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INSIGHTS INTO EUROPEAN PET FOOD TRENDS AND INNOVATION

PETFOOD FORUM EUROPE

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Public

Mild extrusion process yields higher resistant starch that improves gut health of dogs

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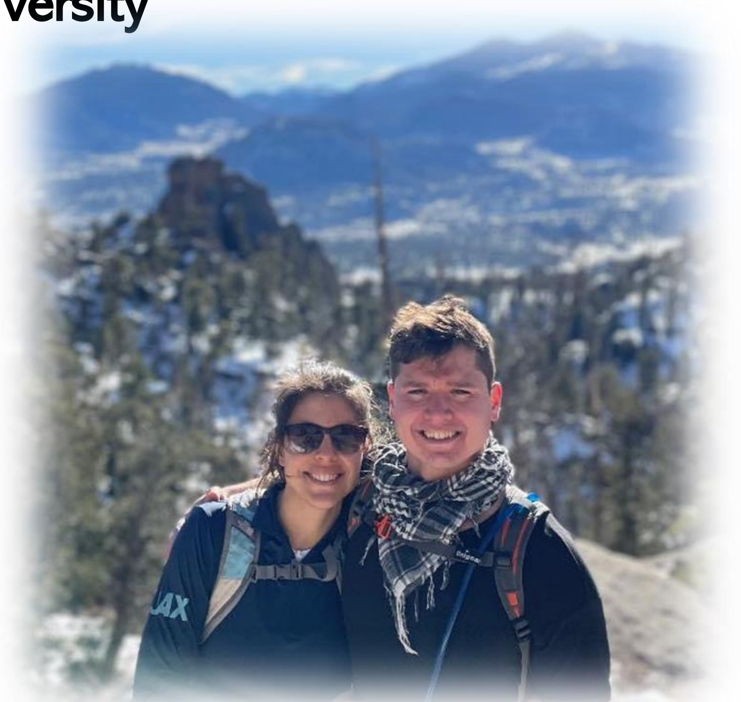
My Background

Isabella Corsato Alvarenga, Ph.D.

- 2007-2012 Veterinary Medicine at the University of Sao Paulo
- 2015-2016 MSc in Grain Science (Pet Food focus) at Kansas State University
- 2016-2021 PhD in Grain Science (Pet Food focus) at Kansas State University
- 2017- Intern at Hill's Pet Nutrition
- 2021-2024 Post Doc at Colorado University (CBD research)
- 2024 – ∞ Pet Health Tech Services Manager at IFF



Fort Collins, Colorado

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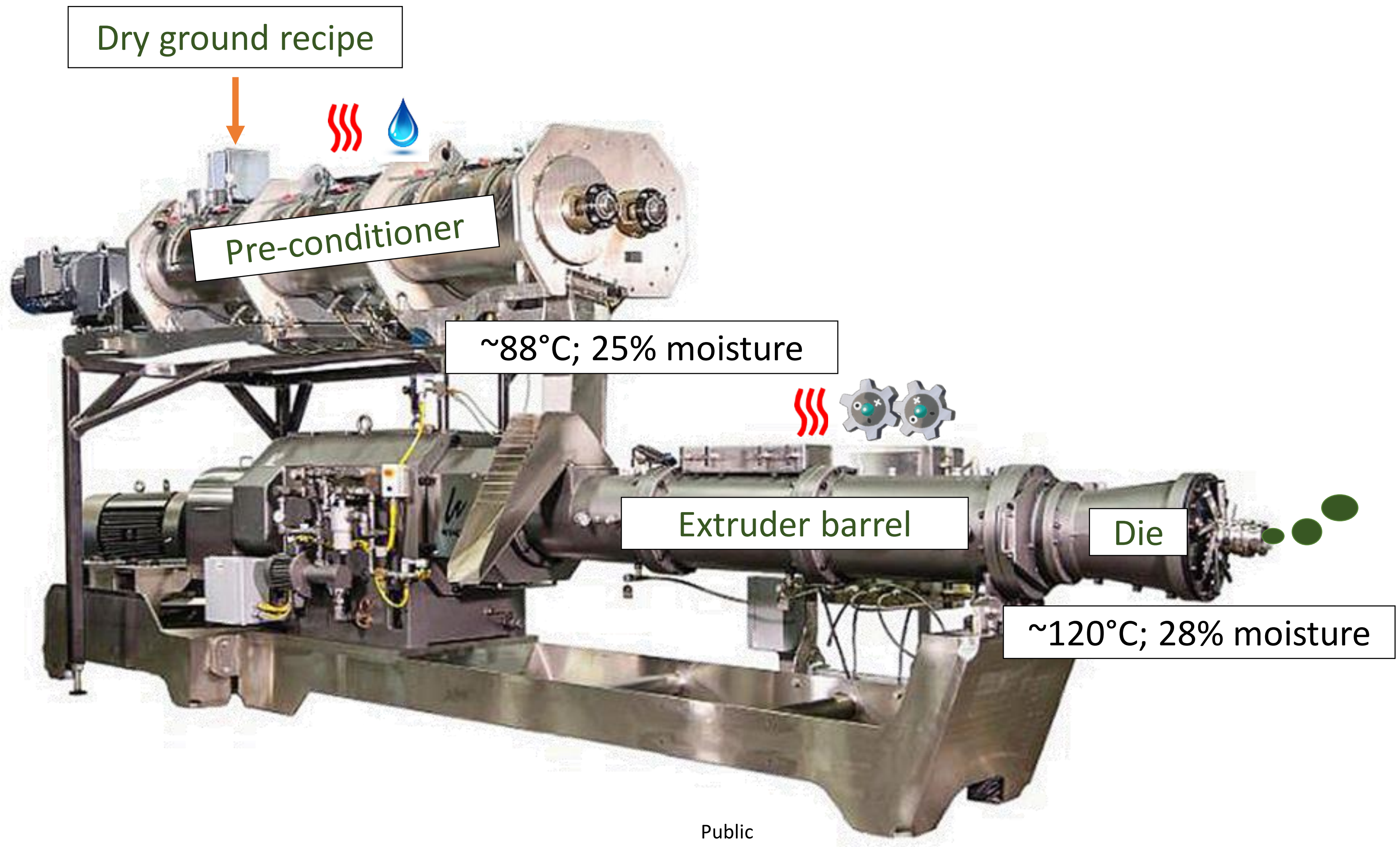
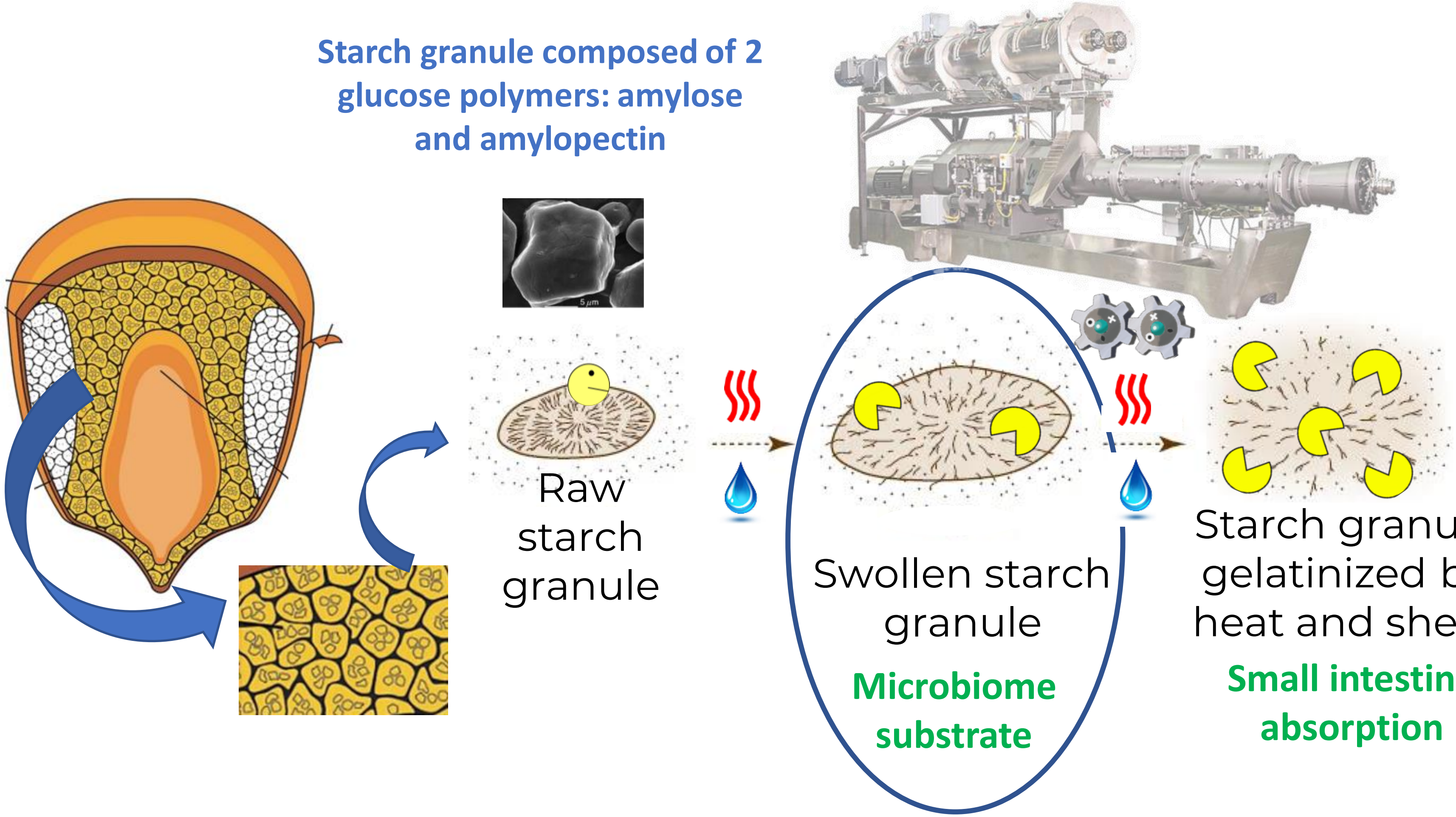
We target optimal nutrition for our pets' health and longevity

- Pet food extrusion
  - Large market share ($84.4 bi in 2024, 6.9% CAGR)
  - Usually requires moderate carbohydrate inclusion (~30-60%)
- Carbohydrates
  - Not essential, source of energy, palatability, aids processing
  - Highly digestible when fully cooked
  - Can lead to metabolic syndromes when in excess
- Our work
  - Change the starch nutrition to benefit gut health

Extrusion is an effective cooking machine

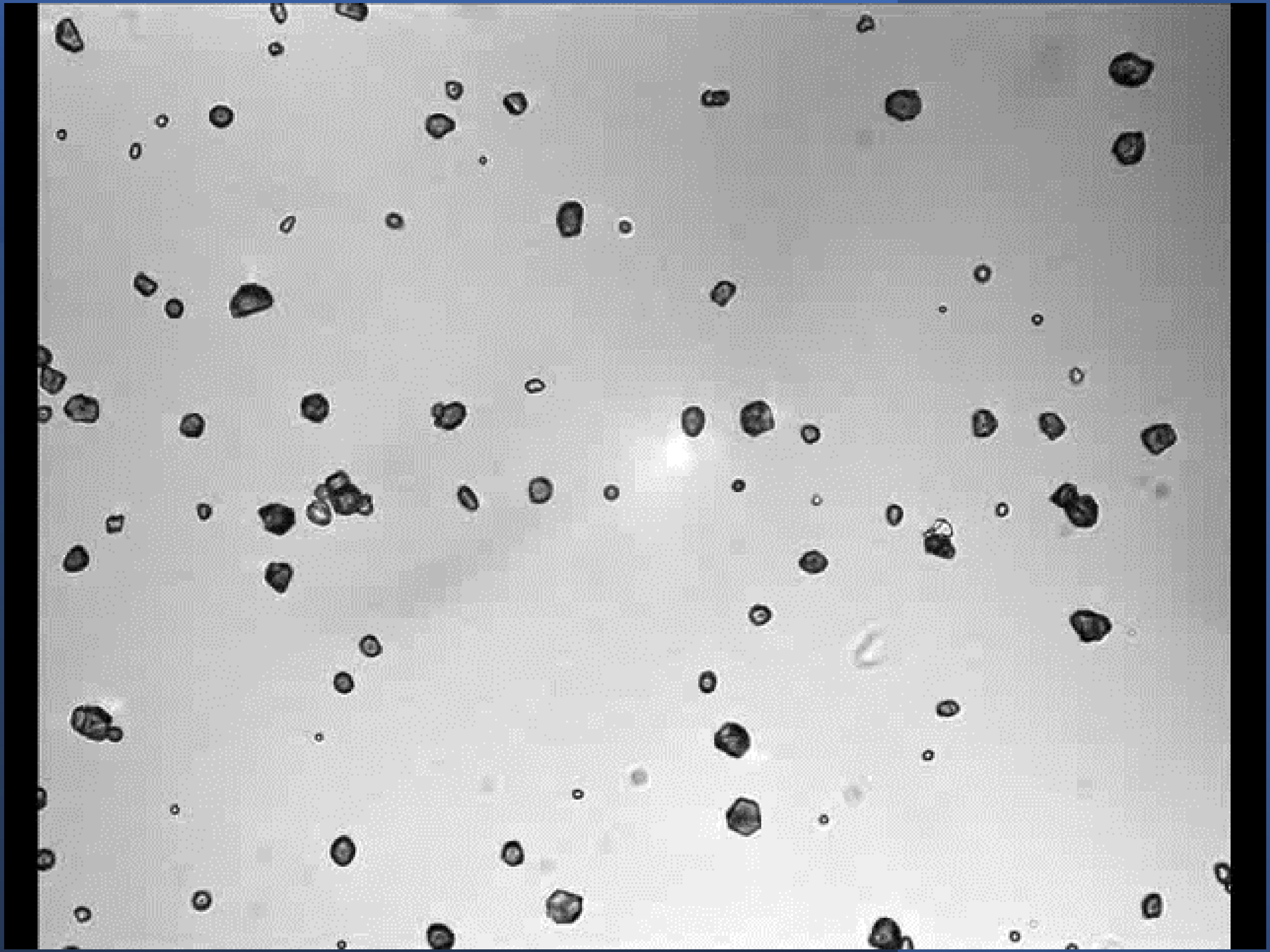


Traditional extrusion promotes starch gelatinization with mechanical and thermal energies

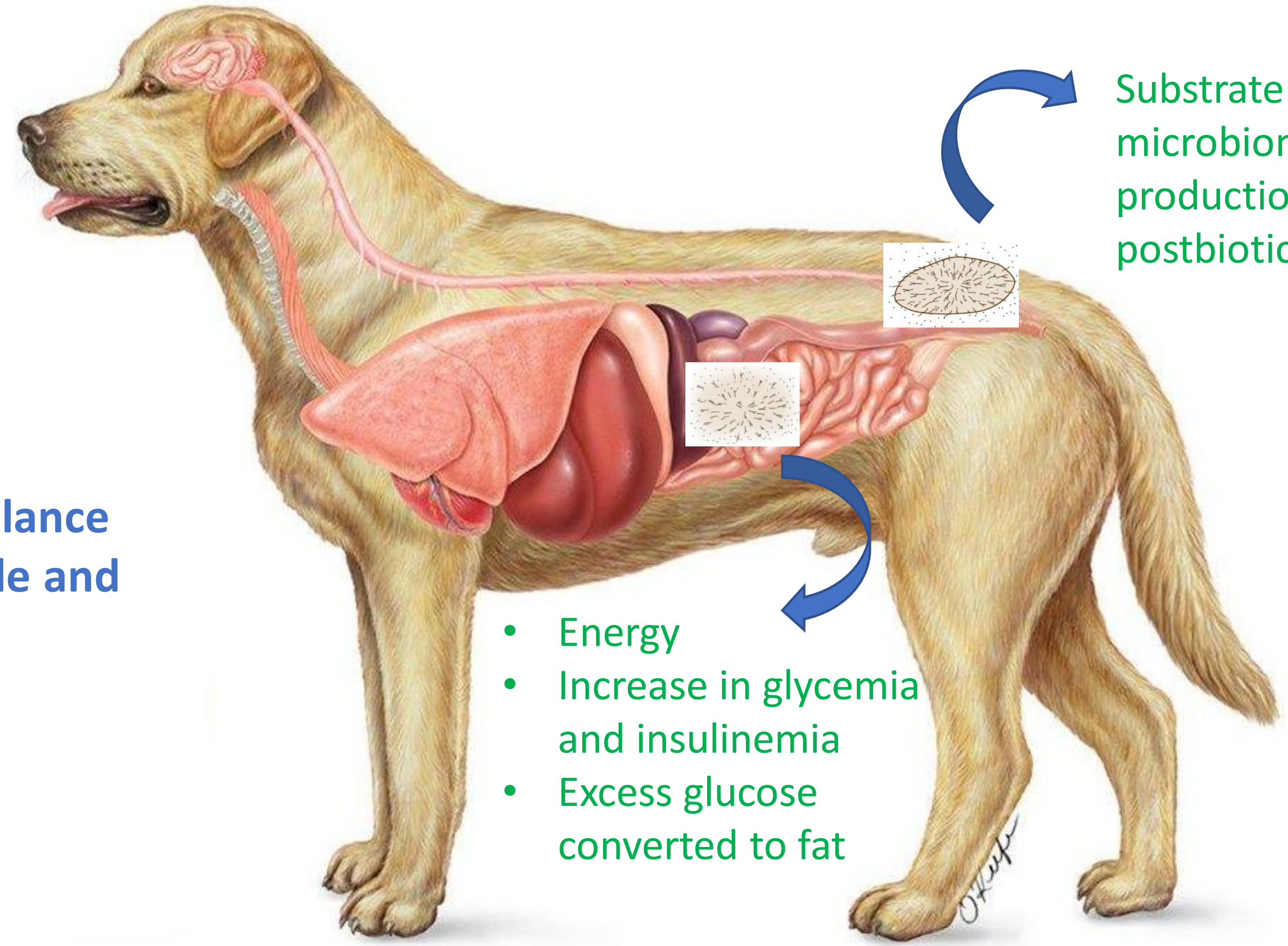


Starch needs water, temperature and time to fully gelatinize

Low mechanical energy, heat and high moisture may cook the starch while preventing shear



Hypothesis: mildly cooking the kibble will increase resistant starch type 2 and promote gut health



Substrate for microbiome: production of postbiotics

- Energy
- Increase in glycemia and insulinemia
- Excess glucose converted to fat

Ideal to find a balance between available and resistant starch

Identical recipe used to produce a high, medium and low shear foods

Ingredient	Inclusion, %
Whole yellow corn	65.4
Chicken meal	20.0
Potassium chloride	0.40
Lysine	0.10
Sodium chloride	0.10
Taurine	0.05
Mineral premix	0.14
Vitamin premix	0.20
Choline chloride, liquid	0.20
Lactic acid	1.50
Choice white grease	8.40
Dry digest	3.50

Parameters	High Shear	Medium Shear	Low Shear
Shaft speed (SS), rpm	458	375	260
In-barrel moisture (IBM), %	25.8	31.2	31.2
Wet bulk density, g/L	386	428	435
SME, kWh/ton	39.5	27.9	23.6

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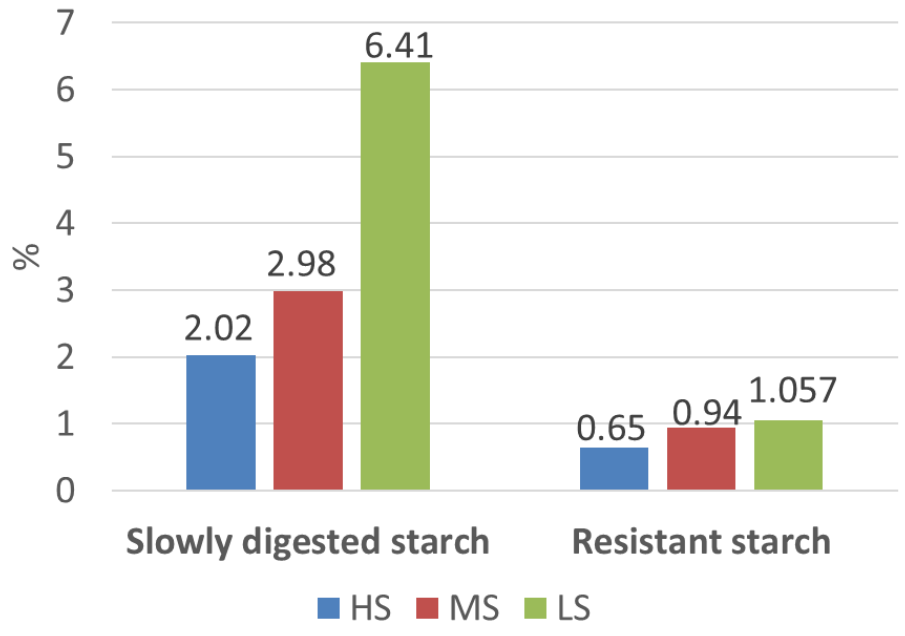
Corsato Alvarenga et al., 2021

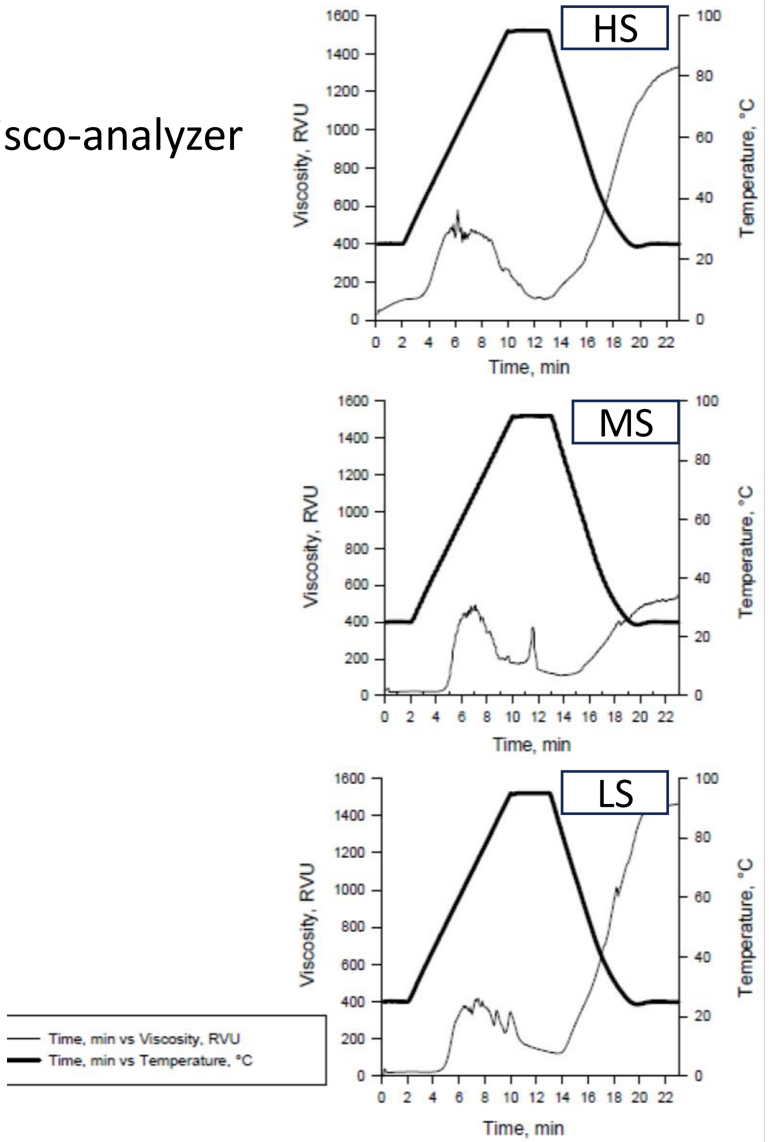
Starch transformation confirmed with chemical and physical methods

Megazyme *in vitro* kit

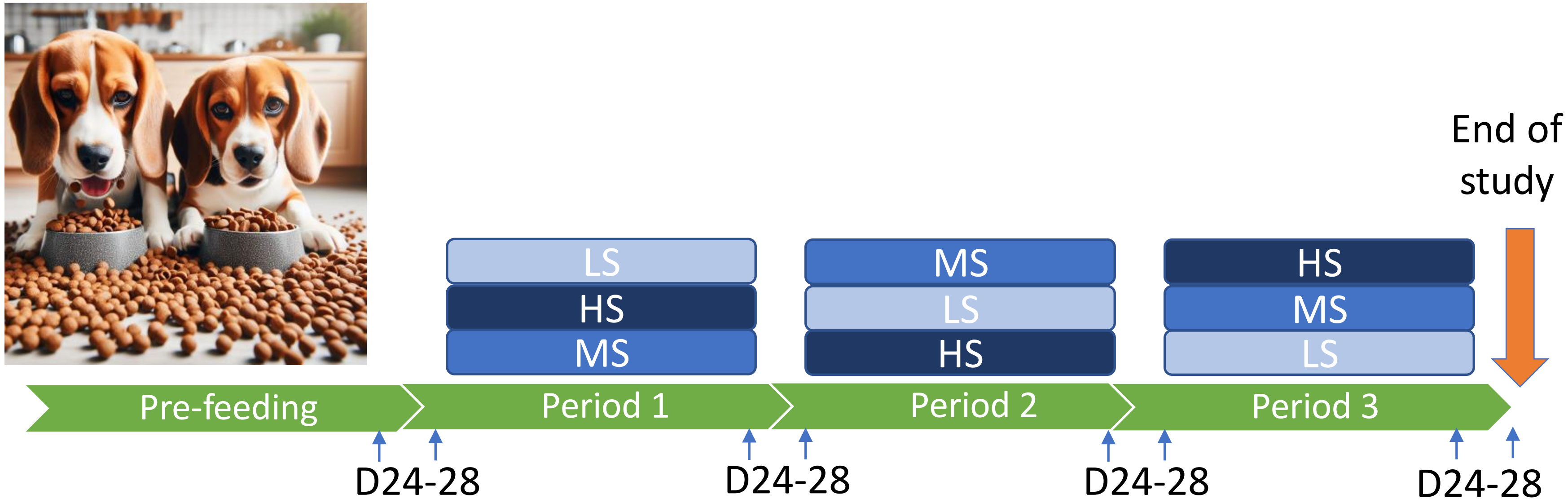


	HS	MS	LS
Starch cook, %	99.6	91.9	88.8

Rapid visco-analyzer



The 3 foods were fed to 18 healthy adult dogs in a 3x3 William's Latin square design



D 24-26: fresh fecal collection for metabolomics, microbiome and SCFAs
D 27-28: blood collection for serum metabolomics and CBC/chem
D 28: switch foods

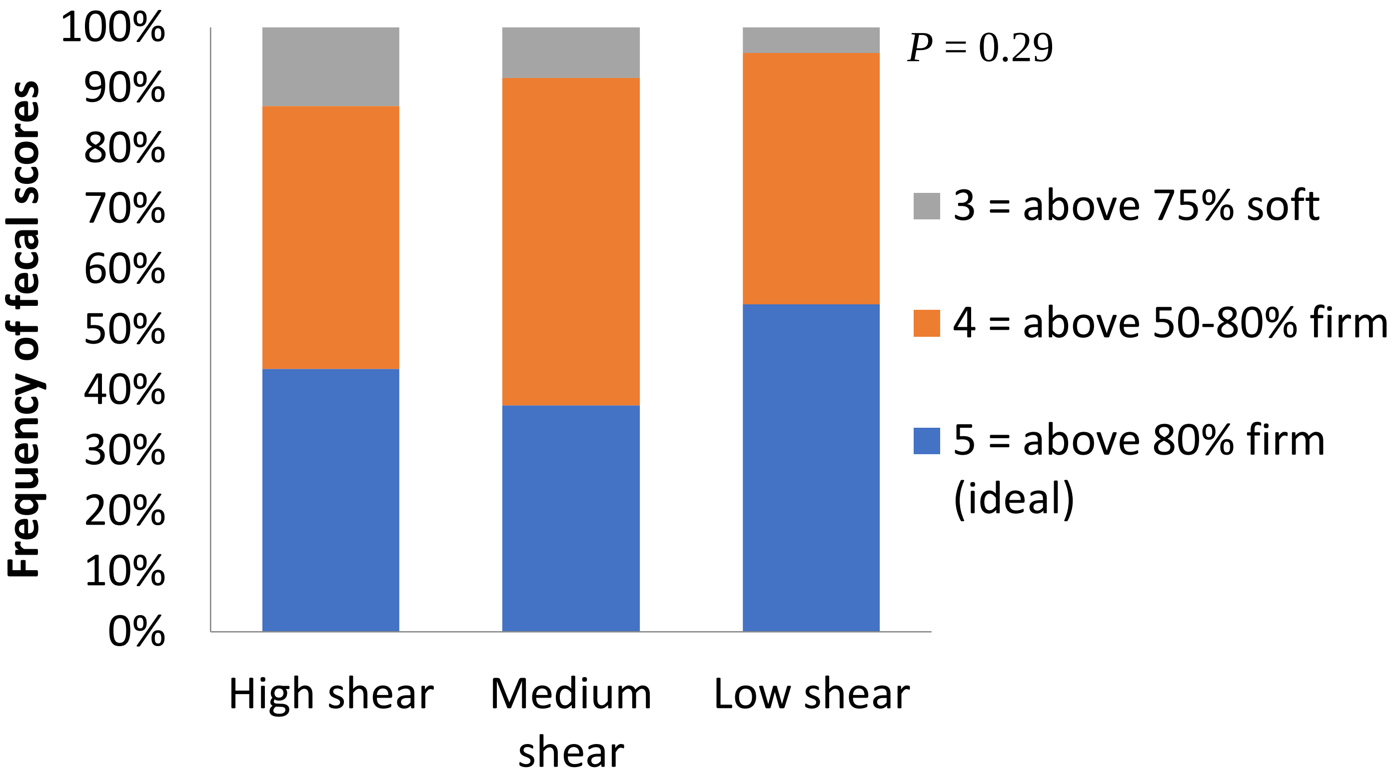
Resistant starch intake (g/BW0.75/day): 0.206c (HS), 0.295b (MS) and 0.319a (LS) (P <.0001)

Data analyzed as mixed model (SAS)

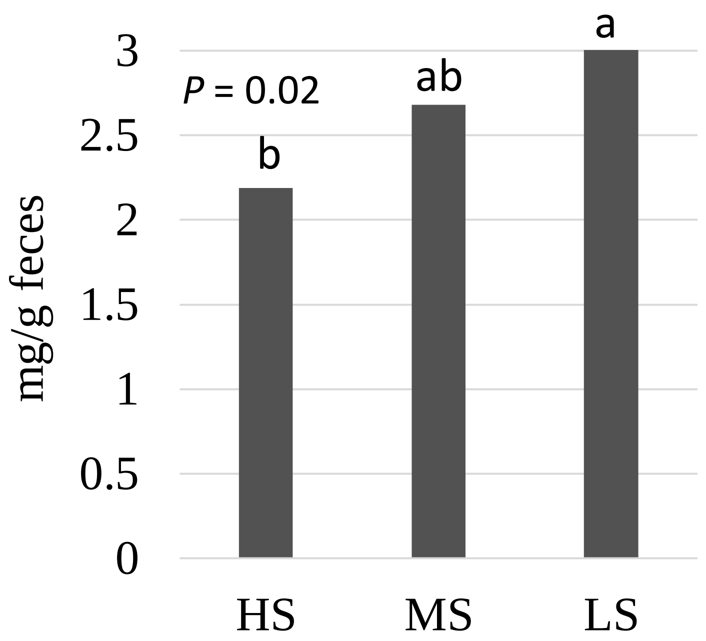
Corsato Alvarenga et al., 2021

Health was maintained during the study

Fecal quality was unaffected by treatment



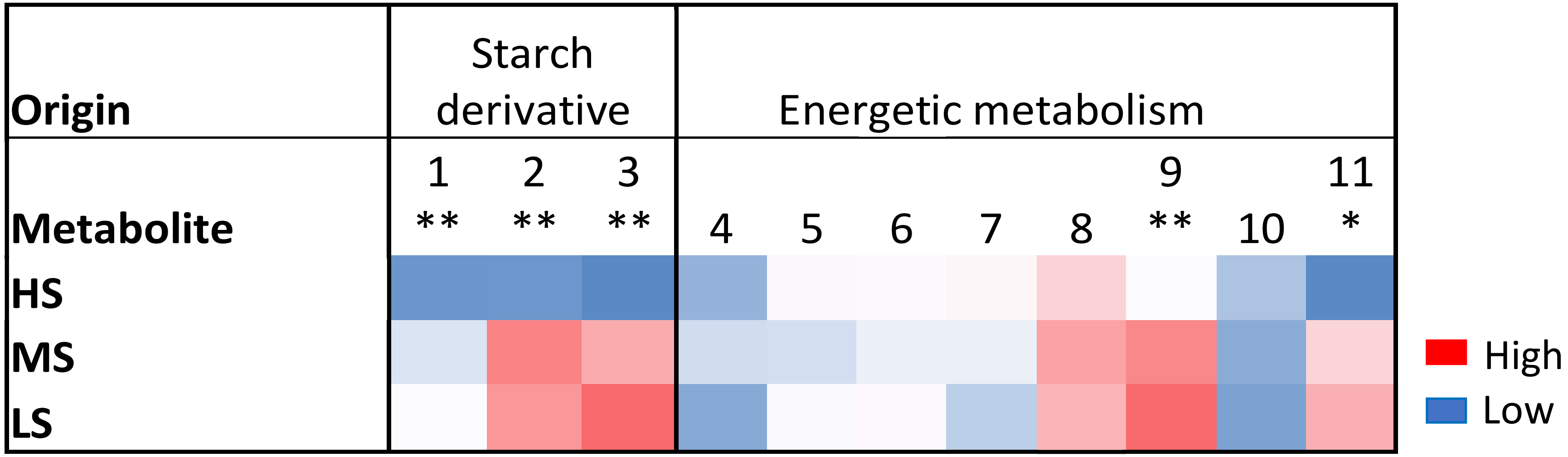
Butyrate was greater in feces of dogs fed the LS compared to HS



Preliminary palatability study indicated that MS was more palatable than HS

Normal levels of complete blood count and blood chemistry

Medium and low shear foods provided starch derivatives to the gut microbiota



1, glucose; 2, maltose; 3, maltotetraose; 4, α-ketoglutarate; 5, citraconate/glutaconate; 6, fumarate; 7, malate; 8, phosphate; 9, succinate; 10, succinylcarnitine (C4-DC); 11, lactate.

**$P < 0.05$; q < 0.10

* $P < 0.05$; q > 0.10

Serum energetic and glucose metabolisms were unaffected by treatment

Starch derivatives in LS and MS foods shifted the microbiota to beneficial saccharolytic fermentation

Bacteria that ferment sugar

	Centered log-ratio						Spearman's rho correlation						
Bacteria (Family genus)	**HS**		**MS**		**LS**		**maltose**	**malto-tetraose**	**butyrate**	**SCFA**	**succinate**	**lactate**	**pH**
Bacteroidaceae Bacteroides		b		a		ab			▲	▲			
Lachnospiraceae Roseburia		b		a		ab	▲			▲			▼
Prevotellaceae unclassified		b		a		ab			▲	▲	▲		
Paraprevotellaceae								▼	▲	▲		▼	
Enterobacteriaceae Yersinia		b		ab		a		▲			▲	▲	▼
Coriobacteriaceae Slackia		a		b		ab	▼		▼	▼			
Porphyromonadaceae unclassified		a		b		b			▼		▼		
Erysipelotrichaceae Catenibacterium		b		a		ab	▲						
Lachnospiraceae Blautia		a		b		ab	▼		▼	▼			▲
Turicibacteraceae Turicibacter		a		b		ab			▼	▼			
Fusobacteriaceae		a		b		ab			▼	▼			
Veillonellaceae		a		b		ab		▼			▼		▲
Bartonellaceae Bartonella		a		b		ab	▼	▼			▼		
Fusobacteriaceae Cetobacterium		a		b		ab					▼	▼	▲
Enterobacteriaceae unclassified		a		b		ab	▼		▼	▼	▼		▲

Study Conclusions

Processing study:

	High shear	**Medium shear**	**Low shear**
Process moisture	▼	▲	▲
Mechanical energy	▲	▬	▼
Kibble expansion	▲	▼	▼
Starch cook	▲	▬	▼
Resistant starch	▼	▬	▲
Slowly digested starch	▼	▬	▲

Dog study:

- Fecal quality and CBC/chem maintained
- Increase in fecal oligosaccharides, fecal butyrate and abundance of saccharolytic bacteria in dogs fed the LS and MS foods

Mildly processed foods increased indicators of gut health in the dog

Thank you!
Any questions?

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