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Pet and owner acceptance of dry dog foods manufactured with sorghum and sorghum fractions

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ABSTRACT

Globally sorghum is an important cereal crop with limited use in the pet food industry. Pet food acceptance and palatability assessments relate to both pet owners as the product purchasers and the pets as the actual consumers. Pet foods containing sorghum or sorghum fractions have not been studied for both animal and pet owner acceptance. The objectives of this study were to 1) understand animal acceptance between sorghum dog food diets and compared to a control, 2) assess consumer acceptance of the dog food products. Thirty dogs of different size and breed were fed three dry dog food diets containing different sorghum fractions and one control diet containing wheat, rice, and maize using the one-bowl in home use test. Results indicated that no difference was observed among diets, and sorghum samples were accepted at the same level as the control diet during the test. A total of 105 pet owners evaluated the samples for appearance, color, aroma, and overall liking. The consumer panel found the whole sorghum and the control samples to be accepted at the same level. These results suggested that sorghum may be suitable for dry dog food formulations.

1. Introduction

The pet food industry is a growing sector of the food industry, which is constantly looking for innovation and new ingredients. Estimated sales in 2016 in USA were $24 billion dollars (APPA, 2016). Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth most important crop in the world after wheat, maize, rice and barley. The United States is the largest producer of sorghum in the world (Sorghum Checkoff Program, 2016). Sorghum, also called milo, originates from Northeastern Africa where it is often used in a porridge-type food (Aboubacar et al., 1999). Sorghum tolerates arid climates with lower moisture and rainfall requirements when compared to other crops such as rice, maize, and soybeans (Aldrich, 2015) and it is one of the most efficient crops in conversion of solar energy and use of water, and therefore considered environmentally friendly (Sorghum Checkoff Program, 2016). Currently it is primarily used for livestock feed and ethanol production, but its potential is considerable in the food industry (Taylor et al., 2006).

Opportunities to increase the use of sorghum may come from targeting industries such as pet food manufacturing. Because of a limited name recognition by consumers and lack of nutritional data and acceptance data by both owners and pets the current use of sorghum by the pet food industry is limited. However, labeling claims such as gluten free and non-genetically modified organism, as sorghum currently is, together with a better understanding of sorghum digestibility and sensory characteristics may contribute to increase its use, especially in pet food specialty markets. Sorghum is also rich in phytochemicals such as tannins, anthocyanins, phytosterols, and policosanols with high antioxidant activity and potential impact on human health (Awika and Rooney, 2004). Some of these factors may cause sorghum to be used less, though, as it may have a bitter and astringent flavor (Kobue-Lekalake et al., 2007). Di Donfrancesco and Koppel (2017) showed that this is not necessarily the case with dry dog foods made with sorghum and its fractions, and in fact that the flavor differences between sorghum-added and a control sample were quite small. Most of the dry pet food produced is processed by extrusion because the adaptability of this process and the functional characteristics that it can impart to the products such as improving texture, detoxifying and sterilizing (Cheftel, 1986). Among these effects, extrusion may also modify other sensory characteristics such as flavor and appearance by increasing friability, crispness, and hardness when compared to baked pet food products (Koppel et al., 2014).

Nutritional and processing properties, palatability, and owners' liking are characteristics that determine the success of a pet food product in the market. Nutritional properties of pet foods manufactured with sorghum fractions have recently been studied by Alvarenga et al. (2018). These authors found that sorghum as a grain source in pet foods

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enables production of comparable nutritional quality to control samples made with corn, rice, and wheat. These authors also found that pet foods that are manufactured with sorghum, can be processed similarly to foods made with other grain sources (Alvarenga et al., 2018). The two principal characters involved in pet food success are the pet owners and the pets themselves. The pet owners need to make decisions on what food to purchase and serve to the pet. Often criteria such as "I think this food will be liked by my pet" is important to pet owners (Di Donfrancesco et al., 2014). The pets then will have a chance to either accept or reject the served food. The pet food industry has been strongly influenced by humanization of pets, where dogs and cats are perceived more as members of the family and pet owners become parental figures. This has led to an increased role of owners 'liking' for product success as compared to the past. Acceptance of owners can be influenced by sensory properties of products such as appearance and aroma (Di Donfrancesco et al., 2014), as well as packaging label information. This can be measured in a central location trial format. However, palatability testing remains an important step in product development for a pet food product and it is often the crucial element for the success of a product in the market (Aldrich and Koppel, 2015). Palatability is not only about the taste of a food, but it deals with other factors such as aroma, mouthfeel, ingestive behaviors, form of the food, and frequencies of feeding (Kvamme, 2003).

Two main methods to assess the palatability of pet food products are the one bowl or single-bowl test and the two-bowl or split plate test. The one-bowl test is used to assess the acceptability of a product, and it measures food intake of pets, while the two-bowl test is used to determine the preference of one product over another while also measuring food intake. The types of pet panels that can be used to conduct palatability testing can be constituted by 'expert' trained pets in pet centers or untrained pets fed in an in-home test setting (Tobie et al., 2015). The two panels can provide different types of information and they both may be used during the product development process. An expert pet panel can be more accurate because the pets are trained to the testing protocol and perform palatability tests on a daily basis, but the training can be intensive with animals that need to be exposed to a different variety of food. An in-home test can provide additional useful information such as overall acceptance of the food, pet behaviors when interacting with the meal, and feedback about pet food diets from the perspective of pet owners after being exposed to the diets and observing their dog consuming those over several test days (Tobie et al., 2015).

In order to understand both consumer acceptability and pet palatability of extruded dry dog foods manufactured with sorghum fractions, this study conducted both an in-home-use test with dog owners and dogs and a central location trial with dog owners. The objectives of this study were to 1) understand palatability of extruded dry dog foods manufactured with sorghum milling fractions, and 2) assess consumer acceptance of these dry dog foods.

2. Materials and methods

2.1. Samples

2.1.1. Milling process

Red sorghum used in the study was selected from locally grown supplies in the Manhattan, Kansas area during the 2014 crop year. The sorghum used in this study was a "tannin" sorghum according to GIPSA with a red testa. Sorghum was first cleaned of impurities such as straw, weed seeds, soil particles and dust. Then, most of the sorghum used in the study to manufacture samples was milled in April 2015 at the Hal Ross Flour Mill (HRFM; Kansas State University, Manhattan, KS, USA) in order to separate flour, bran (mill-feed) and germ. Sorghum was tempered with water to increase the moisture level to 16% from an initial 14% to promote the separation of the endosperm component from the germ and the hull. The milling process separated the different sorghum components according to particle size and consisted of grinding, sifting and purification steps. The grinding process consisted of 5 break passages that removed the endosperm from the bran portion and successively collected in a bin. A purification step followed, where the bran was cleaned from any residual endosperm particles with the use of purifiers during the sifting process. The clean endosperm was then ground into flour. The mill feed fraction (MF) was composed of bran, shorts (finer bran), red dog (leftovers of the last flour cloth in the mill) and some coarse flour. For the whole sorghum diet (WSD), a portion of the sorghum was not milled to flour in the HRFM, but instead was ground using a hammer mill (#16 standard sieve – 1.191 mm). After grinding the sorghum was passed through a sifter with a 560 micron screen to exclude larger particles.

2.1.2. Diet formulations

Experimental diets that contained different sorghum fractions were extruded in the Kansas State University facilities: whole sorghum (WSD), sorghum flour (FD), sorghum bran enriched mill-feed diet (MF) and the control diet (CD) made with maize, wheat, and brewers' rice in a ratio of 1:1:1. Other than sorghum, rice, wheat, and maize, the diets also contained chicken by-product meal, beet pulp, maize gluten, calcium carbonate, potassium chloride, salt, dicalcium phosphate, choline chloride (60% dry), natural antioxidant (dry), trace minerals premix, and a vitamin premix (Table 1).

Rendered chicken fat (IDF Inc.; Springfield, MO, USA) was preserved with a commercial antioxidant added by the seller (BHA, propyl gallate, and citric acid). The additional ingredients were acquired from a local mill that supplies ingredients for pet food production (Fairview Mills L.P., Seneca, KS, USA). The diets were formulated in order to be iso-nutritional for carbohydrate, lipid, protein, and mineral content (Table 2).

2.1.3. Mixing, grinding, and extrusion processes

The mixing, grinding, and extrusion steps were conducted at the Bioprocessing and Industrial Value Added Program (BIVAP) facilities at Kansas State University, Manhattan KS, USA. After being weighed with a digital scale the ingredients were placed in a 227 kg paddle mixer. Micro ingredients (< 1% inclusion) were first mixed together before addition to the bulk ingredients in the mixer. Ingredients were mixed for 5 min and then finely ground through a hammer mill with an 840 μm screen size to facilitate particle size uniformity for the extrusion phase.

For the extrusion of all the diets, a single screw extruder (Model X-20; Wenger Manufacturing, Sabetha, KS, USA) with a standard pet food screw profile was utilized. The screw profile consisted of inlet screw,

Table 1
Experimental diets composition: control (CD), whole sorghum (WSD), sorghum flour (FD) and sorghum mill-feed (MF).

Ingredients, %	CD	WSD	FD	MF
Brewers' rice	21.21	–	–	–
Maize	21.21	–	–	–
Wheat	21.21	–	–	–
Whole sorghum	–	64.69	–	–
Sorghum flour	–	–	63.11	–
Sorghum mill-feed	–	–	–	67.65
Chicken by-product meal	20.94	20.02	20.00	20.00
Chicken fat	5.36	5.54	6.69	3.30
Beet Pulp	4.00	4.00	4.00	4.00
Maize gluten meal	3.00	3.00	3.00	3.00
Calcium carbonate	0.75	0.35	0.26	0.67
Potassium chloride	0.49	0.52	0.65	0.19
Salt	0.46	0.45	0.47	0.43
Dicalcium phosphate	0.87	0.95	1.27	0.24
Choline chloride	0.20	0.20	0.20	0.20
Vitamin premix	0.15	0.15	0.15	0.15
Trace mineral premix	0.10	0.10	0.10	0.10
Natural antioxidant (dry)	0.07	0.07	0.07	0.08