

A NEW PROFIT STREAM FOR GRAIN SORGHUM

SENSORY PROFILES AND CONSUMER ACCEPTANCE OF DRY DOG FOOD



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Summary

- 4 extruded dry dog food prototypes with different sorghum fractions
- Sensory differences in texture and appearance
- No large differences in aroma and flavor
- No higher bitterness or astringency in sorghum samples
- Whole sorghum sample was one of the most liked by pet owners
- HUT indicated sorghum samples were equally liked with the control

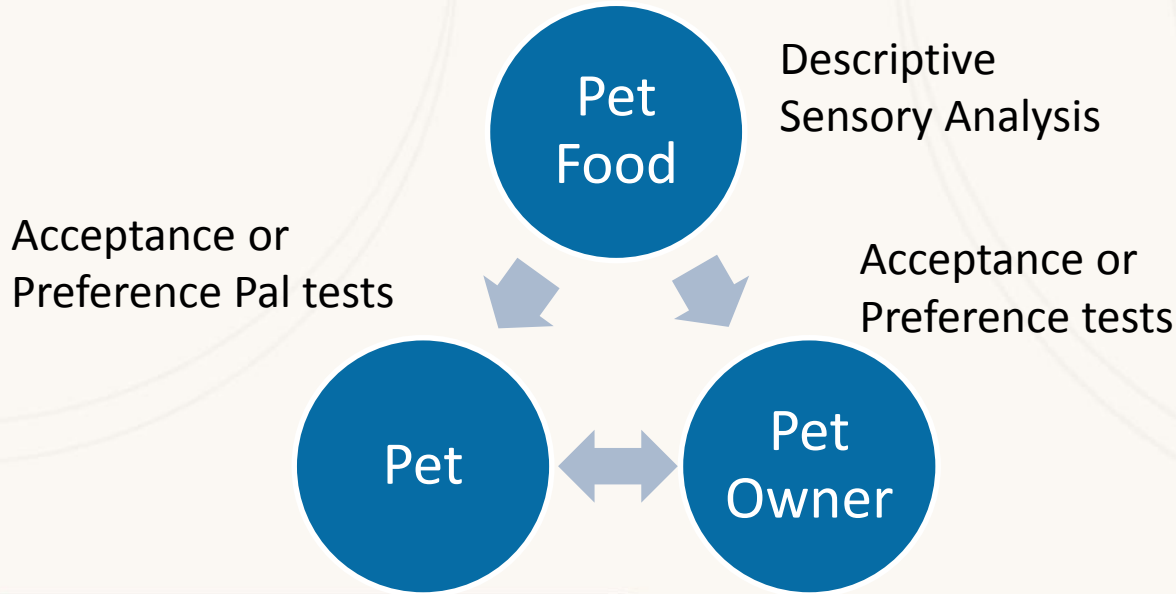


Sensory Analysis

- “Sensory evaluation has been defined as a scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing.” — IFT 1975; Stone and Sidel 1993.



Pet food and sensory analysis





Pet food and sensory analysis

- Sensory analysis of pet foods may be conducted by humans via descriptive or hedonic analysis (Koppel, 2014)
- Human sensory analysis with pet foods has not been frequent. A few studies have been conducted with dog food (Lin et al., 1998; Di Donfrancesco et al., 2012) and cat food (Pickering et al., 2008, 2009)
- Dry dog food sensory lexicon developed by Kansas State University (Di Donfrancesco, et al., 2012)

Sorghum

- Sorghum originates from northeast Africa and Asia
- Perennial grass commonly grown as an annual grain crop in more arid climates.
- Fifth most important grain in the world for production and cultivated acres.
- Kansas is the top sorghum producer in the US.





Nutrient composition

- Nutritionally sorghum should be a good fit for pet food. The nutrient profile compares favorably to corn, with starch being the largest portion (around 75%).
- The protein content is slightly higher than corn at or above 9%
- The fat content of sorghum is slightly lower (about 3%)



Condensed tannins

- All sorghums contain condensed tannins, different polyphenolic compounds produced as secondary metabolites by the plant.
- Common to consider some of the condensed tannins as anti-nutritional factors to avoid since they inhibit digestive enzymes (amylase inhibitor, trypsin inhibitor), and bind (chelate) trace minerals.



Condensed tannins

- In addition tannins have been related to astringent mouthfeel and bitter taste in foods manufactured from sorghum (Brannan et al., 2001).
- This aspect may influence animal acceptability of feeds manufactured with sorghum flour



Condensed tannins

- Not all condensed tannins are the same. Sorghum proanthocyanidins may impart health benefits
- Anti-tumor (esophageal, colon), anti-viral (HIV), melanogenic, and satiety effects
- Antioxidant properties



Condensed tannins

- Condensed tannins are a host of many compounds
- Opportunity to identify and utilize sorghums fractions that concentrate certain elements providing added value.



Sorghum and pets

- Pet food market represents an important segment of the agriculture and feed industry in the US accounting for about 40% of grains production
- It is worth more than 21 billion dollars in the US
- Studies on dogs (Carciofi et al., 2004, Sunvold and Bourchard, 1998) showed that sorghum has a lower glycemic index (GI) compared to other grains
- A low GI claim has become a very popular characteristic for pet food marketers

Sorghum for pets

- Gluten free and currently non-GMO.
- Sorghum may be a perfect pet food ingredients in specialty markets
- Despite added value sorghum is poorly utilized by pet food companies
- Limited name recognition by consumers
- Poor reputation in some feed sectors for being slightly lower value relative to corn





Sorghum for pets

- Several studies have evaluated the use of whole sorghum in extruded dog and cat diets. In dogs, starch digestibility was similar to that of other grains like corn or rice (Carciofi et al., 2004; Twomey et al., 2002; Murray et al., 1999).

Objectives



- Develop a sensory ballot for the 4 dry dog food samples object of study manufactured with different fractions of sorghum
- Provide a sensory profile for appearance, aroma, flavor, aftertaste, and texture of the samples
- Determine consumer acceptance for the samples studied
- Determine dogs acceptance for the sample studied



Descriptive Analysis



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Materials

Samples

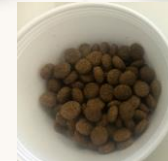
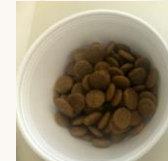
- WSD (Whole sorghum diet)
- FD (Flour diet)
- MF (sorghum bran enriched mill feed diet: bran, germ, red dogs)
- CD (Control diet: Rice, Corn, Wheat)



Chicken by-product meal, Corn Gluten meal, Chicken fat, Beet pulp, Antioxidant, Vitamins, Minerals



Diets



%	CD	WSD	FD	MF
Rice	21.2	0.00	0.00	0.00
Corn	21.2	0.00	0.00	0.00
Wheat	21.2	0.00	0.00	0.00
Sorghum	0.00	64.69	0.00	0.00
Sorghum bran	0.00	0.00	0.00	67.65
Sorghum flour	0.00	0.00	62.31	0.00

Diets



%	CD	WSD	FD	MF
Moisture	6.91	7.13	5.56	6.17
Dry matter	93.09	92.87	94.44	93.83
Protein (crude)	21.7	21.1	21.50	24.6
Fat (acid hydrolysis)	11.4	10.9	10.30	9.17
Fiber (crude)	0.78	0.97	0.38	2.29
Ash	6.03	6.15	6.29	6.14



Sample Preparation and Presentation

- All Samples were served at room temperature
- Dry dog food samples were served in 3.25oz cups for appearance, flavor, aftertaste, and texture evaluation
- Medium covered snifters were used to evaluate aroma of the samples. 3 grams of each sample were placed in the snifter and then covered with a glass lid

Panelists



- Five highly trained panelists from the Sensory Analysis Center, Kansas State University (Manhattan, KS, USA) participated in the study.
- For this project the panelists received further orientation to dry dog food using samples included in the study.
- Each product was evaluated for aroma and flavor using attributes from a specific dry dog food lexicon developed by Kansas State University (Di Donfrancesco *et al.*, 2012)
- Intensity scores were based on a 0 – 15 point scale with 0.5 increments (0.0 = none; 0.5 – 5.0 = slight; 5.5 – 10.0 = moderate; 10.5 - 15.0= high).



Statistical Analysis

- Significant differences ($P < .05$) for attributes intensity of products were determined using analysis of variance (GLIMMIX procedure) and Fisher protected least significant difference in SAS statistical software (Version 9.3, SAS Institute Inc, Cary, NC).
- PLS/PCA



Consumer Acceptance





Materials and Methods

Consumers

- **Screening:** 105 consumers were selected from a total of more 500 consumers screened. All the participants were dog owners, fed their dog dry food, and directly involved in the purchase and selection of the food

Materials and Methods



Testing Procedures

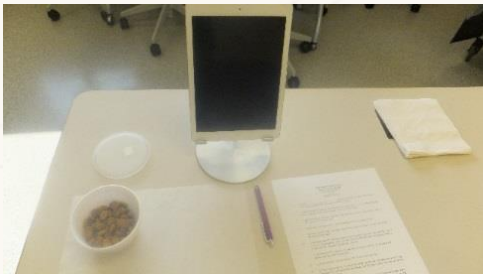
- One cup of each sample diet was served at room temperature into a 8oz Styrofoam bowl covered with a lid. The lid was removed by participants during the evaluation
- *Red Jade* software was used to collect consumer data during evaluation.
- *SAS* software was used to analyze the data



Materials and Methods

Testing Procedures

- Each consumer evaluated 4 dry dog food samples served in a randomized order.
- Evaluation was conducted in one session. A total of 15 sessions were held.





Material and Methods

Testing Procedures

- Data were collected using iPads tablets and Red Jade software
- Consumers were asked to indicate a overall liking score, overall appearance liking score, color liking score and an aroma liking score for the samples, using a 1-9 hedonic scale (1 – dislike extremely, 9 – like extremely).



Material and Methods

Statistical Analysis

- Significant differences ($P < .05$) for pet owners' acceptance of products were determined using analysis of variance (GLIMMIX procedure) and Fisher protected least significant difference in SAS statistical software (Version 9.3, SAS Institute Inc, Cary, NC).



Home Use Test



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Materials and Methods

Dogs

- 30 dogs from households in the Manhattan, KS area were selected for the in-home study. To be selected for the study dogs had to match the following criteria:
- Size > 9lbs and < 100lbs
- Age between 2 and 10 years old
- Good health status
- No food allergies
- Eat only dry food diets
- Be usually fed 1 time a day
- Have the possibility to eat in a room without interruption by other dogs present in the household





Materials and Methods

Testing Procedure

- Each dog was fed each of the sample for 5 days, for a total of 20 days test. The serving order was randomized and different for each dog
- The amount of food fed to each dog was relative to body mass. Dogs daily metabolizable energy (ME) requirements were calculated as an average for laboratory kennel dogs or active pet dogs: $130 * BW^{0.75}$ (National research Council, 2006)
- Each meal was contained in labeled (sample code, dog code, test day) Ziploc bag



Materials and Methods

Testing Procedure

- Owners were asked to pour the whole content of the bag in a bowl leaving the food available for 30 minutes. After 30 minutes the leftover food was removed and placed back in the bag
- Owners were given the first two diets (different for each dog) and were asked to come back after 10 days to drop the leftover and pick the next 2 diets
- Bags with leftover were then weighed by researcher in order to calculate the food intake using the following formula:

$$100 - (\text{leftover}/\text{initial amount} * 100)$$



Materials and Methods

Statistical Analysis

- Significant differences ($P < .05$) for dogs acceptance of products were determined using analysis of variance (GLIMMIX procedure) and Fisher protected least significant difference in SAS statistical software (Version 9.3, SAS Institute Inc, Cary, NC).



Results



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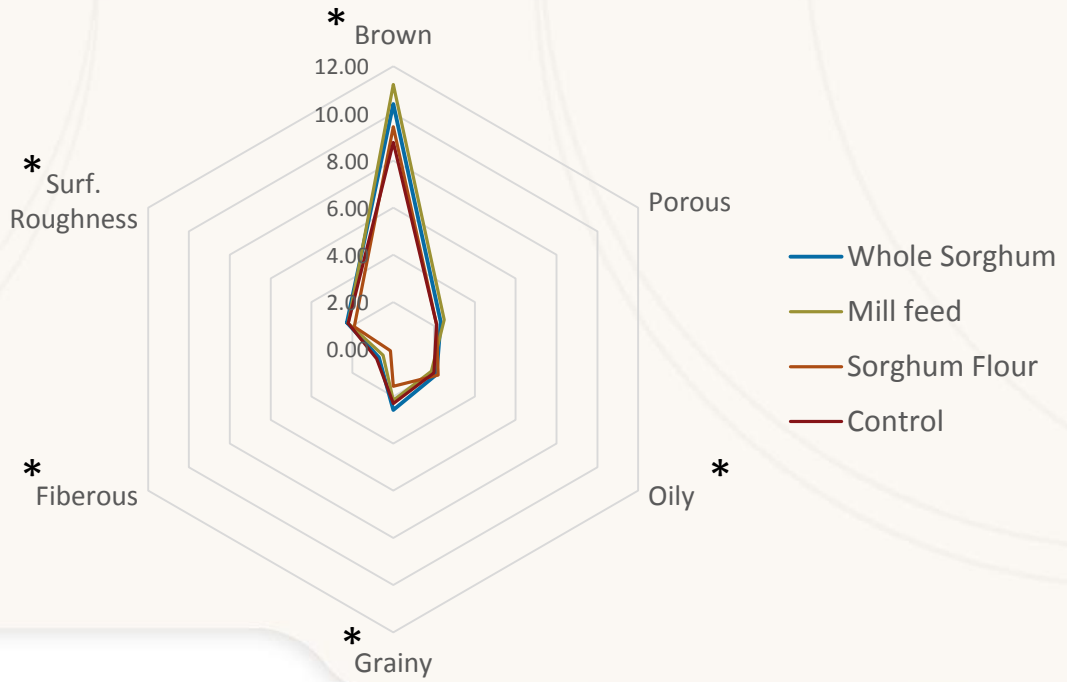
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Descriptive Analysis



Appearance



*Statistically significant (p=0.05)



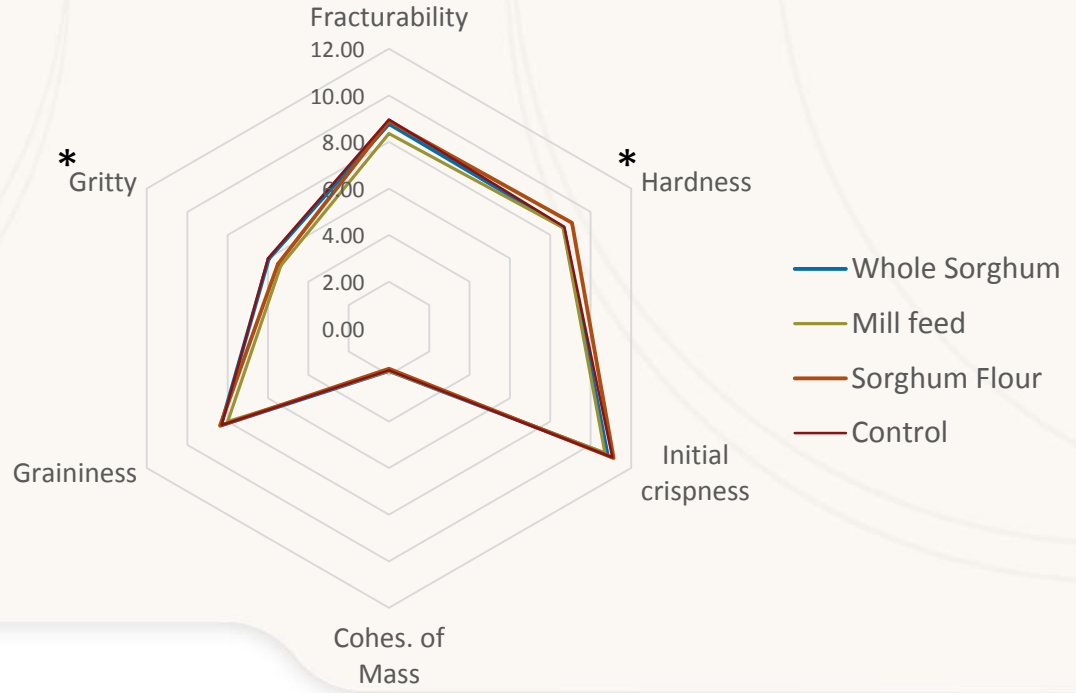
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Descriptive Analysis



Texture



*Statistically significant ($p=0.05$)



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Descriptive Analysis

- Attributes showing a statistical significant difference ($p\text{-value} < 0.05$) were:

Appearance – Brown color (Mill-feed – darkest, Control – lightest), Oily (Flour and Whole Sorghum diets), Grainy (WSD), Fibrous (WSD, CD), Surface roughness (FD – lowest) ($p\text{-value} 0.05$)

Aroma – Toasted (Mill-feed diet)

Flavor – Musty (MF), Dusty (MF)

Aftertaste – Barnyard (FD – lowest), Brown (MF – highest)

Texture – Hardness (FD – hardest), Gritty (WSD, CD – highest)



Owner Acceptance



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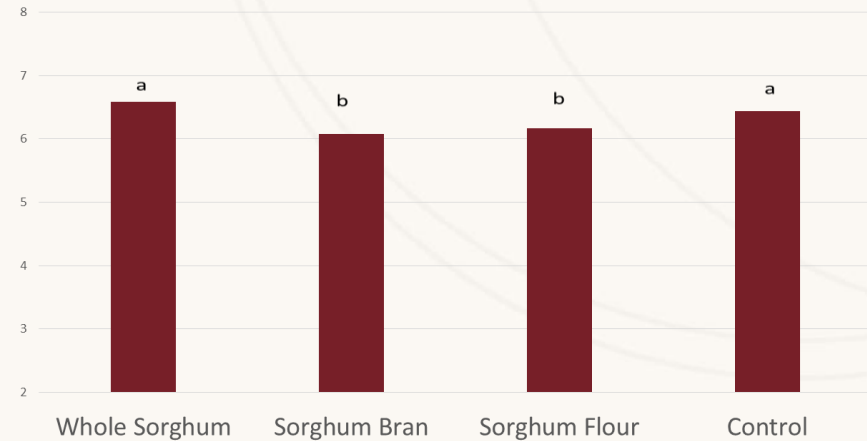




Overall Liking

Overall Liking	
WSD	6.59a
FD	6.17b
MF	6.08b
CD	6.44a
<i>p-value</i>	0.0003

Overall Liking

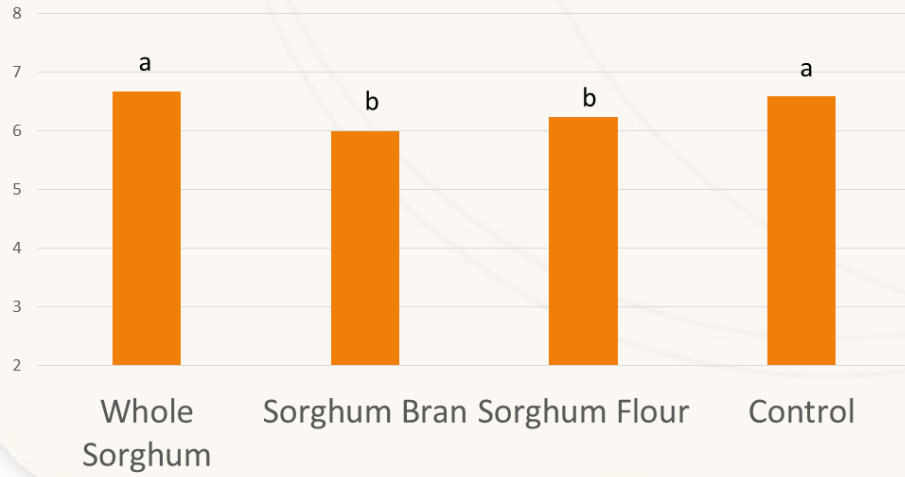


Overall Appearance



Overall Appearance Liking	
WSD	6.67a
FD	6.23b
MF	6.00b
CD	6.60a
<i>p-value</i>	<.0001

Overall Appearance Liking



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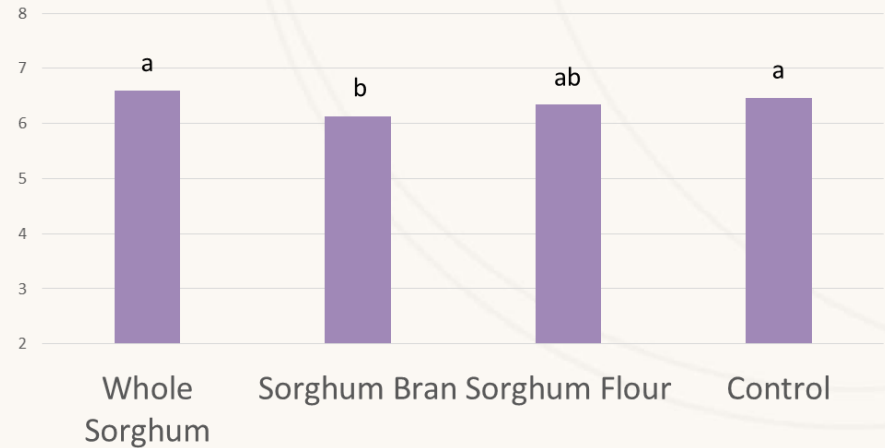


Color Liking



Color Liking	
WSD	6.59a
FD	6.34ab
MF	6.12b
CD	6.46a
<i>p-value</i>	<i>0.0119</i>

Color Liking



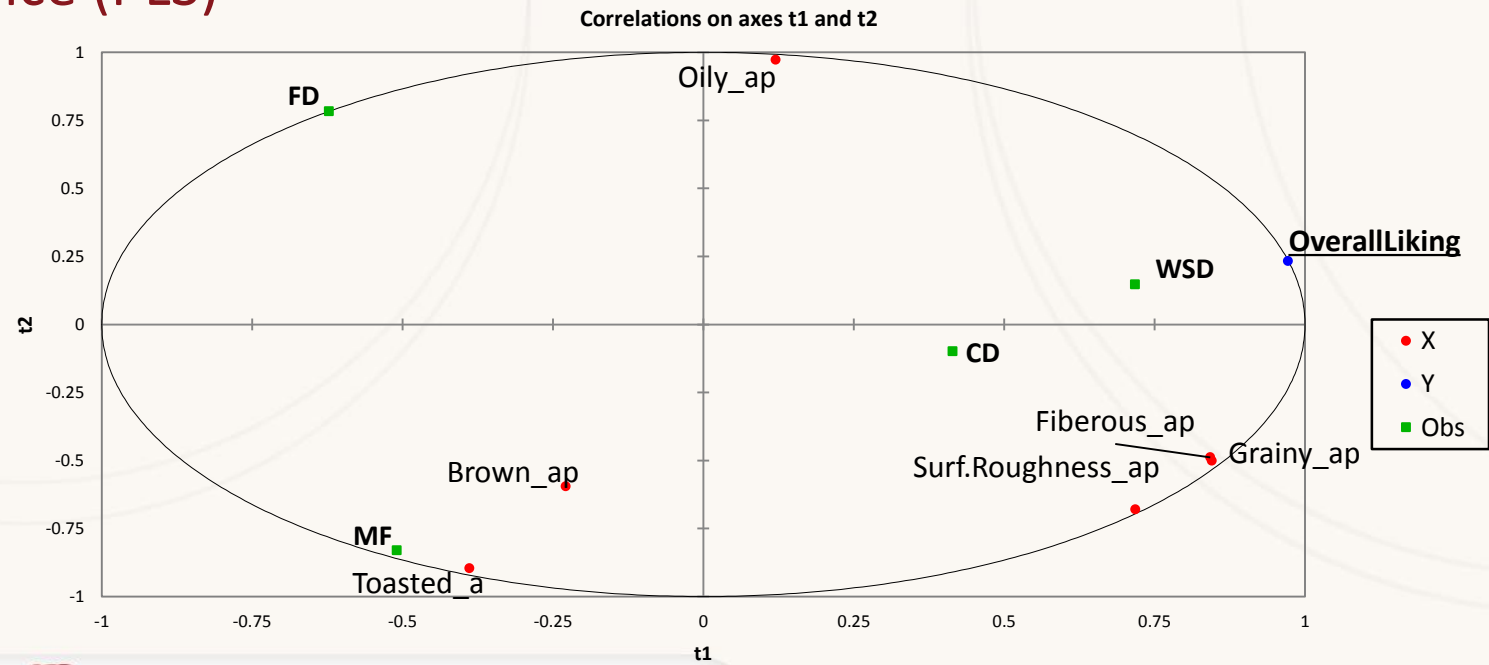
Aroma Liking



Aroma Liking	
WSD	6.09
FD	5.91
MF	5.91
CD	5.89
<i>p-value</i>	0.4231

No statistically significant difference

Descriptive Analysis and Consumer acceptance (PLS)



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Home Use Test



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Intake



Sample	Intake (%)
CD	57.06
MF	57.50
FD	53.44
WSD	55.62
<i>p-value</i>	<i>0.1729</i>



Conclusions

- Results indicate that the slight difference in liking scores among the samples are due to the different appearance of the samples and not to the aroma characteristics as also found in previous studies
- Whole Sorghum diet was accepted at the same level of the Control diet by pet owners. The differences in liking for the other sorghum samples were not large indicating the possibility of a higher consumer acceptance if the product for appearance characteristics are improved.
- There was no difference in acceptance by dogs between sorghum samples and control sample.

Acknowledgment

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