

Sensory analysis of extruded pet food with rendered protein meals

Sirichat Chanadang, Kadri Koppel, and Greg Aldrich



What is 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.





SENSORY PERCEPTIONS



Why is sensory analysis important?

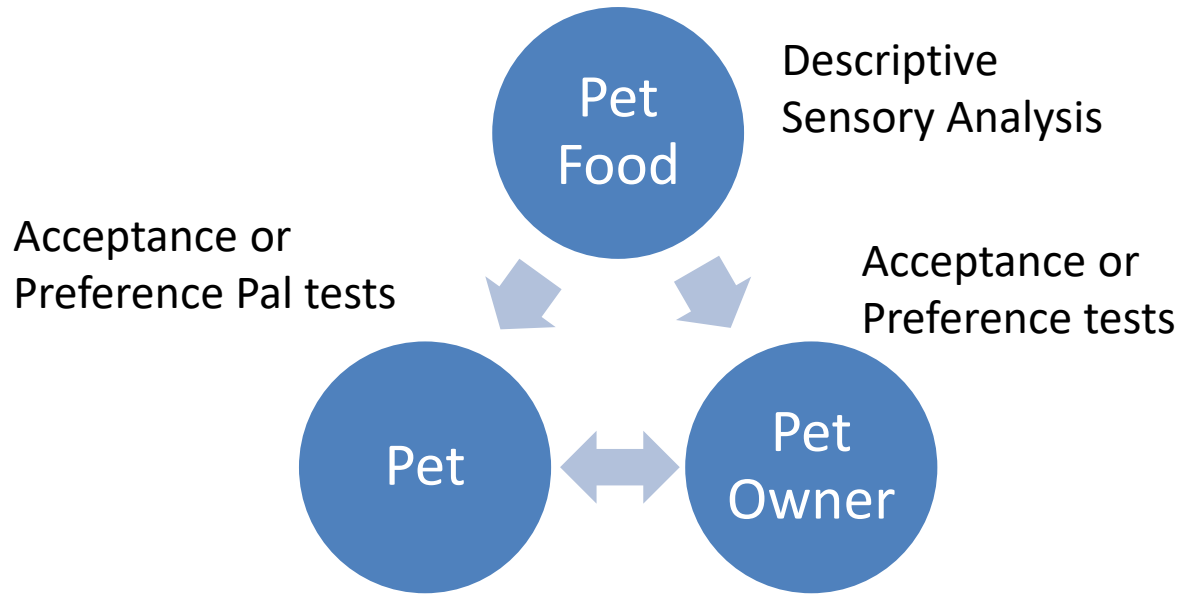
- Understand your product and client
- Generate ideas for new products and services
- Product improvement
- Maintain quality of product
- Evaluate a range of products for their appearance, flavor, taste, and texture
- Consumer acceptance
- Analyze a test kitchen sample or a new recipe for your restaurant or facility lunch room
- Check that the final product meets its original specifications

What products can sensory analysis be used?

- Food
 - Human Food
 - Animal food
- Non-Food
 - Automobiles
 - Cosmetics
 - Services



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
- Human sensory analysis with pet foods has not been frequent. A few studies have been conducted with dog food and cat food.
- Dry dog food sensory lexicon developed by Kansas State University

Pet food with Rendered Protein Meals

- Pet food industry is an important part of the U.S. economy.
- Rendered protein meals are widely used in pet food industry.
 - Excellent source of protein, energy and mineral



Pet food with Rendered Protein Meals

- Expected to maintain their desired characteristics for 12 months or more.
- Lipid oxidation is the major factor that affects the shelf life of food products, including pet food



Lipid oxidation measurements

- Peroxide value (PV)
- Oxygen consumption (oxygen-bomb)
- Thiobarbituric acid reactive substances (TBARS)
- Gas chromatography-mass spectrometry (GC-MS)

Relating an acceptable level of lipid oxidation measured from those analytical methods is not well defined



Lipid oxidation measurements

- Shelf lives of many food products are limited by the changes in their sensory characteristics
 - Changes can occur before any risk to consumers' health is reached
- Sensory Analysis
 - Descriptive sensory analysis using a human panel
 - Hedonic analysis from pet owners

Sensory profiles created by human panel and acceptability data from pet owners may enable a more rapid, quantitative and predictive indication of changes on the products due to processing and storage.

Objectives

- To investigate how increasing levels of oxidation in rendered protein meals used to produce extruded pet food affected the sensory properties and
- To determine the sensory standard for rancidity that could be allowed in a rendered protein meal without negative affecting acceptability (liking) of the finish pet food.



Materials and Methods



Rendered protein meal	Antioxidant	Oxidation level	Sample Code
Beef meat and bone meal	None	High	BMBM-High
	Mixed tocopherols	Medium	BMBM-Medium
	Ethoxyquin	Low	BMBM-Low
Chicken byproduct	None	High	CBPM-High
	Mixed tocopherols	Medium	CBPM-Medium
	Ethoxyquin	Low	CBPM-Low

The pet food was not coated with flavors or fats upon exiting the dryer to eliminate confounding factors



Materials and Methods

- Shelf life

- Each sample was placed in freezer storage bags.
- Each bag was punctured with a pin sized hole to facilitate air exchange
- Stored in a covered plastic tote at ambient condition ($\sim 22^{\circ}\text{C}$ and 45% RH) for 0, 3, 6, 9, and 12 months.
- Samples at all time points were pulled from the shelf-life test and stored in the freezer (-18°C) until descriptive sensory analysis and consumer testing were performed.

Materials and Methods

- **Descriptive sensory analysis**

- Conducted by six highly-trained panelists
- Evaluated Rancidity-related sensory attributes
 - Stale
 - Cardboard
 - Oxidized oil
 - Rancid
- A numeric scale of 0–15 with 0.5 increments where 0 represents none and 15 extremely high



Attribute	Definition	Reference
Cardboard	<p>The aromatic associated with cardboard or paper packaging. The intensity rating is only for the “cardboardy” character within the reference.</p>	<p><u>Mission tortilla white flour = 2.5 (aroma).</u> Preparation: Serve 4 pieces of 1” square in a medium snifter and covered with a watch glass .</p> <p><u>Cardboard = 7.5 (aroma).</u> Preparation: 2” cardboard square in 1/2 cup of water. Serve in a medium snifter and covered with a watch glass.</p>
Stale	<p>The aromatic impression that is flat, dull and lacks freshness.</p>	<p><u>Mission tortilla white flour = 2.0 (aroma).</u> Preparation: Serve 4 pieces of 1” square in a medium snifter.</p>
Oxidized Oil	<p>The aromatic associated with aged or highly used oil and fat.</p>	<p><u>Microwave Oven Heated Wesson vegetable oil = 6.0 (aroma).</u> Preparation: Add 300 mL of oil from a newly purchased and opened bottle of Wesson vegetable oil to a 1000 mL glass beaker. Heat in the microwave oven on high power for 3 min. Remove from microwave and let sit at room temperature to cool for approximately 25 min. Then heat another 3 min, let cool another 25 min, and heat for one additional 3 min interval. Let beaker sit on counter uncovered overnight. Serve 1 tablespoon of the oil in a medium snifter, covered with a watch glass.</p>
Rancid	<p>A somewhat heavy aromatic characteristic of old, oxidized, decomposing fat and oil. The aromatics may include painty, varnish, or fishy</p>	<p><u>Microwaved Wesson vegetable oil (4 min) = 2.5 (aroma).</u> Preparation: microwave 1 1/2 cups oil on high power for 4 min. Let cool and Serve 1/4 cup in a snifter and covered with a watch glass.</p> <p><u>Microwaved Wesson vegetable oil (5 min) = 5.0 (aroma).</u> Preparation: microwave 1 1/2 cups oil on high power for 5 min. Let cool and Serve 1/4 cup in a snifter and covered with a watch glass.</p>

Materials and Methods

- **Consumer acceptance test**

- A Central Location Trial (CLT)
- Both foods produced with BMBM and CBPM samples without antioxidant (BMBM-High and CBPM-High) at 0, 3, 6, 9, and 12 months were selected for consumer study.
- A total of 106 pet owners who feed their pets dry food were recruited
 - Dog or Cat ownership
 - Willing to participate in the study
 - Have no allergies

Materials and Methods

- **Consumer acceptance test(cont.)**
 - A total of 10 samples were evaluated by each consumer
 - Questionnaires were administered by RedJade software (RedJade®, Redwood Shores, CA, USA).
 - Blind-coded samples were served to the pet owners monadically in a randomized order



Materials and Methods

- **Consumer acceptance test(cont.)**

- The pet owners were asked to evaluate their acceptability of each sample on a nine-point hedonic scale where 1 indicated “dislike extremely”, and 9 indicated “like extremely”.
- Pet owners were also asked about aroma intensities on a five-point Just-About-Right (JAR) scale where 1 indicated “too weak”, 3 “just about right”, and 5 “too strong”.



Materials and Methods

• Data Analysis

- Data from BMBM and CBPM diets were analyzed separately.
- Descriptive sensory data for each diet were analyzed by repeated-measures analysis overtime using PROC GLIMMIX procedure (SAS version 9.4, The SAS Institute Inc., Cary, NC, USA).
 - The fixed effects: Antioxidant treatment, Storage time, and their interaction
 - The random effects: Replication and panelist
 - Least Significant Difference (LSD) was used to determine significant effects of antioxidant treatment and storage time



Materials and Methods

- **Data Analysis (cont.)**

- Liking scores from consumer study were analyzed by a one-way ANOVA mixed effect model (SAS version 9.4, The SAS Institute Inc., Cary, NC, USA) using PROC GLIMMIX to determine significant differences among samples on liking scores.
- Partial least square regression (PLSR) was used to create external preference mapping by regressing descriptive attributes and consumer liking data to explore the drivers of liking for dry pet food. PLSR was performed using XLStat version 2015.3.01 (Addinsoft, New York, NY, USA)
- Penalty analysis for just-about-right (JAR) attributes for all storage time points were performed using XLStat version 2015.3.01 (Addinsoft, New York, NY, USA).

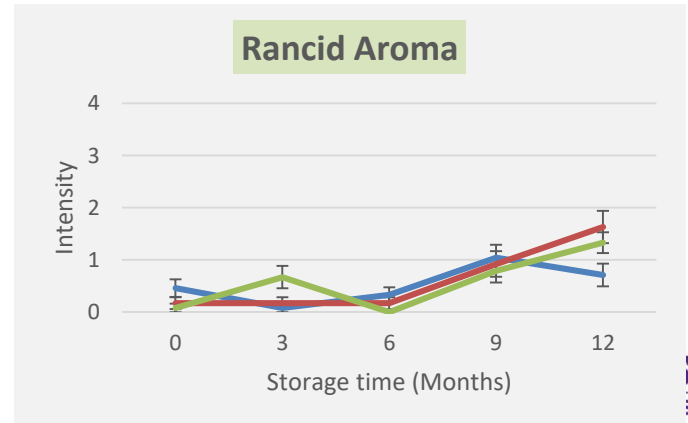
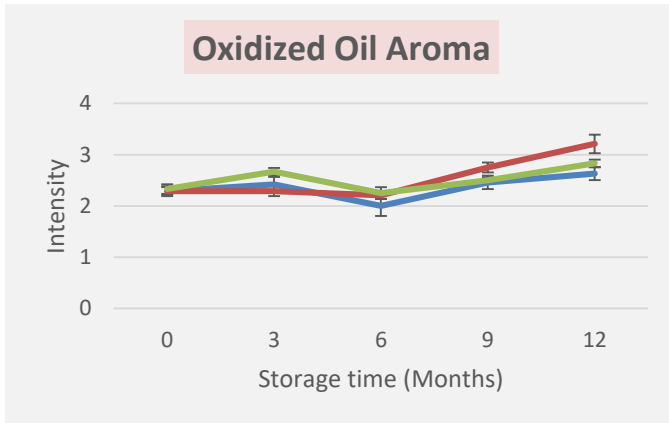
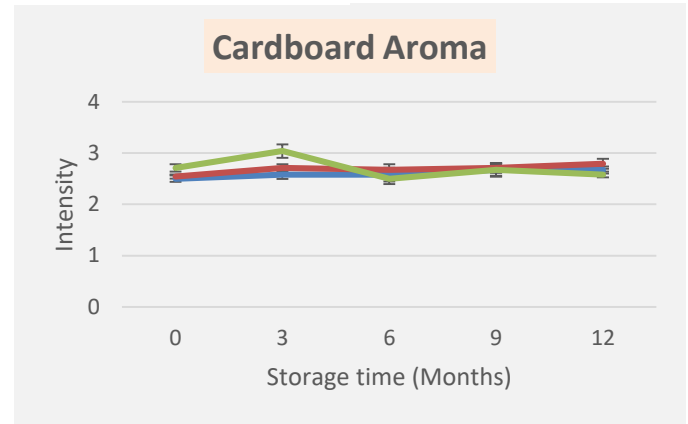
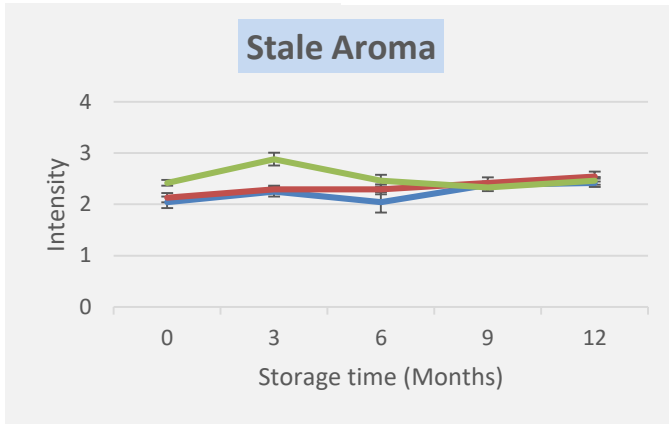


Results

Descriptive Sensory Analysis

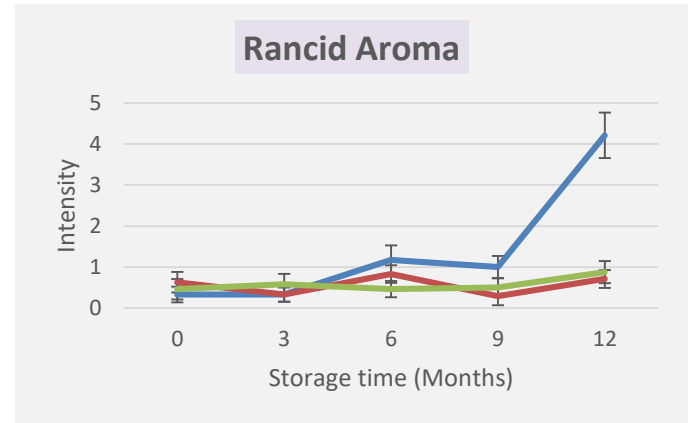
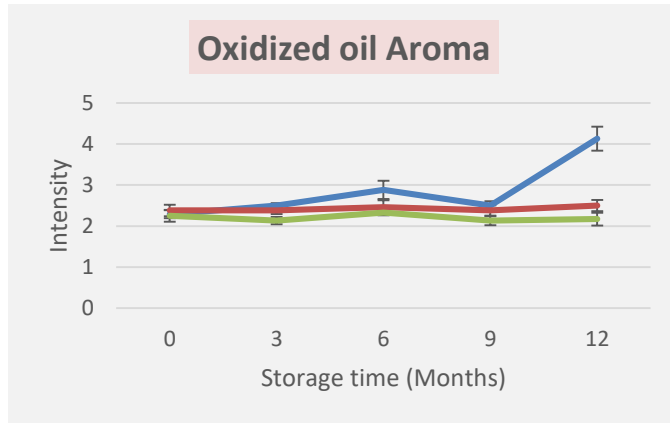
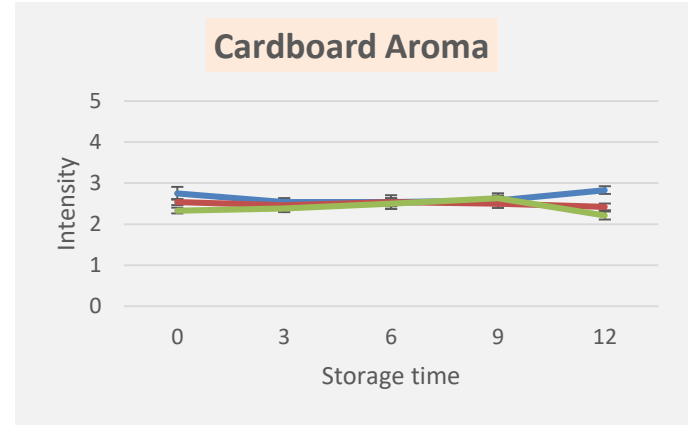
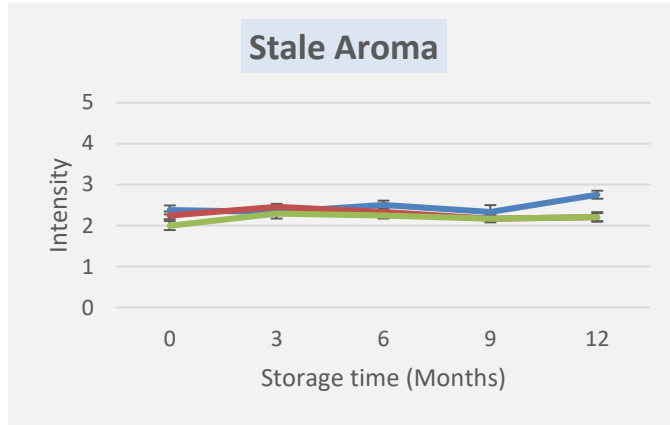
Beef meat and bone meal

■ BMBM-High ■ BMBM-Medium ■ BMBM-Low



Chicken byproduct meal

■ CBPM-High ■ CBPM-Medium ■ CBPM-Low





Results:

Consumer test

Beef meat and bone meal

Time point (month)	Overall liking	Appearance liking	Aroma liking
0	4.97	4.66	5.08
3	4.81	4.47	5.05
6	4.73	4.61	4.99
9	4.87	4.67	5.22
12	5.13	4.92	5.29
<i>p</i> -value	0.5227	0.4398	0.7108



Variable	Level	Frequencies	%	Mean drops	p-value	Significant
	Too little	44	41.51%	0.685	0.048	Yes
AromaJAR	JAR	45	42.45%			
	Too much	17	16.04%	2.139		

Chicken byproduct meal

Time point (month)	Overall liking	Appearance liking	Aroma liking
0	5.52 a	5.42	5.53 a
3	5.39 a	5.23	5.35 ab
6	5.32 a	5.23	5.22 ab
9	5.24 a	5.25	5.01 bc
12	4.95 b	5.05	4.79 c
<i>p</i> -value	<i>0.0013</i>	<i>0.0797</i>	<i>0.0004</i>

Acceptability



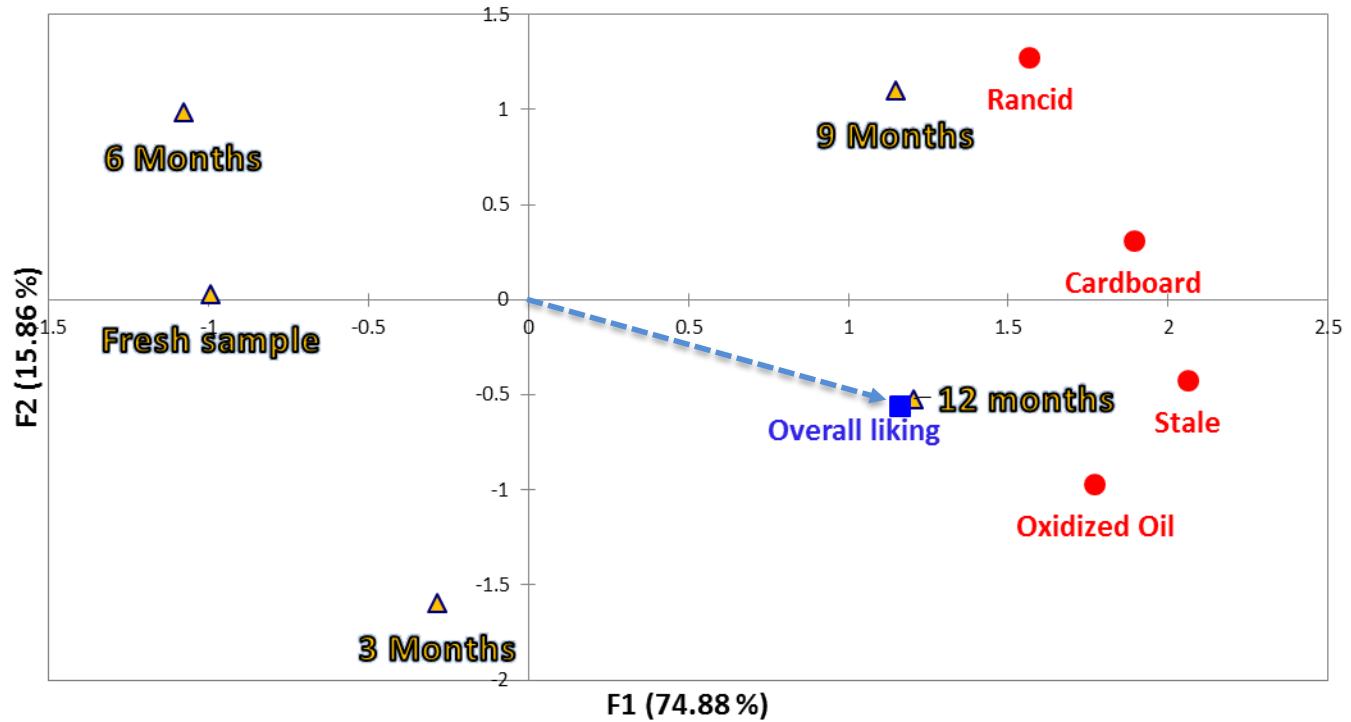
Variable	Level	Frequencies	%	Mean drops	p-value	Significant
	Too little	28	26.42%	0.536	0.240	No
AromaJAR	JAR	56	52.83%			
	Too much	22	20.75%	1.166	0.020	Yes



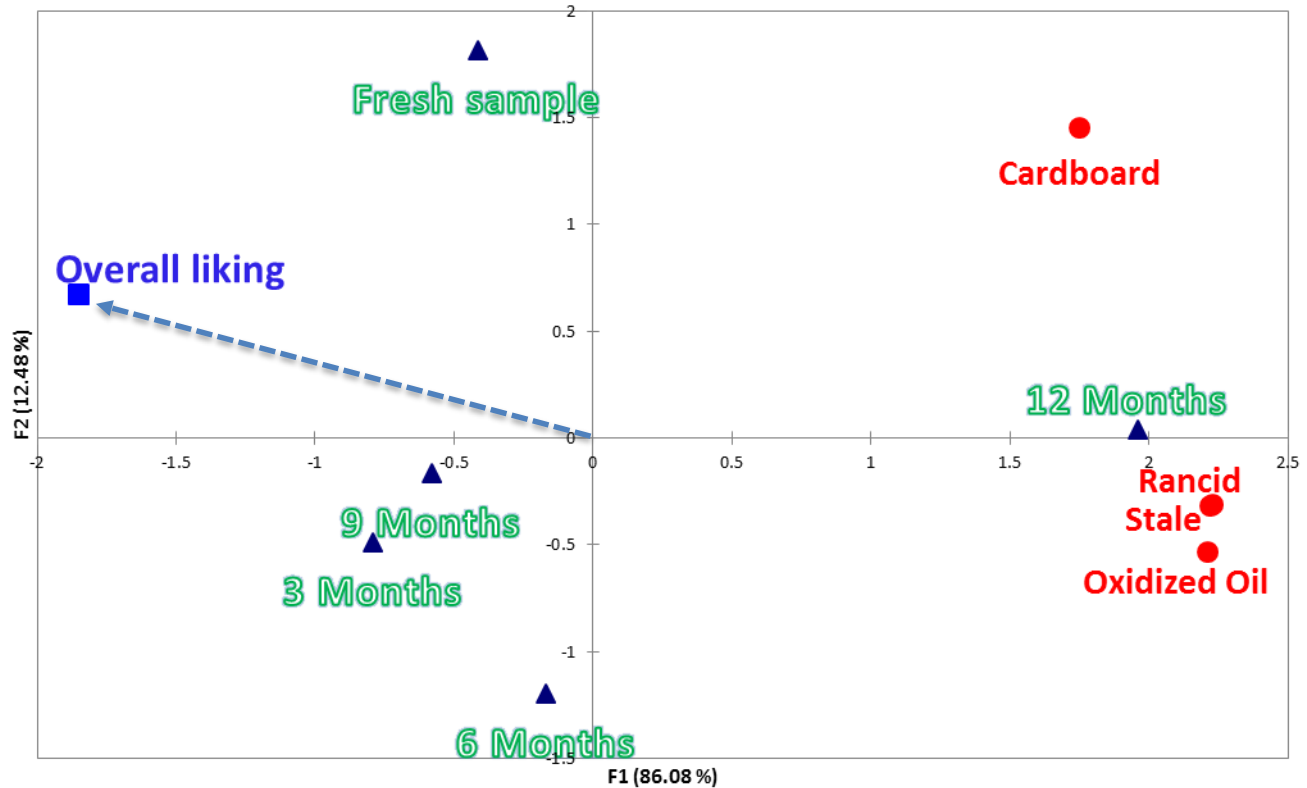
Results:

Drivers of Liking

Beef meat and bone meal



Chicken byproduct meal





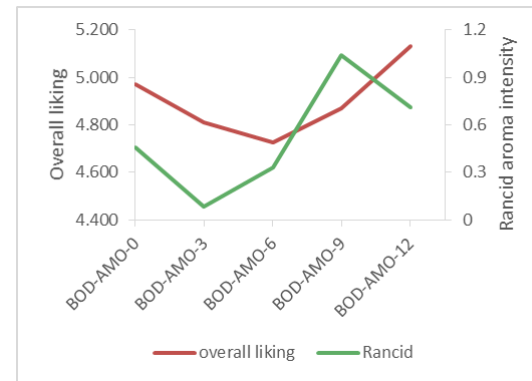
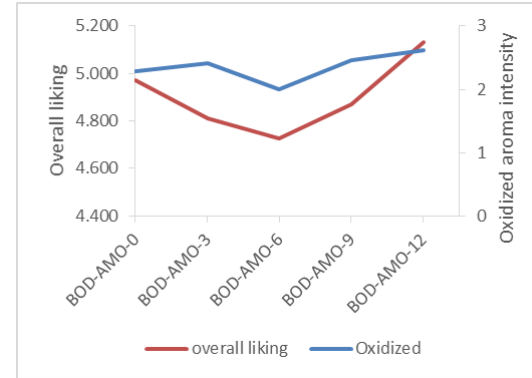
Results:

Determination of acceptable
levels of oxidation

Beef meat and bone meal

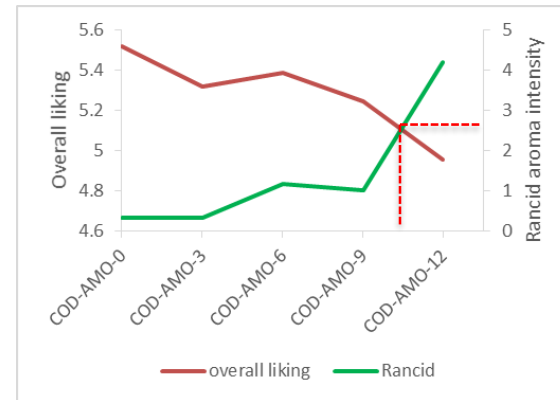
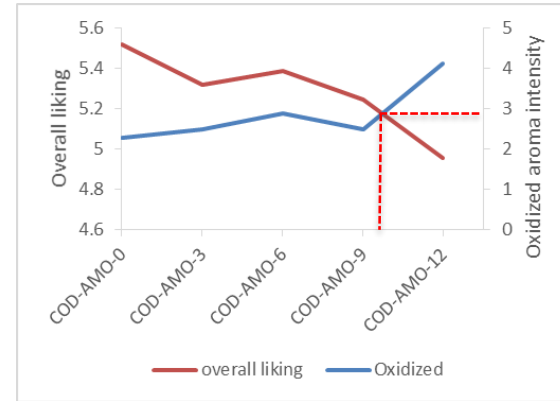
Variables	overall liking
Oxidized	0.760
Stale	0.503
Cardboard	0.241
Rancid	0.408

No significant correlation
between sensory attributes and
overall liking



Chicken byproduct meal

Variables	Overall liking
Oxidized	-0.882
Stale	-0.747
Cardboard	-0.441
Rancid	-0.903





Conclusions

Conclusions:

- Descriptive sensory analysis detected significant changes in pet food sensory characteristics for both the beef meal samples and the chicken byproduct meal samples.
 - Chicken byproduct meal samples, the differences were more pronounced and directional.



Conclusions:

- The consumer study showed no differences in consumer liking for beef meat and bone meal samples.
- The noticeable increase in aroma characteristics in chicken meal samples over storage time did have an effect on consumer liking.
- Consumers tended to give lower liking score for samples with either too low or too intense in aroma
 - Too intense aroma had more negative impact to sample liking.
- *Sensory profile created by human could be used successfully as a powerful and predictive indicator of acceptable levels of oxidation for consumers (purchasers).*

Acknowledgements

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