Sorghum in Pet Food

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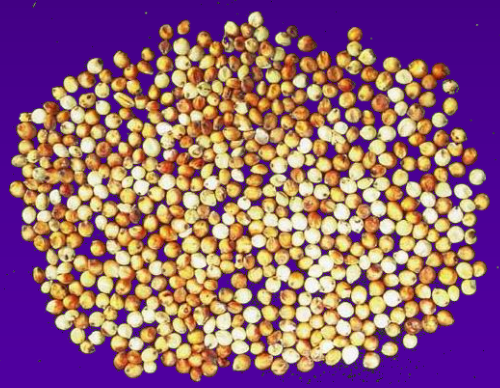
Sorghum/ Milo

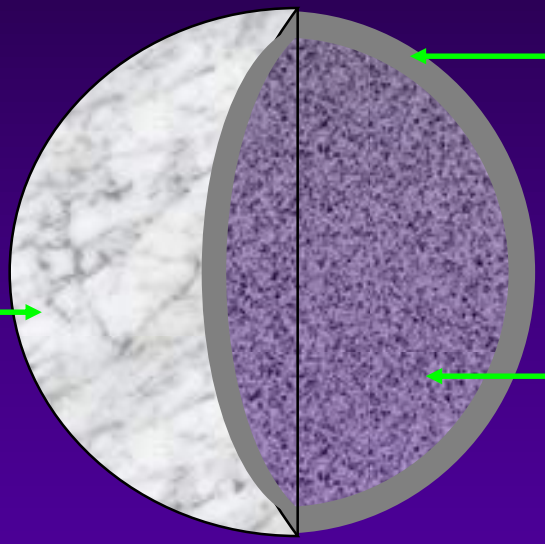
Picture courtesy
http://pdc.unl.edu/hottopicsfiles/10-1-01/panicle.htm



Picture courtesy
www.kanbou.maff.go.jp

Picture courtesy
www.foodsubs.com

Sorghum protein body schematic

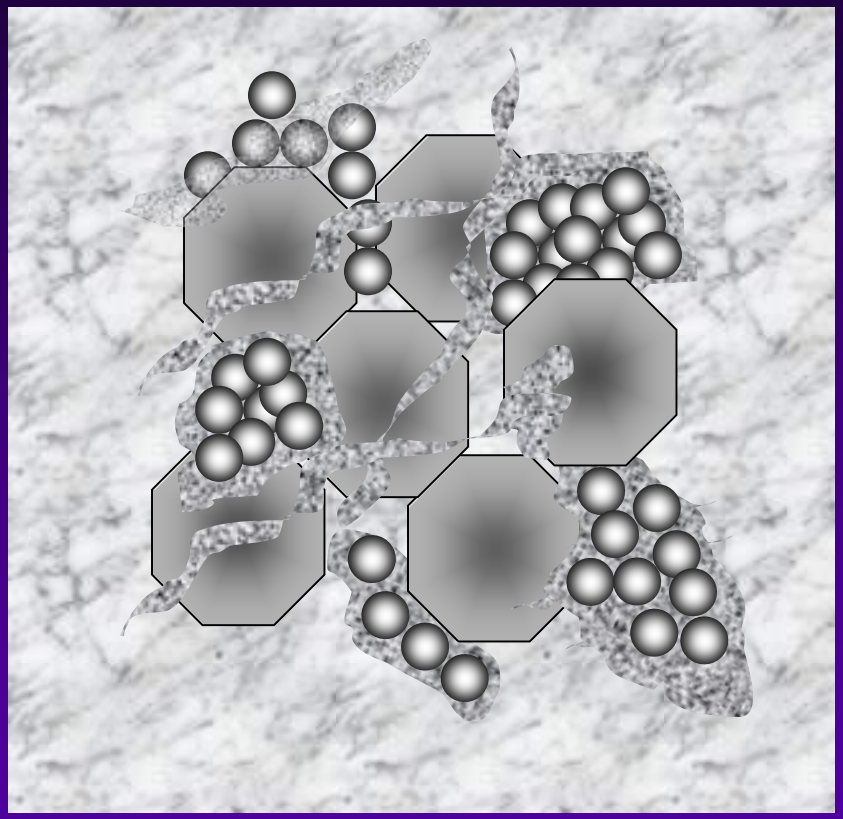


Outer "shell" composed mainly of crosslinked β- and γ- kafirins

Interspersed glutelin matrix material coating the protein body

Interior composed mainly of α-kafirin

Protein bodies and starch granules are embedded in the glutelin matrix.

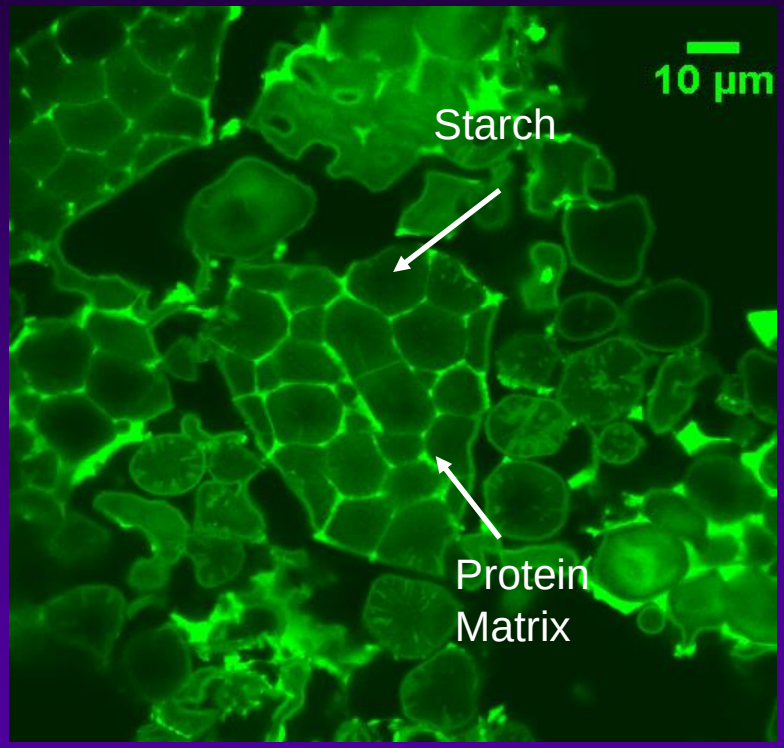


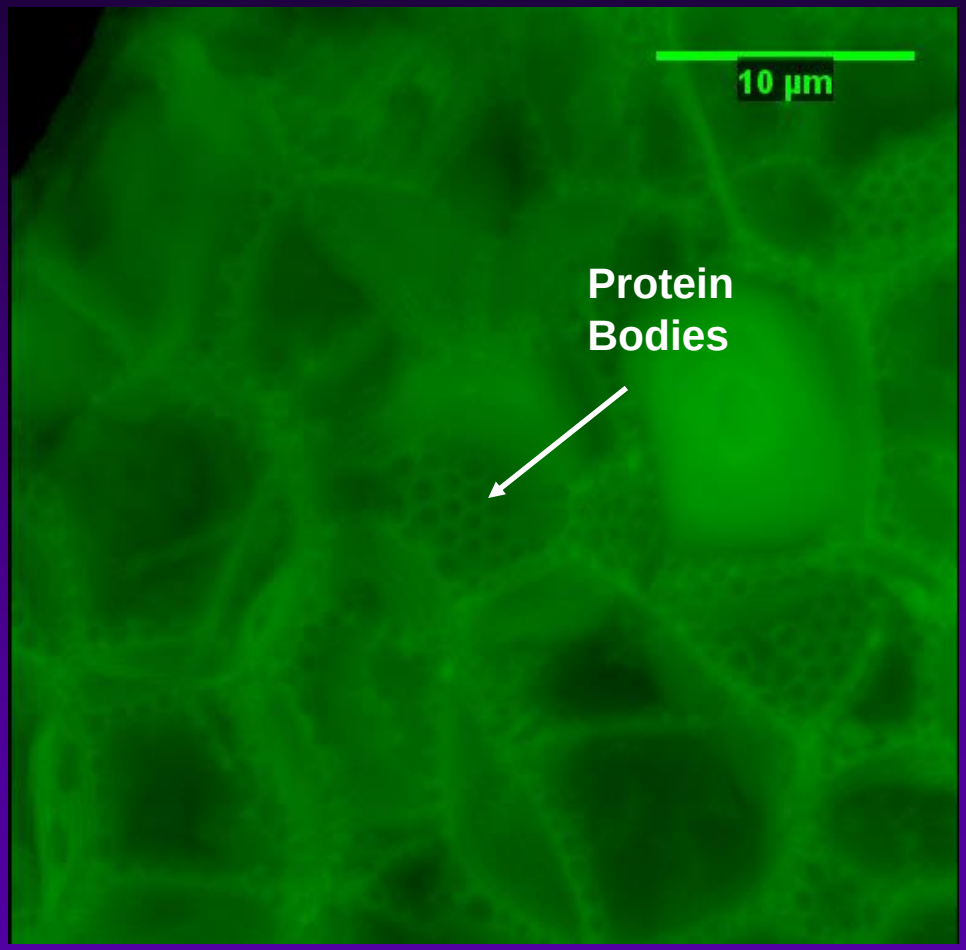
Protein bodies

Starch granule

Glutelin protein matrix

Raw Sorghum Flour





Extrusion as Sustainable Processing Technology

extrude \ik-’strüd\ vb

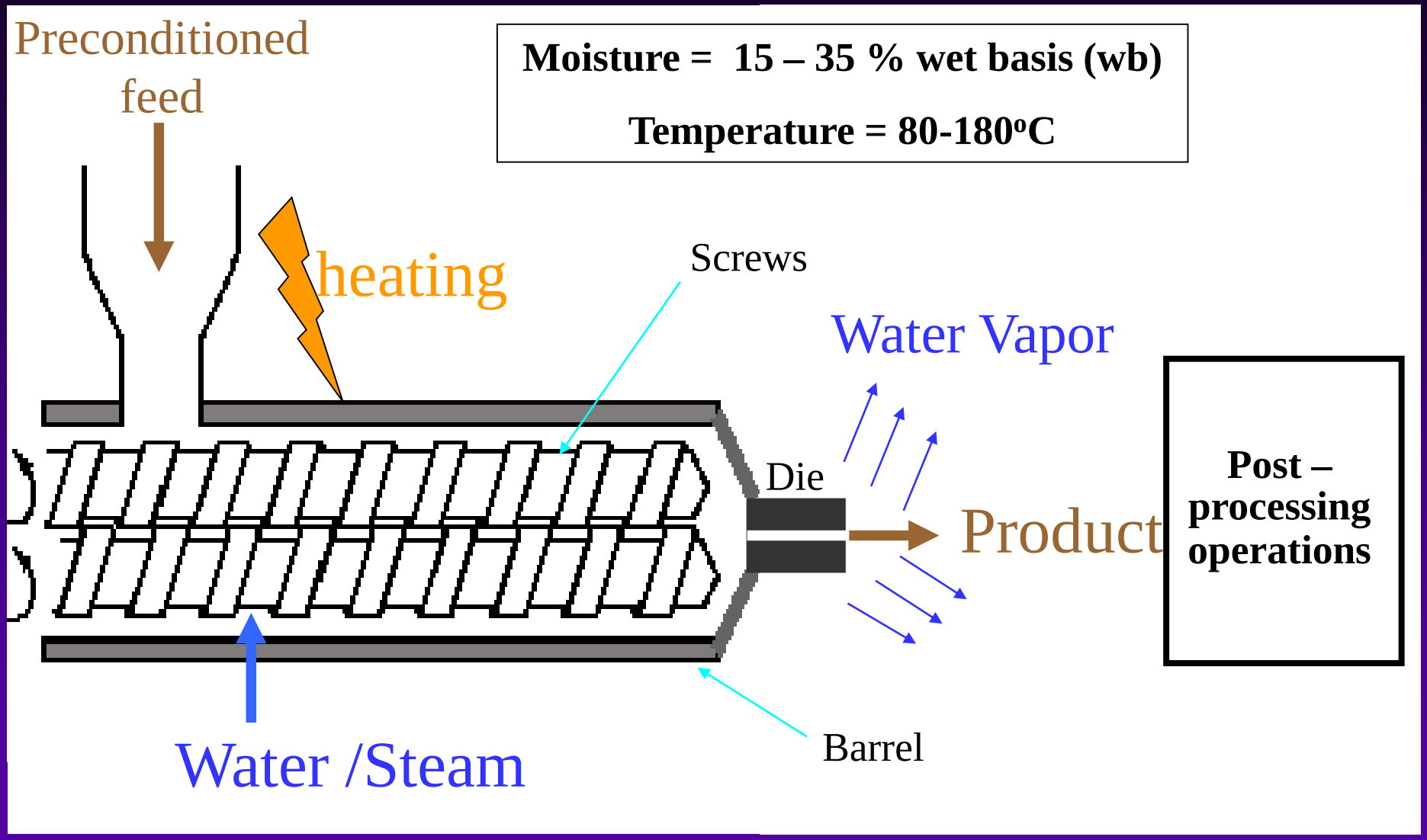
(Webster’s Ninth New Collegiate Dictionary)

Origin – Latin *extrudere* – to thrust

1. to force, press or push out
2. to shape by forcing through die

extruder \ik – ‘strüd-ər \ n

Extrusion cooking

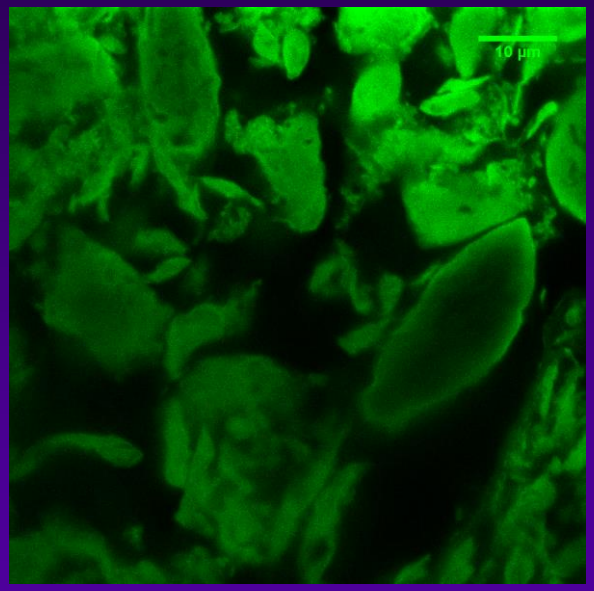


Extrusion Cooking Versus Conventional Batch Cooking

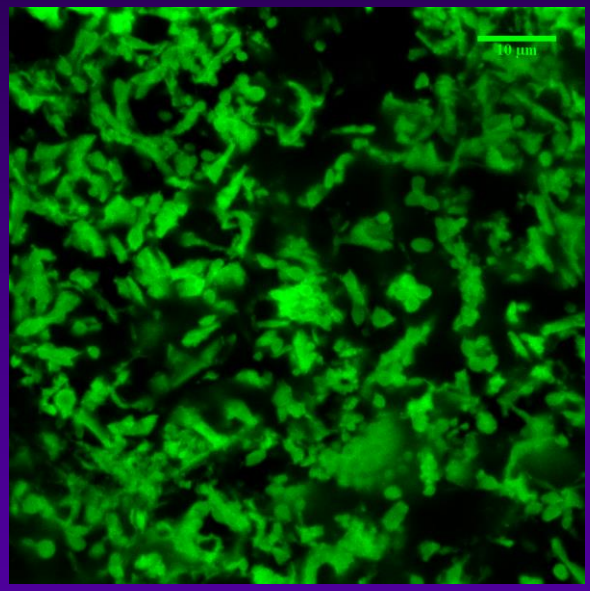
	Extrusion	Conventional
• Moisture (%)	15-35	70-95
• Temp (°C)	150-200	80-120
• Pressure (bar)	20-100	1-5
• Mechanical Energy/ Shear	Yes	No
• Time (min)	<1	>30

Processed/ Cooked Sorghum

Confocal Laser Scanning Microscopy (CLSM) is a useful tool in explaining the structural changes underlying the differences in digestibility.



38 % digestibility



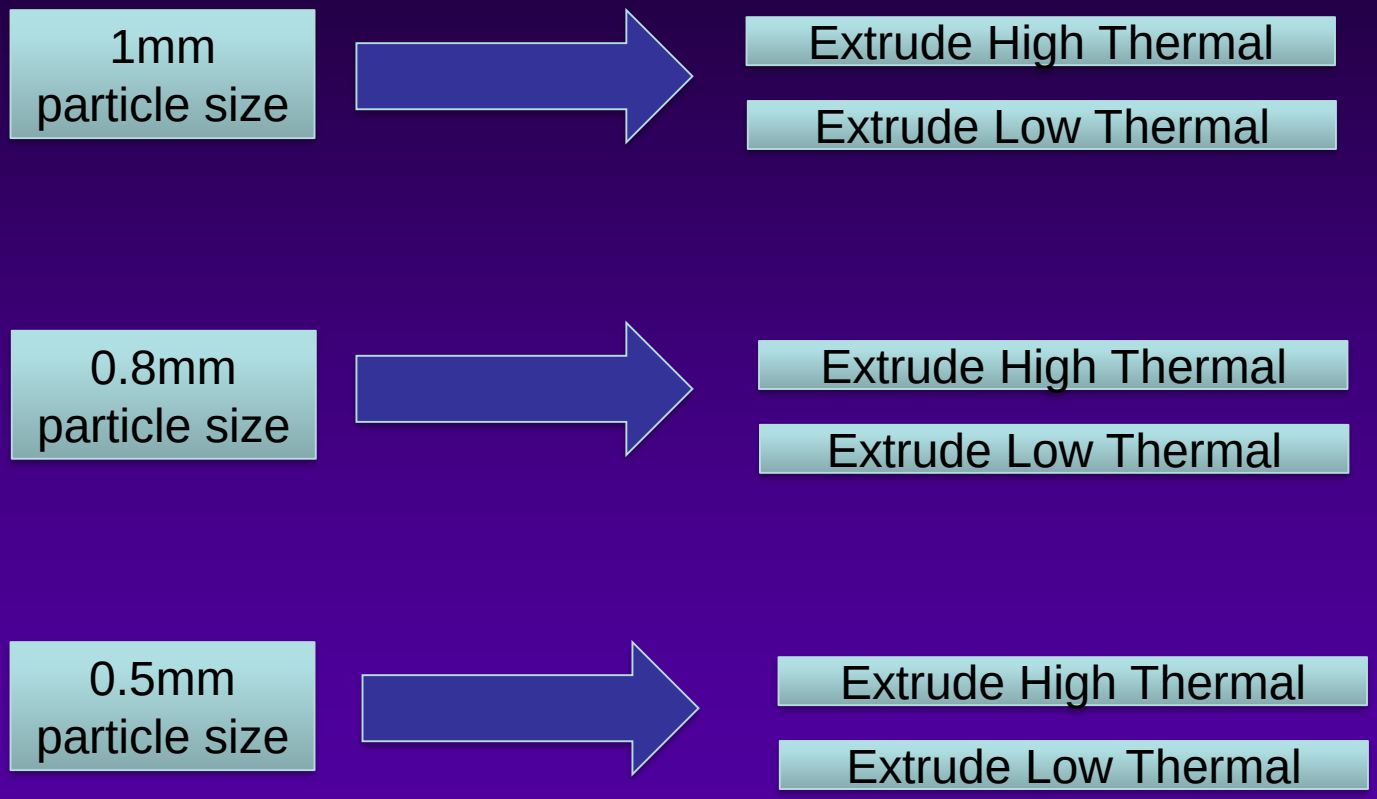
66 % digestibility

Goal and Objectives

- Goal
  - Develop highly palatable premium pet food products with grain sorghum as the primary cereal ingredient
    - Based on resistant and low glycemic sorghum starch
- Objectives
  - To formulate nutritionally balanced diets with red and white sorghum
  - Different particle sizes, thermal versus mechanical energy input and extrusion.
  - In vivo studies and palatability

2x3x2 Experimental Design

White and Red Sorghum Varieties



Materials & Methods

Diet formulation

Ingredient	Quantity (%)
sorghum-based diet	
Sorghum (red or white variety)	42.5
Chicken By Product Meal	35.0
Poultry Fat	7.0
Corn Gluten Meal (60% CP)	9.0
Liquid palatant	3.0
Beet Pulp	2.0
Salt	0.45
Potassium Chloride	0.35
Premix Min/Vit.*	0.30
Choline chloride	0.25
Mold inhibitor	0.10
Antioxidant	0.04

Methods

- Batching and Mixing
- Extrusion
  - Varying Steam and Water addition
  - Wenger X-20 Single Screw Extruder
  - Wenger 4800 Series dryer

Expansion/ Bulk Density

Treatments	Bulk Density (g/L)
Red 1.0 / 400 / low T	377.40
Red 1.0 / 300 / high T	333.93
Red 0.8 / 400 / low T	308.87
Red 0.8/ 300 / high T	318.25
Red 0.5 / 400 / low T	294.13
Red 0.5 / 300 / high T	282.25
White 1.0 / 400 / low T	363.75
White 1.0 / 300 / high T	349.25
White 0.8 / 400 / low T	324.15
White 0.8/ 300 / high T	312.10
White 0.5 / 400 / low T	301.57
White 0.5 / 300 / high T	291.10

Particle size

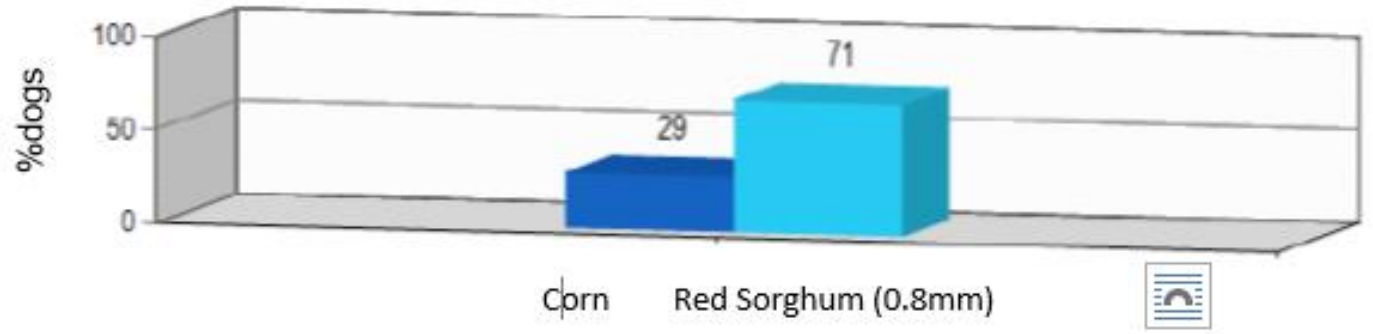
fine grind

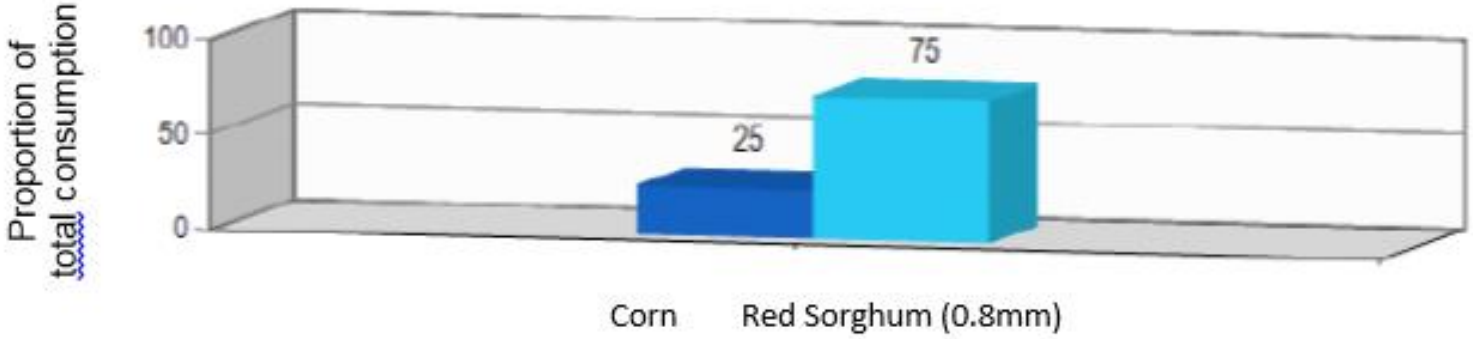
coarse grind

Starch Gelatinization%

Treatments	Starch gelatin (%)
Red 1.0 / 400 / low T	77.28
Red 1.0 / 300 / high T	83.56
Red 0.8 / 400 / low T	85.05
Red 0.8/ 300 / high T	79.56
Red 0.5 / 400 / low T	92.2
Red 0.5 / 300 / high T	90.8
White 1.0 / 400 / low T	85.31
White 1.0 / 300 / high T	83.5
White 0.8 / 400 / low T	85.85
White 0.8/ 300 / high T	89.45
White 0.5 / 300 / high T	93.55
White 0.5 / 400 / low T	95.46

Palatability





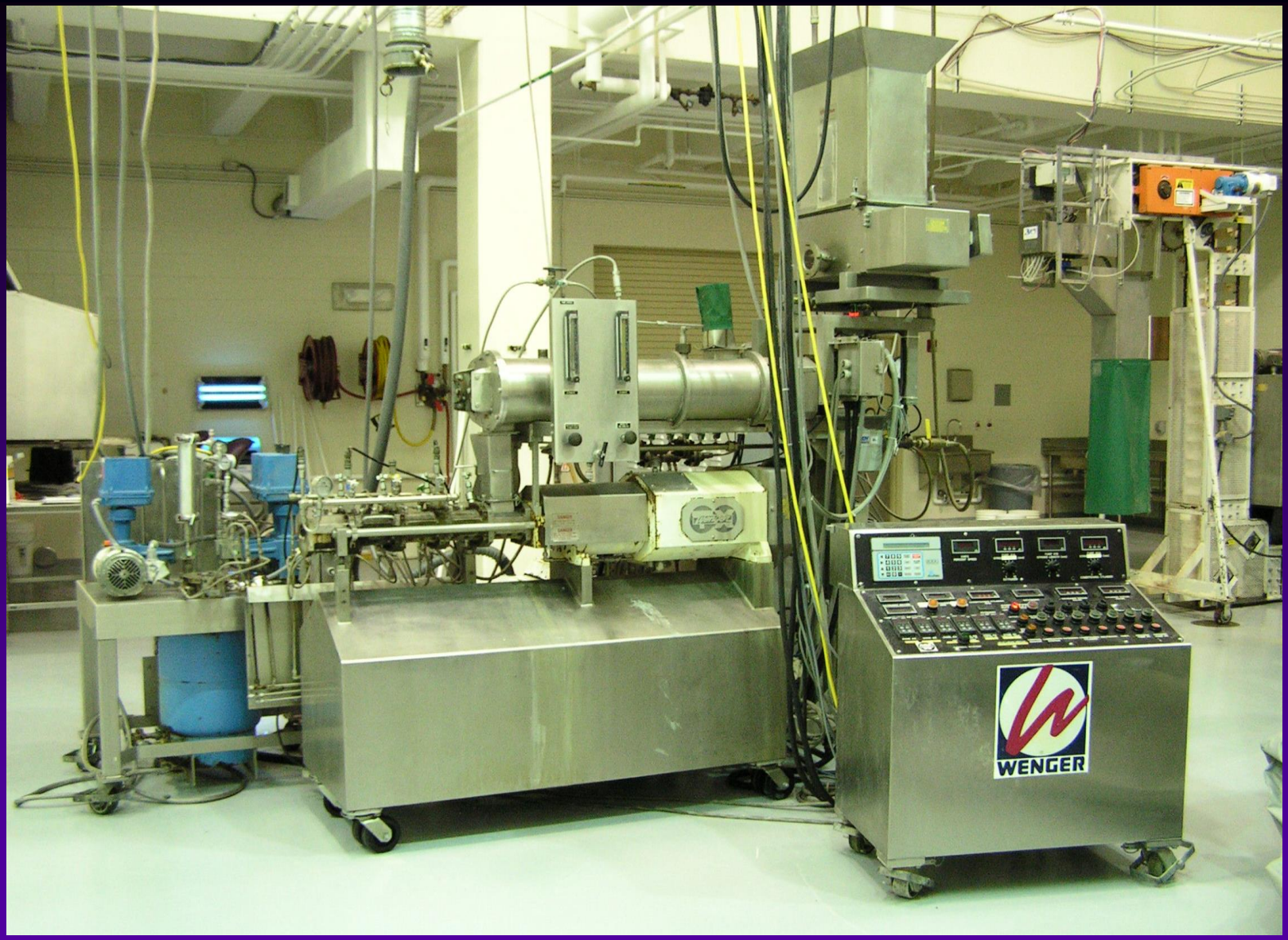
In Vivo Digestibility Studies

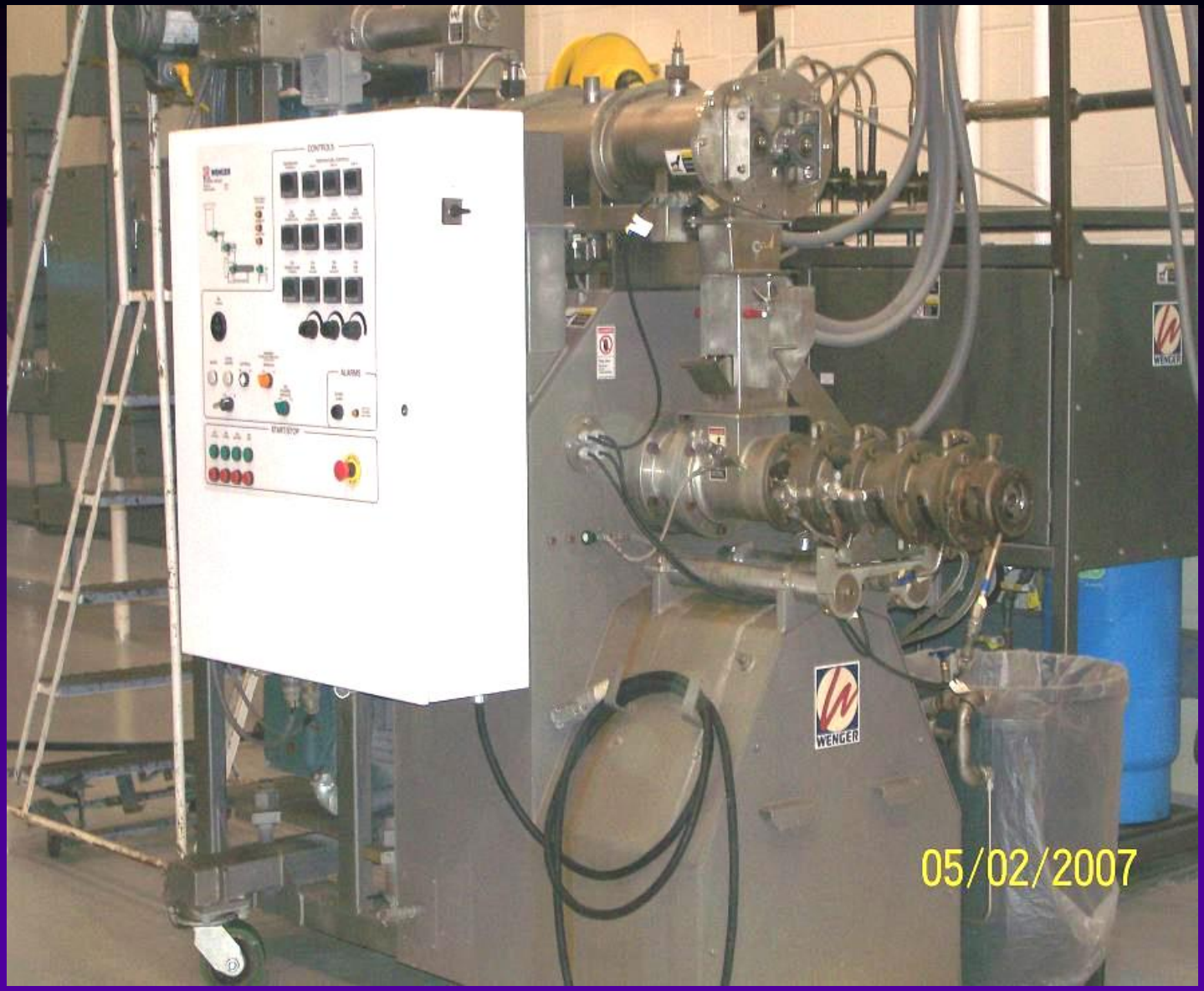
- No significant differences between sorghum based and control (rice and corn) basd diets in food intake, total apparent digestibility and fecal production/ quality
- Coarse ground recipe based products had higher concentration of colonic fermentation products (mainly propionate and butyrate); prebiotic effect?
- Post prandial glucose response – higher peak concentration for control (rice and corn) than red sorghum

Facilities in Grain Science and Industry

Biological and Industrial Value-Added Processing (BIVAP) Facility

Extrusion Lab


WENGER


CONTROLS
ALARMS
START/STOP
WENGER
WENGER
05/02/2007

WENGER

EXIT
HAPPY VALLEY

Acknowledgements

United Sorghum Checkoff Program