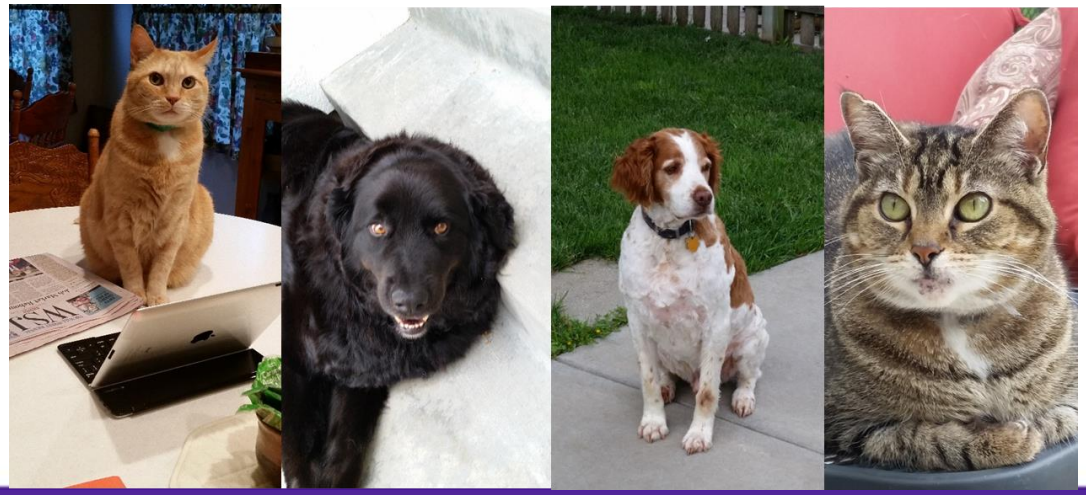
Alternative co-products streams from grains used in pet food applications

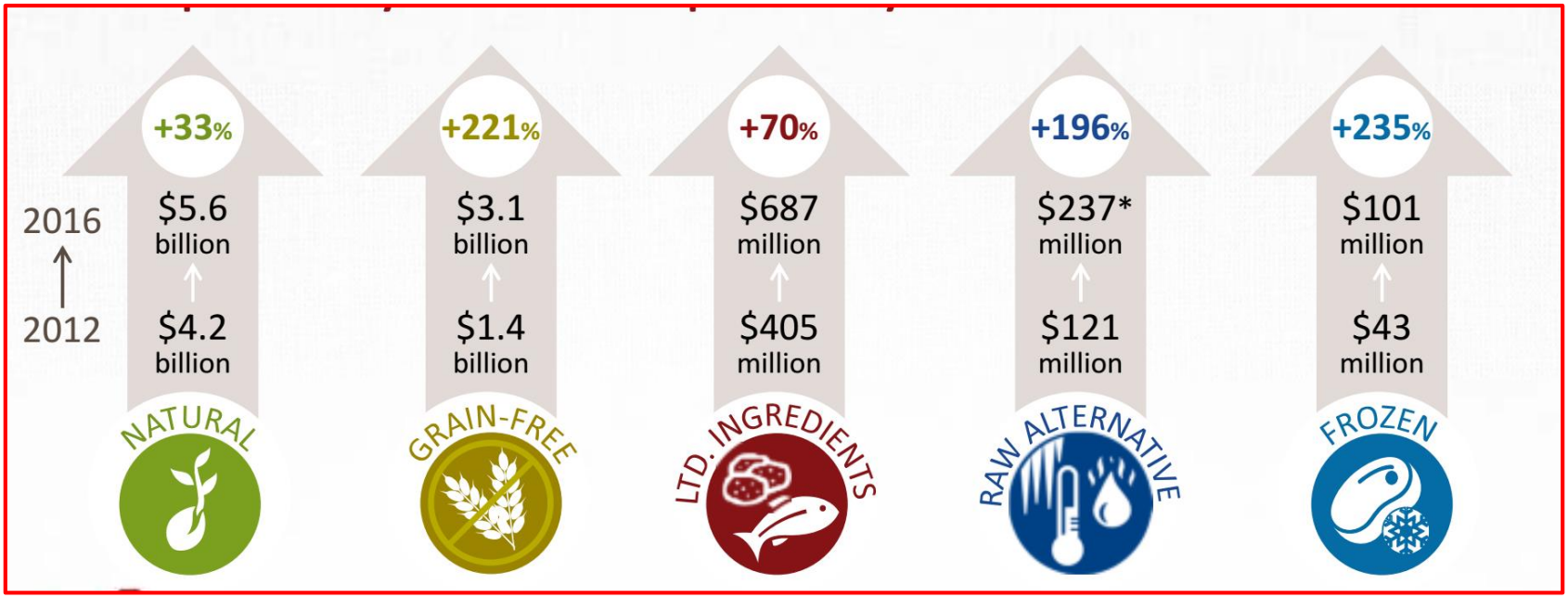
Presented by: Greg Aldrich, PhD



Overview

- Going with the Grain
- Pet Food Program at K-State
- Sorghum Fractions
- Next-Generation Distillers Grains
- Beyond Grain-Free

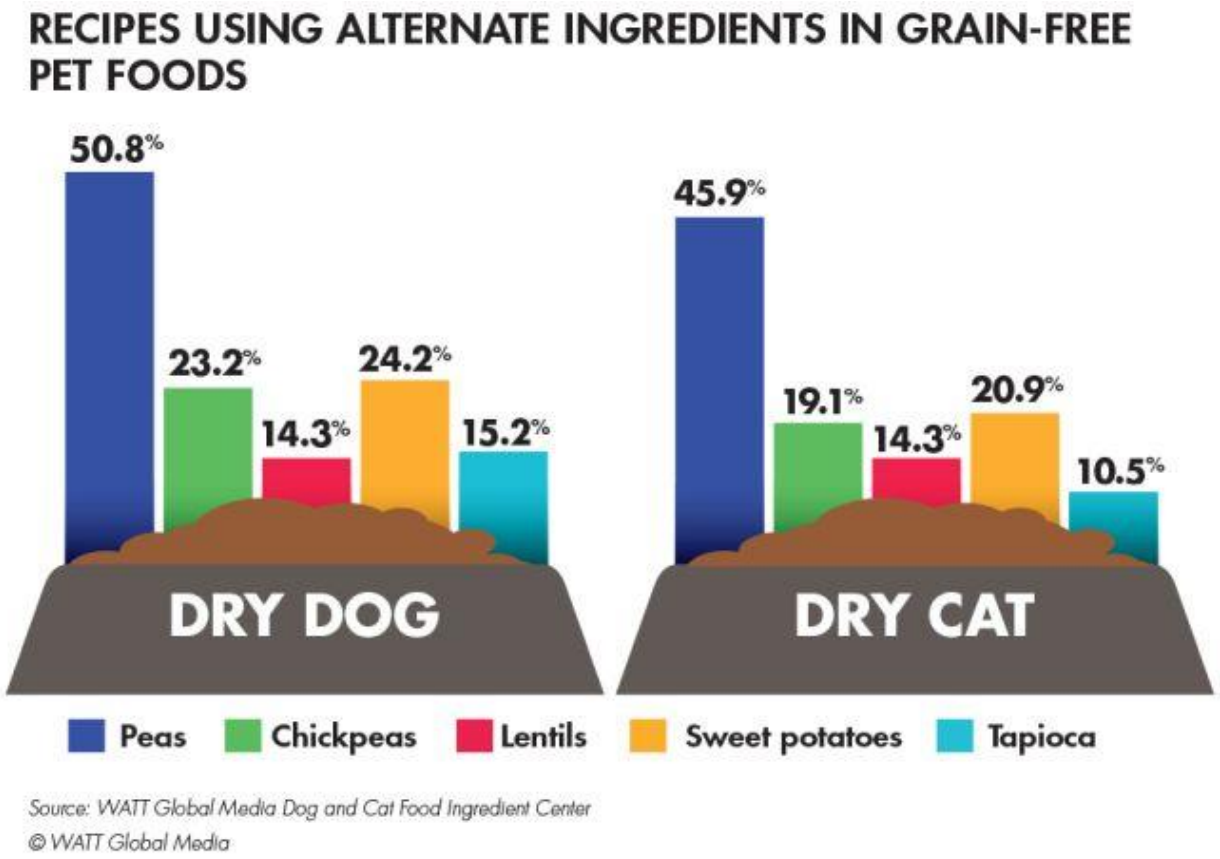
Evolution of Premiumization in Pet Specialty over the Past 5 years



*Raw Alternative represents full meal of 100% Freeze-Dried, 100% Dehydrated, and Dehydrated & Freeze-Dried Mixes. Segments are not mutually exclusive. Most grain-free products are also Natural. etc.

Lange, 2017 GfK: Petfood Forum 2017

Dog and Cat Food Ingredient Database



- 44% dog and 47% of cat recipes do not contain grain
- 28% of dog and 22% of cat have "grain free" in the product name

But……

- 80% of the $30 B pet food market remains conventional ingredients
- “Value Premium” products are growing
- As any product position begins to dominate new approaches will be begin to emerge
- In 1997 there were only a few therapeutic “elimination diets” - today they seem to predominate.
- Perhaps a new era is soon to emerge….Beyond Grain Free

KSU:Pet Food Program

- Established KSU 2012
- Home: Grain Science & Industry
  - Feed Science & Mgt
- Training: Short courses, Minor, BS, MS, PhD
- Cross-campus Initiative
- ECO-DEVO support

Hal Ross Flour Mill & BIVAP Extrusion Lab

Milling yields (%) for Sorghum used to produce experimental pet diets

Item	Flour	Mill-feed	Germ	Loss
Milled fractions, %	68.3	27.2	1.25	3.25

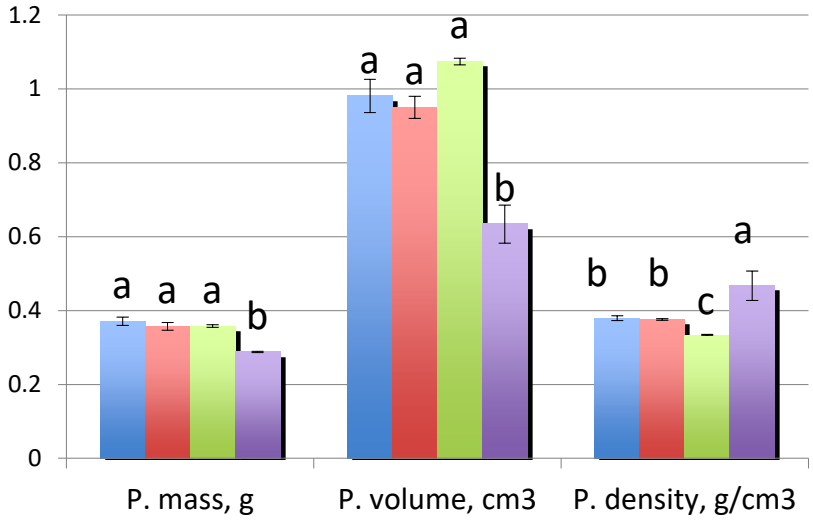
Proximate analysis of red sorghum (as is) used to incorporate into the dietary treatments

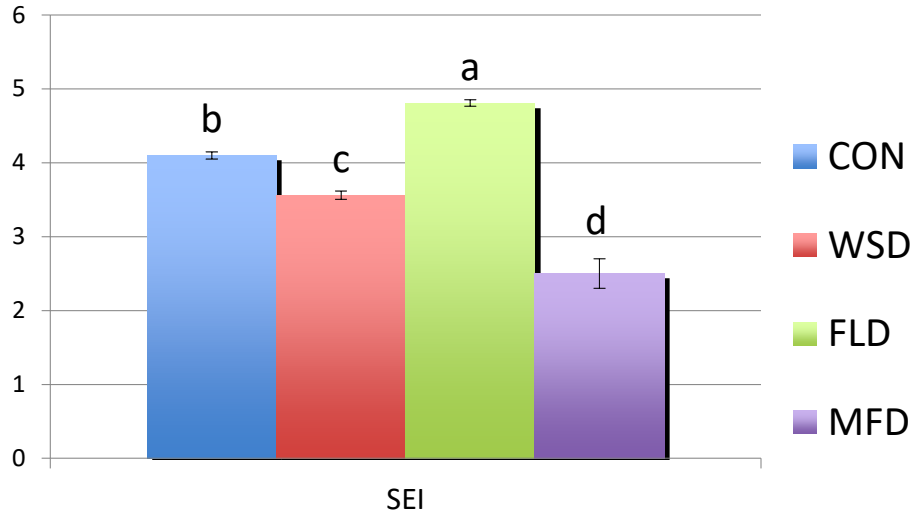
Item	Whole sorghum	Flour	Mill-feed
Moisture, %	12.94	12.37	11.49
Crude Protein, %	10.50	9.68	13.40
Crude Fat, %	2.81	3.68	5.02
Crude Fiber, %	1.18	n.d.	3.56
Ash, %	1.38	1.19	2.04

Carbohydrate analysis of red sorghum used to incorporate into the dietary treatments

Item	Whole Sorghum	Sorghum Flour	Sorghum Mill-feed
Crude Fiber, %	1.18	n.d.	3.56
ADF, %	3.80	1.40	7.70
NDF, %	6.70	1.50	16.80
TDF, %	8.80	3.20	20.0
Soluble Fiber, %	2.60	2.50	1.60
Insoluble Fiber, %	6.20	0.70	18.30
Lignin, %	n.d.	n.d.	2.90
Starch, %	61.5	67.0	43.8

Mean piece mass, volume, density and sectional expansion index (SEI) of kibbles from CON, WSD, FLD and MFD.





Food intake and feces collected (on DM basis) per day, number of defecations per day and fecal scores of dogs fed control (CON), whole sorghum (WSD), flour (FLD) diets and mill-feed (MFD) diets (N=12)

Item	CON	WSD	FLD	MFD	SEM	P
Food intake, g/d	185	186	181	195	6.5	0.4818
Feces excreted, g/d	42.0^{c}	55.7^{b}	32.6^{c}	95.4^{a}	3.24	<.0001
Defecations per day	2.18^{b}	2.38^{b}	2.10^{b}	3.02^{a}	0.098	<.0001
Fecal score	3.60^{b}	3.68^{ab}	3.78^{ab}	3.92^{a}	0.068	0.0007

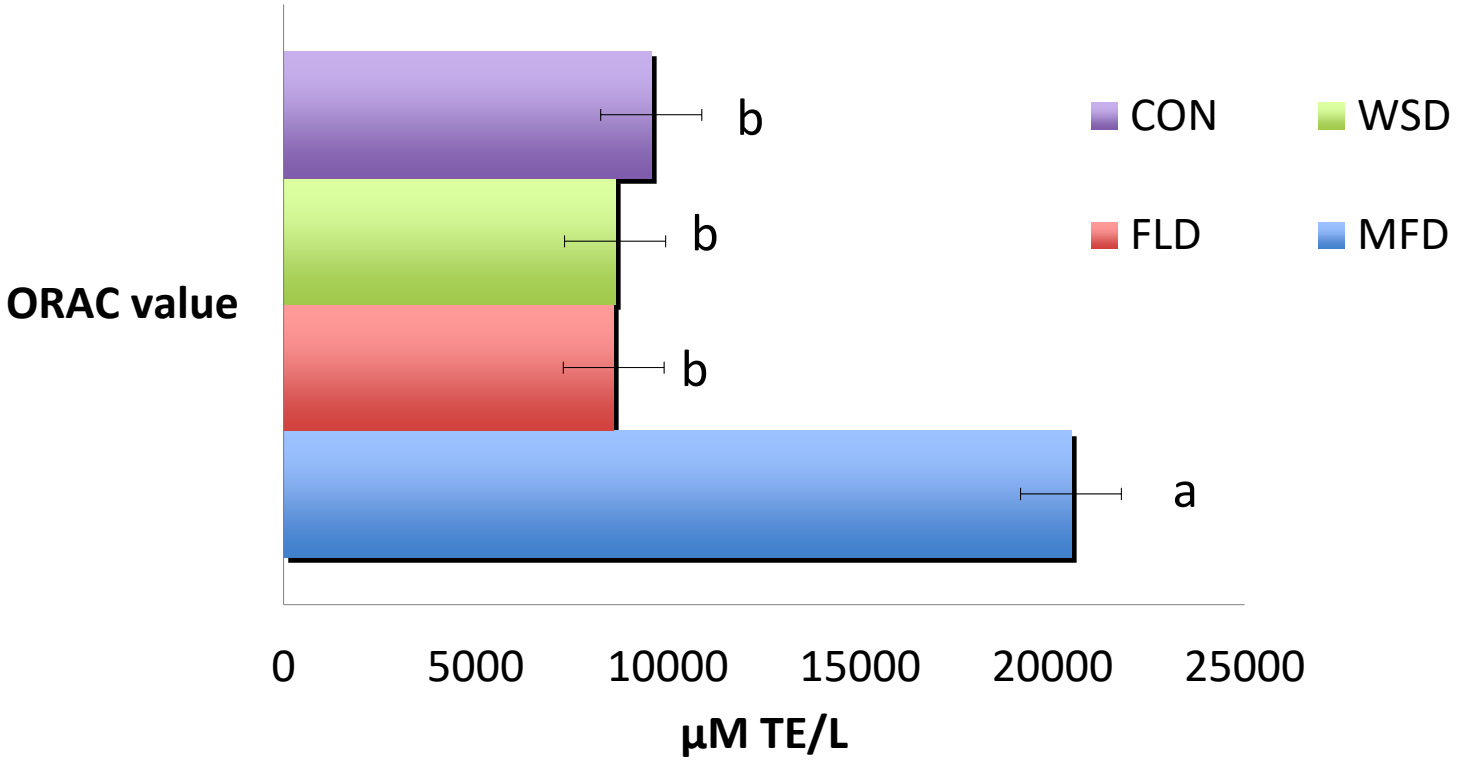
^{abc} Means within a row that lack a common superscript differ ($P \leq 0.05$).

Apparent total tract digestibility determined by estimates of fecal output by chromic oxide of dogs fed control (CON), whole sorghum (WSD), flour (FLD) and mill feed (MFD) diets

Item	CON	WSD	FLD	MFD	SEM	P
Dry Matter, %	83.0^{b}	81.1^{c}	86.0^{a}	65.9^{d}	0.44	<.0001
Organic Matter, %	88.0^{b}	85.8^{b}	90.7^{a}	70.6^{c}	0.34	<.0001
Energy, %	87.2^{b}	85.4^{b}	90.3^{a}	70.2^{c}	0.68	<.0001
Crude Protein, %	77.5^{b}	76.3^{b}	81.8^{a}	67.2^{c}	0.73	<.0001
Crude Fat, %	91.5^{a}	88.4^{b}	91.4^{a}	77.9^{c}	0.37	<.0001

^{abc} Means within a row that lack a common superscript differ ($P \leq 0.05$).

Oxygen radical absorbance capacity (ORAC) of plasma collected from dogs at the end of each period fed diets based on various sorghum fractions



USDA Agricultural Marketing Service:

Federal State Marketing Improvement Program

- Reintroducing Kansas Grains to Midwest Pet food Manufacturing and Processing Markets
  - *Sorghum Value Added Pet Food Focus*
  - Kansas Department of Agriculture
  - Lynne Hinrichsen (KDA), Greg Aldrich (GSI), Brandi Miller (GSI), Kadri Koppel (SAC), Sarah Sexton-Bowser (CSI)
- *Goal:* The Reintroducing *Kansas Grains to Midwest Pet food Manufacturing and Processing Markets; Sorghum Value Added Pet Food Focus* project is a three-phase project that will provide the necessary education and awareness to assist pet food manufactures in reformulating products and retooling processes to include sorghum in pet food and snack formulations.

ParticiPoll

- Navigate to: http://igp.participoll.com

Sorghum Utilization

What factor limits your inclusion of sorghum in formulations?

A) Availability/supply chain surety

B) Pricing

C) Consumer Perception

D) Lack of utilization knowledge

Sorghum Sourcing

Would you be interested in directly sourcing grains from farmers?

A) Yes

B) No

C) Yes, if the process was facilitated

Next-Generation Distillers Grains

- Higher protein distillers grains
- Processing evaluation
- Physical properties (texture)
- Digestibility in dogs
- Palatability in dogs and cats

Kibbles Produced from CGM, SBM, NG-DDG

Nutrient Composition of Experimental Ingredients Expressed on an as-is Basis.

Item	CGM	SBM	NG-DDG
Moisture	10.17	12.33	6.71
Crude Protein	67.1	47.8	50.8
Crude Fat	1.58	1.12	3.90
Crude Fiber	n.d.	3.18	4.13
Ash	1.00	6.10	4.26

Experimental Diets Ingredient Composition to Evaluate NG-DDGs Relative to CGM And SBM.

Ingredient Name	CGM	SBM	NG-DDG
Base Ration	72.71	72.71	72.71
Corn	33.94	33.94	33.94
Chicken Meal, Low Ash	28.85	28.85	28.85
Beet Pulp	4.00	4.00	4.00
Fish Oil	0.14	0.14	0.14
Vitamins and MInerals	1.35	1.35	1.35
Natural AOX, Dry	0.04	0.04	0.04
Corn Gluten Meal	20.5	-	-
Soybean Meal	-	24.75	-
NG-DDG Flinthills (cp 49.2)	-	-	25
Corn Starch	4.50	0.25	-
Titanium Dioxide	0.40	0.40	0.40
Chromium Sesquioxide, mw 151.99	0.25	0.25	0.25
Chicken Fat**	5.00	5.00	5.00
Flavor Powder**	1.00	1.00	1.00
Natural AOX, liquid**	0.03	0.03	0.03
Total	100.0001	100.0001	100.0001

**surface applied (not administered through extrusion)

Defecations, Scores, and Fecal Output of Dogs Fed Vegetable Protein Diets

	Diet				
Item	CGM*	SBM*	NG-DDG*	p-Value	SEM
Daily Defecations	2.03^{b}	2.43^{a}	2.38^{a}	0.0299	0.38
Fecal Score**	3.28^{b}	3.43^{ab}	3.64^{a}	<.0001	1.37
Dry Fecal Weight	35.91^{c}	43.25^{b}	55.65^{a}	<.0001	4.46

abc indicates that within a row, samples with unlike letters were significantly different ($p<0.05$)

*Corn Gluten Meal (CGM), Soybean Meal (SBM), Next Generation-Distillers Dried Grains (NG-DDG)

**Feces Were Scored On A 1-5 Scale with 1 = completely liquid and 5 hard, dry Pellets.

The Effect of Vegetable Protein Source on Nutrient Digestibility by Dogs in Extruded Dry Food Kibble Calculated by Total Fecal Collection.

	Diet				
Item	CGM*	SBM*	NG-DDG*	p-Value	SEM
Dry Matter	84.25[a]	81.07[b]	77.27[c]	<.0001	1.35
Organic Matter	88.09[a]	84.53[b]	82.25[c]	<.0001	1.37
Crude Protein	86.90[a]	83.36[b]	82.92[b]	<.0001	1.31
Crude Fat	92.15[a]	92.09[a]	90.54[b]	<.0001	0.77
Crude Fiber	30.00[a]	23.20[a]	3.67[b]	0.0007	15.73
Ash	37.39[b]	42.50[a]	38.12[b]	0.0449	5.18

abc indicates that within a row, samples with unlike letters were significantly different ($p<0.05$)
*Corn Gluten Meal (CGM), Soybean Meal (SBM), Next Generation-Distillers Dried Grains (NG-DDG)

The effect of vegetable protein source* on palatability assessed by dogs

Diet A vs. B	n[1]	IR of diet A[2]
NG-DDG vs. CGM	17	0.365*
SBM vs. CGM	13*	0.432
SBM vs. NG-DDG	20	0.454

*p-value is less than 0.05

[1]Number of first visits to bowl with diet B can be obtained by 40-n

[2]IR of diet A = intake (g) of diet A/total intake (g) of diets A+B
IR of diet B can be obtained by 1-IR of diet A

[3]Corn Gluten Meal (CGM), Soybean Meal (SBM), Next Generation-Distillers Dried Grains (NG-DDG)

The effect of vegetable protein source* on palatability assessed by cats

Diet A vs. B[3]	n[1]	IR of diet A[2]
NG-DDG vs. CGM	22	0.606*
SBM vs. CGM	19	0.632*
SBM vs. NG-DDG	20	0.456

*p-value is less than 0.05

[1]Number of first visits to bowl with diet B can be obtained by 40-n

[2]IR of diet A = intake (g) of diet A/total intake (g) of diets A+B
IR of diet B can be obtained by 1-IR of diet A

[3]Corn Gluten Meal (CGM), Soybean Meal (SBM), Next Generation-Distillers Dried Grains (NG-DDG)

Conclusions

- Markets evolve and change – Ancient, alternative, and grain co-products may have a place in the next generation of pet foods
- Sorghum fractions created two potential new products for the pet market
  - Sorghum Bran rich in antioxidants and fiber
  - Sorghum Flour for specialty products
- Next-generation DDG's create a new alternative protein to soybean meal as a value-added and sustainable contribution to pet foods.

Acknowledgments

Events & Short Courses

- 2017
  - *October 12-14* Pet Food R&D Showcase – Going with the Grain – KSU – Manhattan
  - *December 5* Technolgia de Alimentos para Mascotas: Innovacion en Dietas Superpremuim – UABC, MX
- 2018
  - *January 8-12* Pet Food Formulation for Commercial Production – KSU (IGP)
  - *April 23-25* Pet Food Innovation Workshop & Petfood Forum
  - *August 6-10* Pet Food Workshop & Extrusion Workshop


Pet Food
Processing Lab