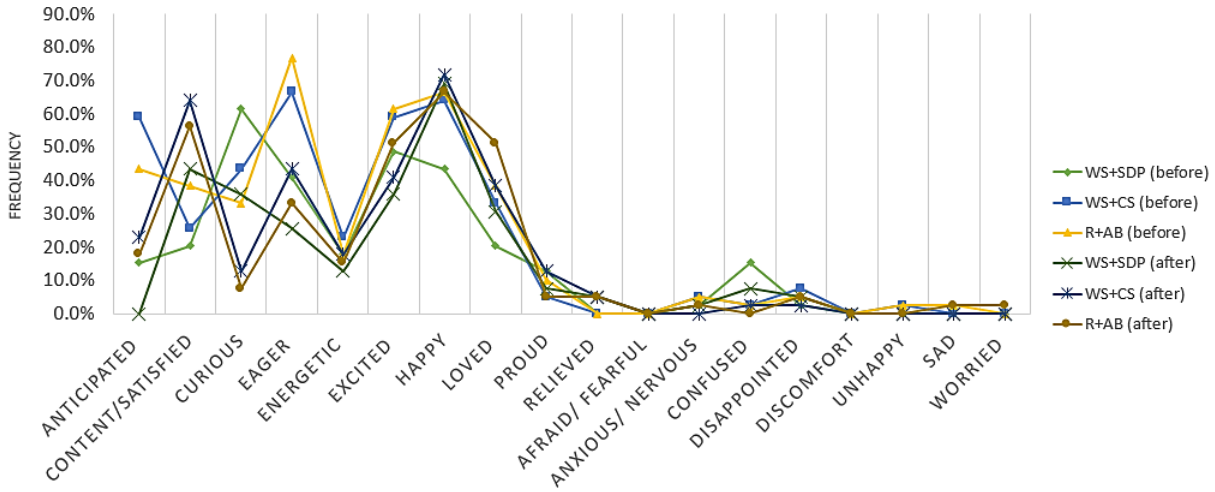

Figure 4.3 Frequency distributions of dog emotions before and after the treats were consumed. Treats evaluated were treatment with white sorghum and spray dried plasma (WS+SDP), white sorghum and corn syrup (WS+CS), and with rice and albumin (R+AB).

Content/satisfied, eager, and happy were reported the most by the owners when the dogs ate the treats (Figure 4.3). This is consistent with a previous study that dogs engaged in behaviors related to positive emotions, such as increasing tail wagging, when being offered palatable food (Travain et al., 2016). Some owners mentioned that their dogs were eager as they returned to the

owners to ask for more treats after consumed the treat. Emotions experienced by the dogs among different samples (WS+SDP, WS+CS and R+AB) were similar. The order effect was observed in some emotions such as anticipated, curious, and confused when the dogs consumed the treats. In addition, the dogs felt more content/ satisfied and loved but less excited after eating the treats compared to when they were given the treats. These results indicated that dogs were curious and confused when receiving novel food, while positive emotions may have been induced after eating the food.

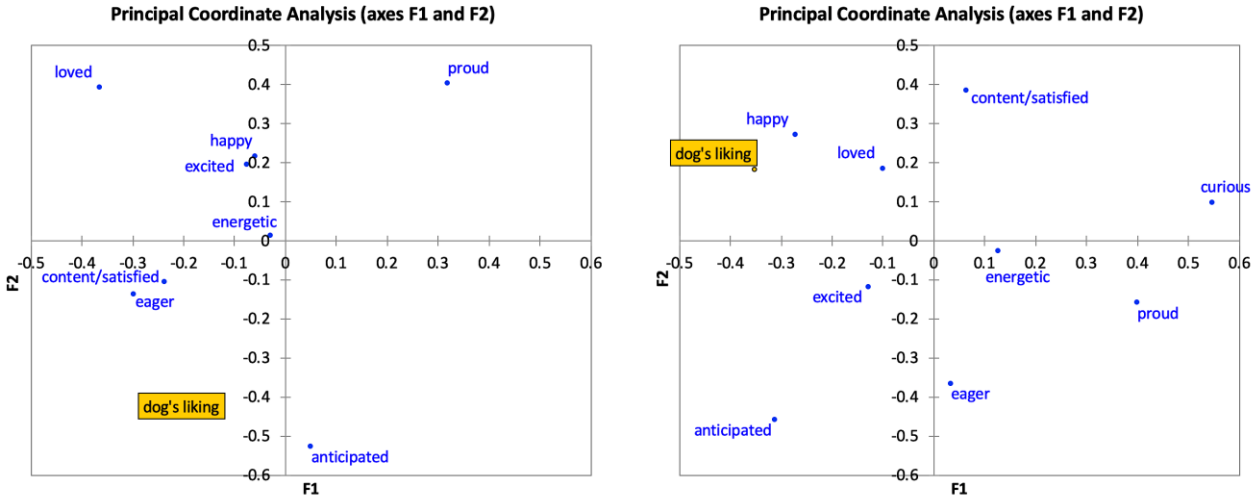

Figure 4.4 Results of principal coordinate analysis on dog emotions and dog's liking: emotions related to treat offering (left) and emotions related to treat consumption (right).

Chi-square tests of independence showed that the listed dog emotions were independent to the samples tested, whenever these samples were offered to or eaten by the dogs. The association between these emotions and the treats was not observed with a significant level of 0.05, when these treats were received by the dogs (χ^2 (26) = 38.89, p=0.18) and when the treats were consumed by the dogs (χ^2 (28) = 41.34, p=0.20). This indicated that dog emotions were not able to discriminate the sample tested. This is because the samples tested were close to each other as mentioned before.

On the other hand, principal coordinate analysis showed the relationship between dog's liking and dog's emotion (Figure 4.4). Dog's liking of the treats was correlated with anticipation when the sample was offered, and happiness when the sample was consumed. Dog emotion responses provided an alternative way to understand dog's liking toward food.

Limitations

Our study examined consumer acceptance (both pet and pet owner) for treats made with different sources of crisp and binder, in which the acceptability of these treats was similar. This indicated the potential use of sorghum in dog treats. In addition, the study demonstrated how pet emotion responses to help in understanding the acceptability beyond liking. It is important to notice that this study was based on a relatively small number of pet owners in the Midwest, which may not be representative on a larger scale, nationwide or worldwide. Furthermore, this test was built on a home-use-test setting which was close to daily experience, but researchers had less control to the testing process and how the data were recorded. The less control of the testing variables may bias the information collected. Especially, the study was conducted for 30 days where some consumers mentioned that it's a bit too long for them. Consumers might lose the patience of the test to answer the questionnaires given, which resulted in missing data or indiscriminate responses.

In order to gain a comprehensive view of pet food consumers (both pet and pet owner), one should choose the test setting carefully, to meet their research goal; for example, home use test (HUT) versus central local test (CLT). In addition, incorporating sensory analysis of the products can help understand the characteristics of the samples, in which possible drivers of liking can be explored. Moreover, the behavioral aspect of the animal may be included in the future to support and justify the emotion responses measured. Scores of sensory characteristics and acceptability

may be further associated with emotion responses in future studies, to provide an overall understanding in pet food products.

CONCLUSION

A home-use-test consumer study was conducted to understand consumer (dog and dog owner) acceptance and emotion responses of dog treats made with sorghum crisp and various binder. Overall liking, dog's liking, appearance liking, and texture liking of the sorghum-included treats were not significantly different from the treats made with rice crisp. This result exhibited the potential of using sorghum as an ingredient in pet treats. Regarding the emotion responses collected from pets and pet owners, positive emotions were reported more frequently than negative emotions. The owners felt content/ satisfied, happy, and relaxed when they offered treats to their pet and when their dogs ate the treats. Dogs were eager, excited, and happy when being offered the treats, and then they felt content/satisfied and happy after taking the treats. The collected emotion terms were not able to discriminate the samples, yet dog's liking of the treats provided was correlated with 'happy' and 'loved'.

The emotions terms generated in the previous study were validated, in which pet owners were able to use these terms to describe how they feel about the treats. This study demonstrated the use of emotion responses in pet food products to gain information on top of acceptance scores. Association of the emotion responses to sensory analysis data or palatability test results may be conducted in the future. By doing so, it could help the pet food industry to better communicate with the consumers and to propel product development.

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Appendix A - Meat samples for the preference ranking test

	Raw	Cooked
Beef		
Chicken		
Lamb		
Pork		
Turkey		

Appendix B - Arrangement of the testing space during the preference ranking procedure

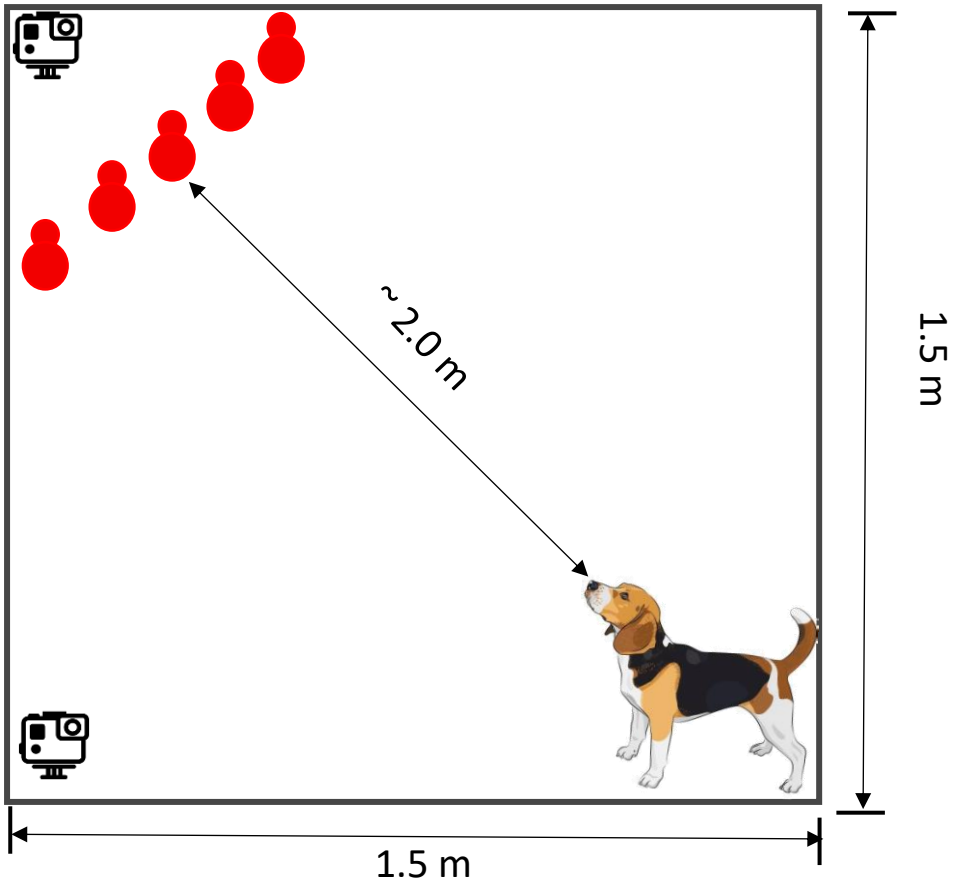


Figure B.1 Example of the arrangement of the testing space during the preference ranking test. The space for the ranking test is about 1.5 square meter. The kongs were placed randomly at a corner in a row from the start point. The dog was kept at the start point which is approximately 2 meters from the kongs at the beginning of the test. Go-pro cameras were placed at the corner to videotape dog's behavior and their choices

Appendix C - Ballot used in the preference ranking test

Phase:

Date: Day:

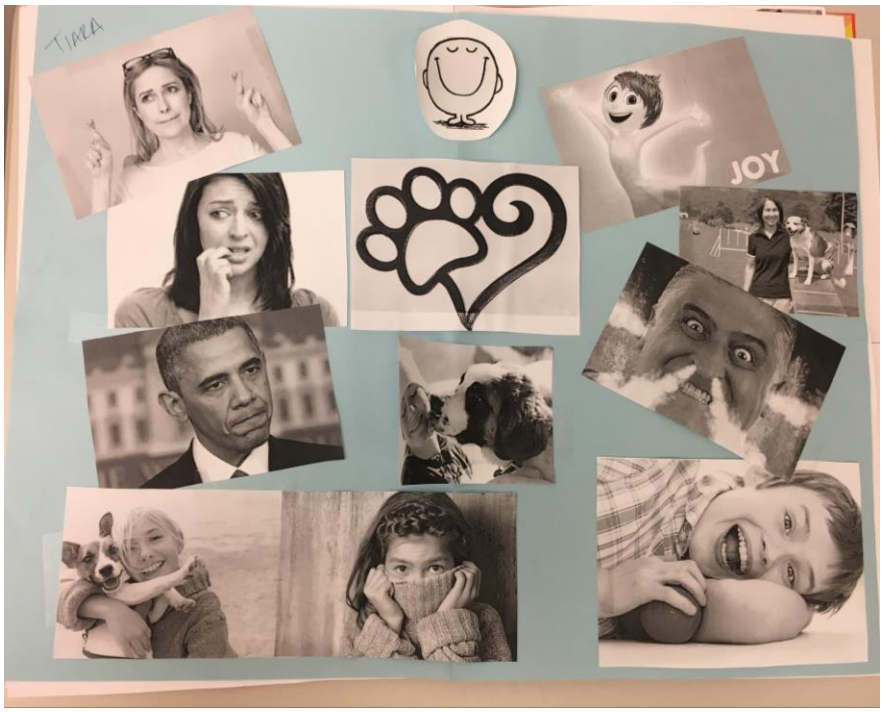
Researchers:

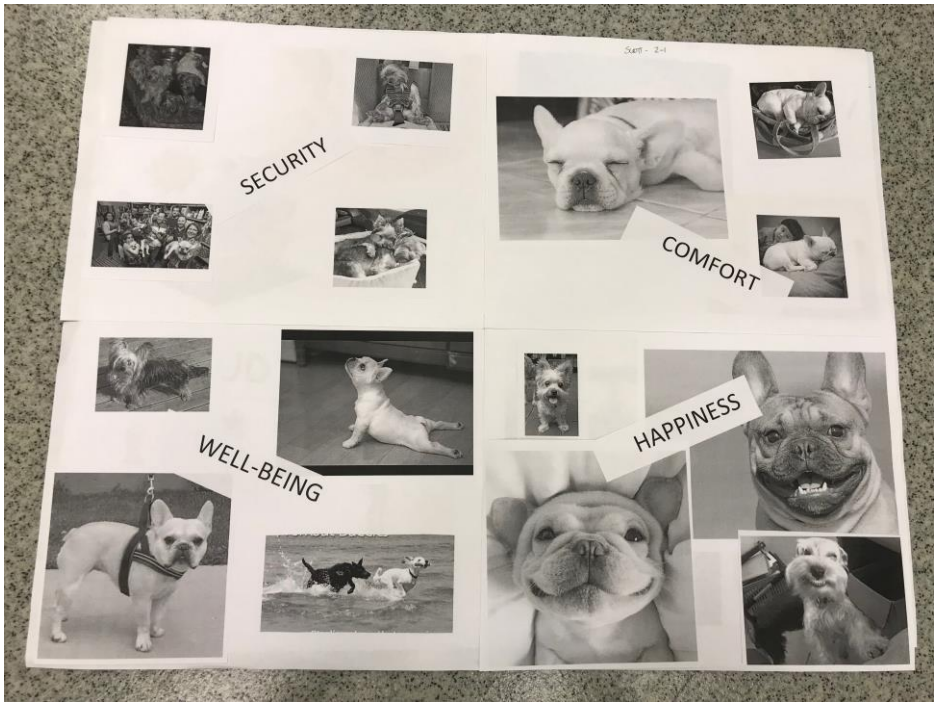
Dog	Beef			Lamb			Turkey			Pork			Chicken		
	Kong #	Time(s)	Rk	Kong #	Time(s)	Rk	Kong #	Time(s)	Rk	Kong #	Time(s)	Rk	Kong #	Time(s)	Rk
Tulsa (54)															
Paris(92)															
Challis (59)															
London (88)															
Chicago (82)															
Pip (43)															
Theon (11)															
Wichita (59)															
Dallas (72)															
Fairbanks (50)															
Jamie (23)															
Phoenix (39)															

Notes:

Appendix D - Examples of the focus group homework

Examples from dog owners





Examples from cat owners

Appendix E - Dog treats with different sources of crisps and binders

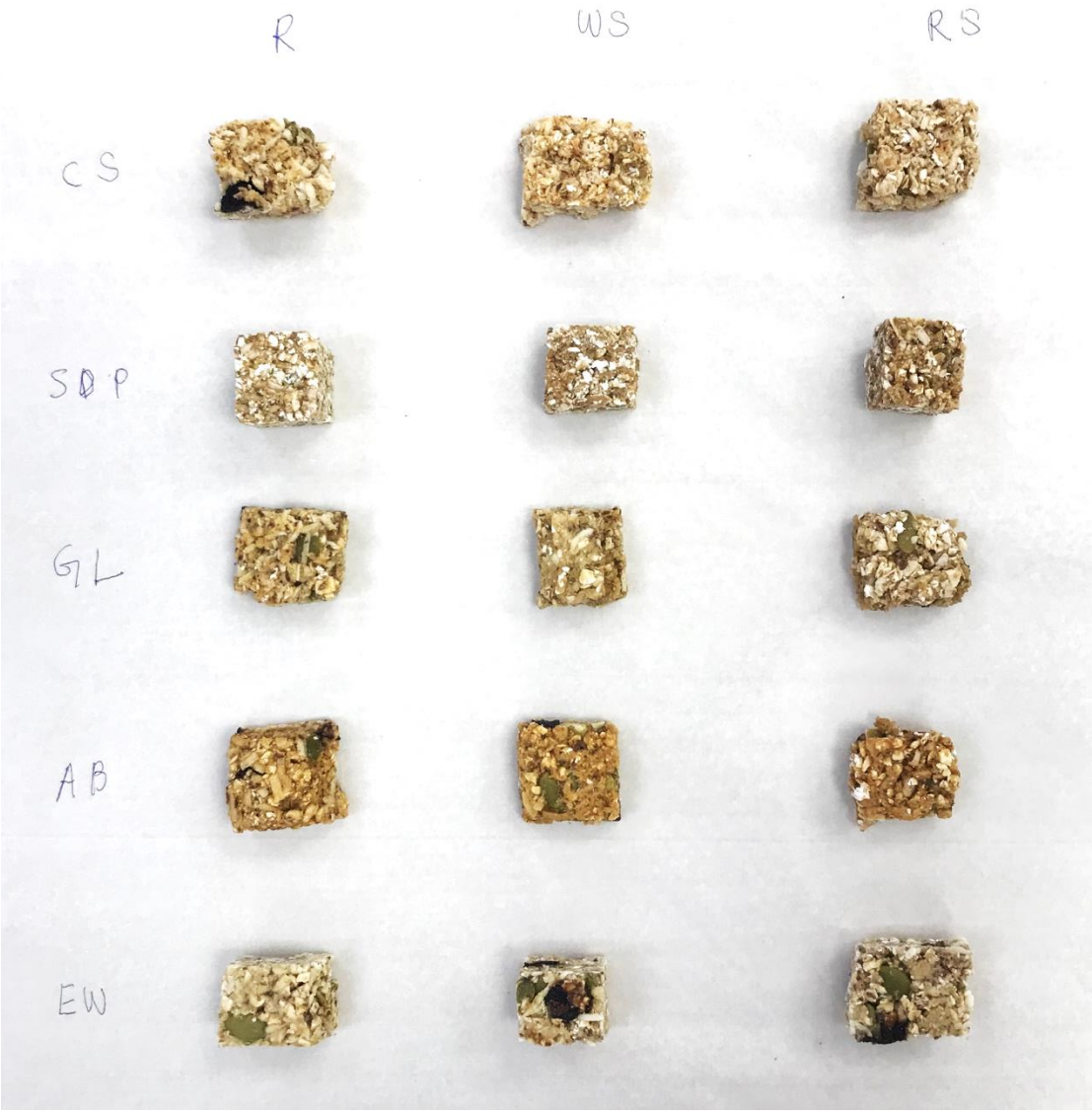


Figure E.1 Dog treats made with different sources of crisps and binders. Sources of crisp: rice, R; white sorghum, WS; red sorghum, RS; sources of binder: corn syrup, CS; spray dried plasma, SDP; gelatin, GL; albumin, AB; and egg white, EW

Appendix F - Screener for the home use test

Screener for selecting participants (home use test):
Number of participants required: 40 *participants*

1. Please indicate your age
    1) Under 18 years (Terminate)
    2) 18-34 years
    3) 35 – 50 years
    4) 51 years or over

2. Gender
    1) Male
    2) Female

3. Do you have any dogs in your home?
    1) Yes
    2) No (Terminate)

If you have more than one dog, in the following questions only refer to the one that will participate in the test.

4. Does your dog have any health problems which affect to the food selection for your dog?
    1) Yes (Terminate)
    2) No

5. Does your dog have any known food allergies?
    1) Yes (Terminate)
    2) No

6. Does your dog currently eat treats?
    1) Yes
    2) No (Terminate)

7. Please indicate the age range of the dog participating in the study:
    1) 1 year or under
    2) 2-5 years
    3) 6-10 years
    4) 10+ years

8. What is the size of the dog taking the test?
    1) Small size (10-35 lbs.)
    2) Medium size (35-75 lbs.)
    3) Large size (75-120 lbs.)
    4) Giant size (over 120 lbs.)

9. Please specify the exact weight of your dog:_____ lbs.

10. If you have multiple pets in your household, can the dog participating in the test be fed in a room without interruption from the other pets?
    1) Yes
    2) No (Terminate)

11. Would you be willing to participate in a 30-consecutive-day test where your dog will be offered 15 treats manufactured in the KSU facilities?
    - Diets may contain common dog treat ingredients,
    - You will be given a $75 compensation at the end of the feeding test.

    1) Yes
    2) No (Terminate)

Thank you for your time and interest in our study. Please provide some personal contact information below. We will contact you soon with more scheduling details and instructions.

Name:

Preferred email address:

Preferred phone number:

Appendix G - Questionnaires for the home use test

Dog treat in home use test

Day ____ of 30
Sample code: 968
Date: _____
Participants: _____

Questionnaire

Please take a look and smell **sample 968**, and then give **sample 968** to your dog as you regularly would during a treat offer process.

Please evaluate the following.

1. How much do you like or dislike this sample **overall**?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

2. How much do you think **your dog** likes or dislikes this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

3. How much do you like or dislike the **appearance** of this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

4. How much do you like or dislike the **aroma** of this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

5. How much do you like or dislike the **texture** of this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

*** Please turn over to the next page. ***

6. What did you like about this sample? (open-ended)

7. What did you dislike about this sample? (open-ended)

Comments: (Please include any notes you may have. For example, any usual or unusual behavior from your dog during/after the testing.)

Dog treat in home use test

Day 1 of 30
Sample code: 124
Date: _____
Participants: _____

Questionnaire

Please take a look and smell **sample 124**, and then give **sample 124** to your dog as you regularly would during a treat offer process.

Mark the statement applies to the test today, and follow the instruction for the questionnaire.

☐ My dog ate this sample today. --- Please finish ALL the following questions.

☐ My dog did not eat this sample today. --- Please answer Questions 1~9.

Please evaluate the following.

1. How much do you like or dislike this sample **overall**?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

2. How much do you think **your dog** likes or dislikes this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

3. How much do you like or dislike the **appearance** of this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

4. How much do you like or dislike the **aroma** of this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

5. How much do you like or dislike the **texture** of this sample?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like or dislike	Like slightly	Like moderately	Like very much	Like extremely
○	○	○	○	○	○	○	○	○

*** Please turn over to the next page. ***

6. What did you like about this sample?

(Open ended)

7. What did you dislike about this sample?

(Open ended)

Comments: (Please include any notes you may have. For example, any usual or unusual behavior from your dog during/after the testing.)

Please recall the process when offering the treat to your dog, and answer the following.

8. **I feel** _____ when offering this sample to my dog. (Check all that apply)

____ Amused	____ Relaxed	____ Fearful/ Scared
____ Content/ Satisfied	____ Surprised	____ Exhausted/ Tired
____ Excited	____ Angry	____ Frustrated
____ Energetic	____ Anxious/ Nervous	____ Sad
____ Happy	____ Concerned	____ Unhappy
____ Proud	____ Disappointed	____ Worried

*** Please turn over to the next page. ***

9. I think **my dog was** _____ during the offering process of this sample. (Check all that apply)

____ Anticipated	____ Happy	____ Confused
____ Content/ Satisfied	____ Loved	____ Disappointed
____ Curious	____ Proud	____ Discomfort
____ Eager	____ Relieved	____ Unhappy
____ Energetic	____ Afraid/ Fearful	____ Sad
____ Excited	____ Anxious/ Nervous	____ Worried

10. **I feel** _____ when my dog ate this sample. (Check all that apply)

____ Amused	____ Relaxed	____ Fearful/ Scared
____ Content/ Satisfied	____ Surprised	____ Exhausted/ Tired
____ Excited	____ Angry	____ Frustrated
____ Energetic	____ Anxious/ Nervous	____ Sad
____ Happy	____ Concerned	____ Unhappy
____ Proud	____ Disappointed	____ Worried

11. I think **my dog feels** _____ when he/she ate this sample. (Check all that apply)

____ Anticipated	____ Happy	____ Confused
____ Content/ Satisfied	____ Loved	____ Disappointed
____ Curious	____ Proud	____ Discomfort
____ Eager	____ Relieved	____ Unhappy
____ Energetic	____ Afraid/ Fearful	____ Sad
____ Excited	____ Anxious/ Nervous	____ Worried