Energy analyses and use of novel grains in pet food applications

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Extrusion Basics

extrude \ik-'strüd\ vb

(Webster's Ninth New Collegiate Dictionary)

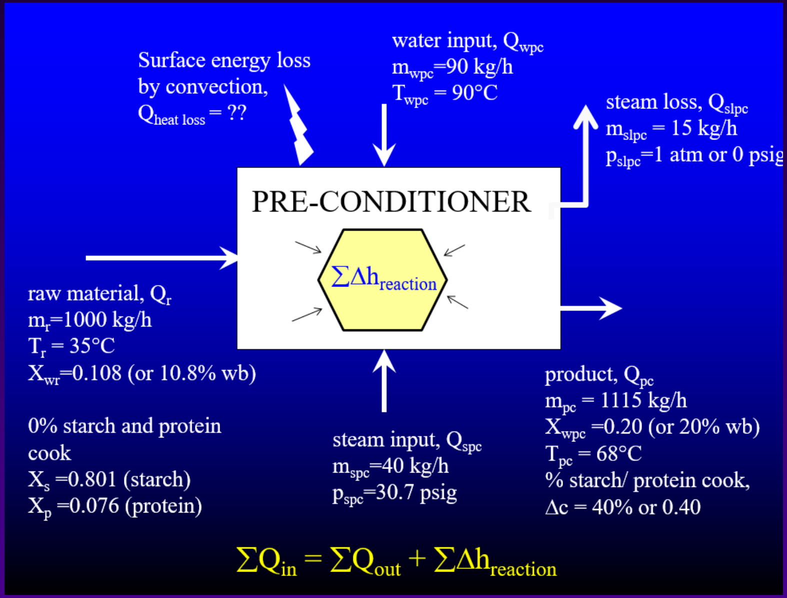
Origin – Latin *extrudere* – to thrust

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

extruder \ik – 'strüd-ər \ n

I - Energy analyses in pet food applications

$$\Sigma Q_{in} = \Sigma Q_{out} + \Sigma \Delta h_{reaction}$$



Material Energy from
SPECIFIC HEAT/
HEAT CAPACITY, C_p (kJ/kg°C or btu/lb°F)

In general for food and feed materials:

$$C_p = C_{pw} * X_w + C_{ps} * (1-X_w)$$

where C_{ps} ~ 1.5 kJ/kg°C and C_{pw} ~ 4.18 kJ/kg°C;
and X_w = moisture content expressed as a fraction
(wet basis or as is basis)

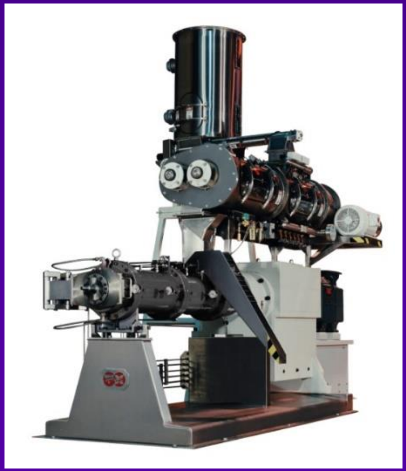
$Q_r = m_r * T_r * C_{pr}$
(kJ/hr)

$Q_{pc} = m_{pc} * T_{pc} * C_{ppc}$
(kJ/hr)

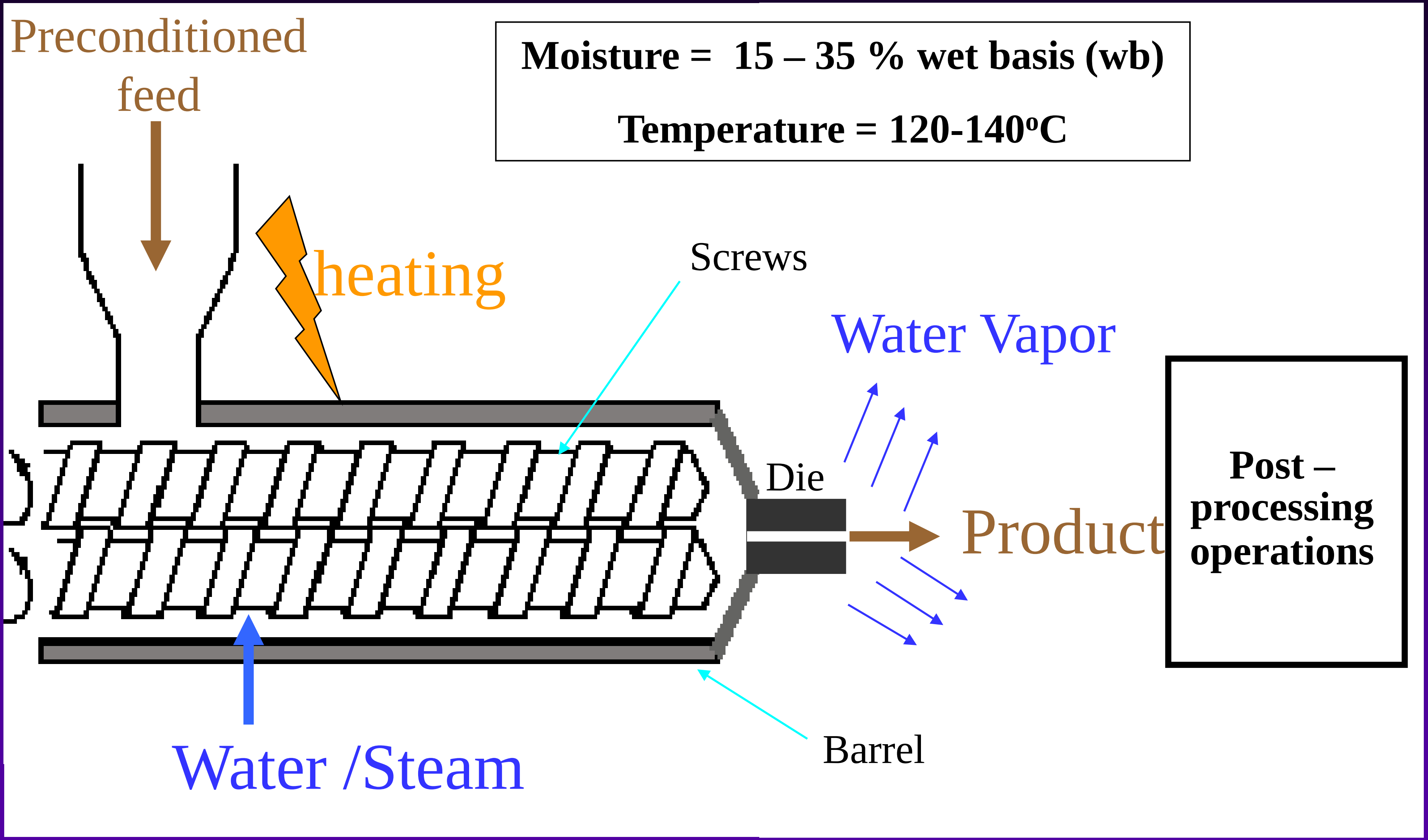
$Q_{wpc} = m_{wpc} * T_{wpc} * C_{pw}$
(kJ/hr)

A.4-1 *Continued*

Material	H_2O (*wt %*)	c_p (*kJ/kg·K*)
Ice cream		
Fresh	58–66	3.27†
Frozen	58–66	1.88‡
Lamb	70	3.18*
Macaroni	12.5–13.5	1.84–1.88
Milk, cows'		
Whole	87.5	3.85
Skim	91	3.98–4.02
Olive oil		2.01**
Oranges		
Fresh	87.2	3.77†
Frozen	87.2	1.93‡
Peas, air-dried	14	1.84
Peas, green		
Fresh	74.3	3.31†
Frozen	74.3	1.76‡
Pea soup		4.10
Plums	75–78	3.52
Pork		
Fresh	60	2.85†
Frozen	60	1.34‡
Potatoes	75	3.52
Poultry		
Fresh	74	3.31†
Frozen	74	1.55‡
Sausage, franks		
Fresh	60	3.60†
Frozen	60	2.35‡
String beans		
Fresh	88.9	3.81†
Frozen	88.9	1.97‡
Tomatoes	95	3.98†
Veal	63	3.22
Water	100	4.185**



Energy analyses in pet food applications



Energy analyses in pet food applications




	Extrusion	Baking
• Moisture (% wet basis)	15-30	40
• Temp (°C)	150-200	225
• Pressure (bar)	20-100	1
• Mechanical Energy/ Shear	Yes	No
• Thermal Energy	Yes	Yes
• Time (min)	<1	10-20

Mechanical and Thermal Energy Input – Impact on Dog/ Cat Palatability

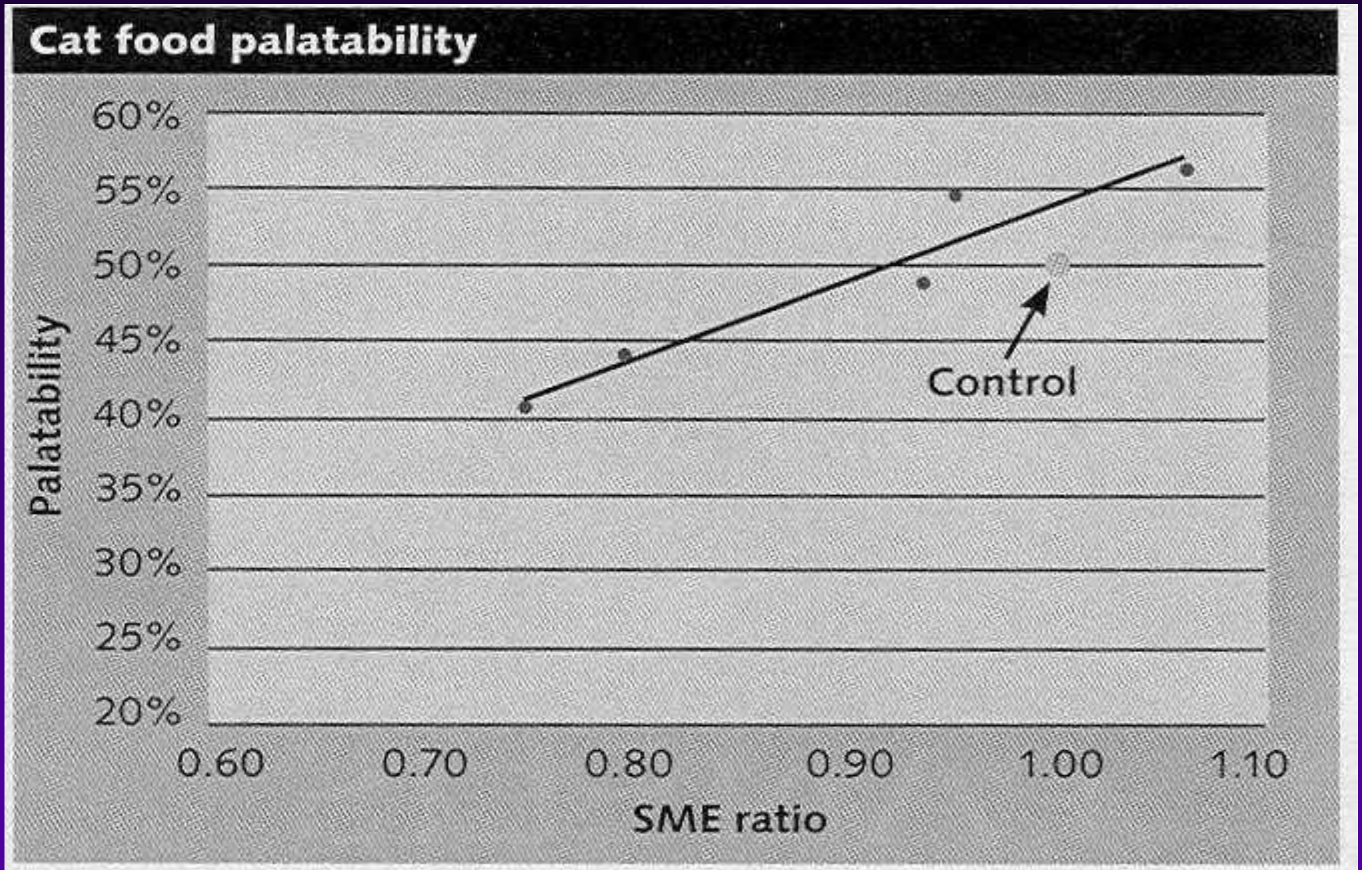


Figure 3. The data seem to indicate that SME is of considerable importance for felines. As the SME increased, the palatability increased proportionally.

(Plattner, 2005)

Mechanical and Thermal Energy Input – Impact on Dog/ Cat Palatability

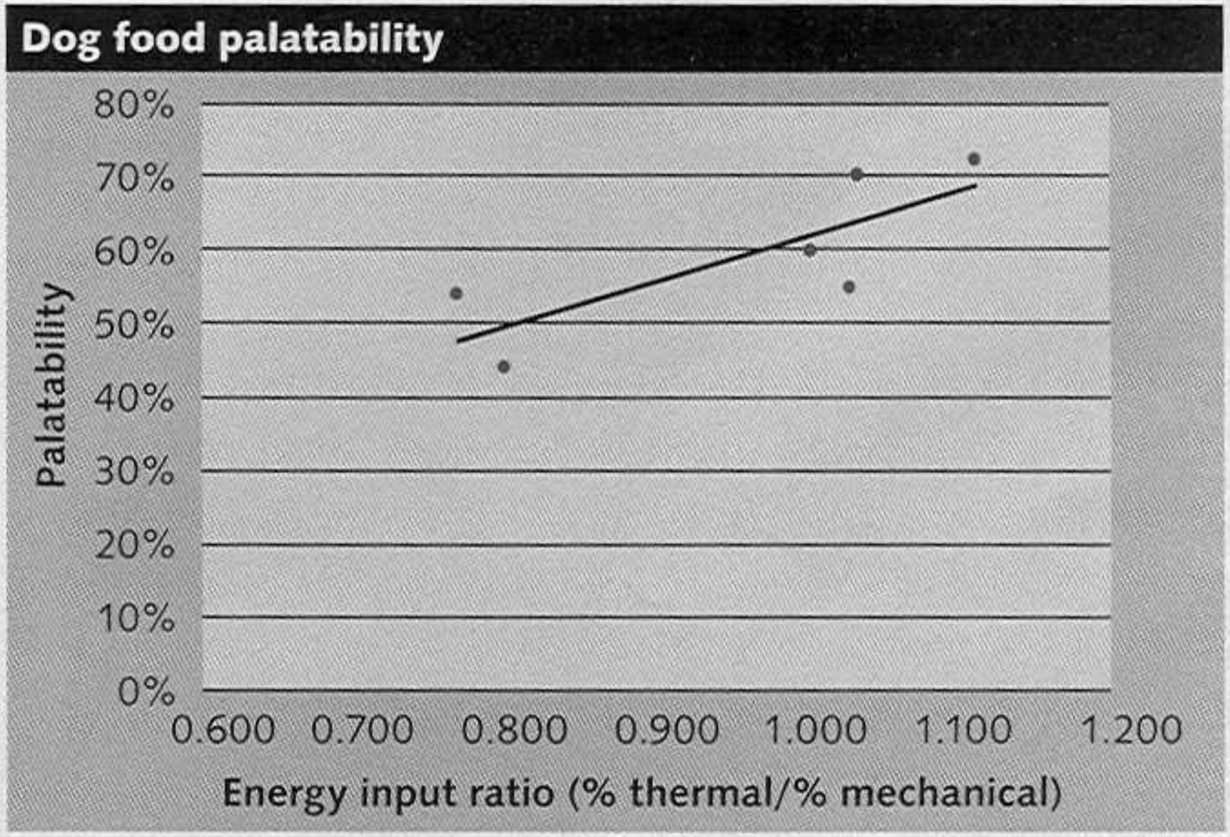


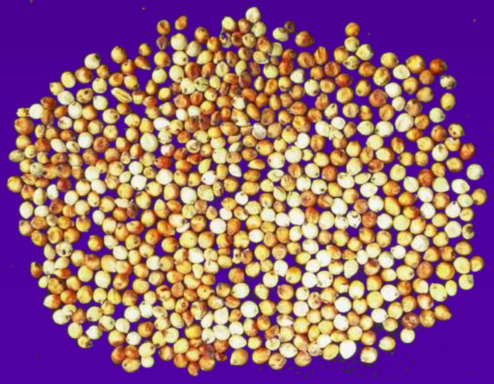
Figure 4. The relationship between SME and canine preference seems to be just the opposite. Reducing SME levels, or at least minimizing them, seems to be extremely important for some canine diets.

(Plattner, 2005)

II - Use of Novel Grains in Pet Food Applications

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

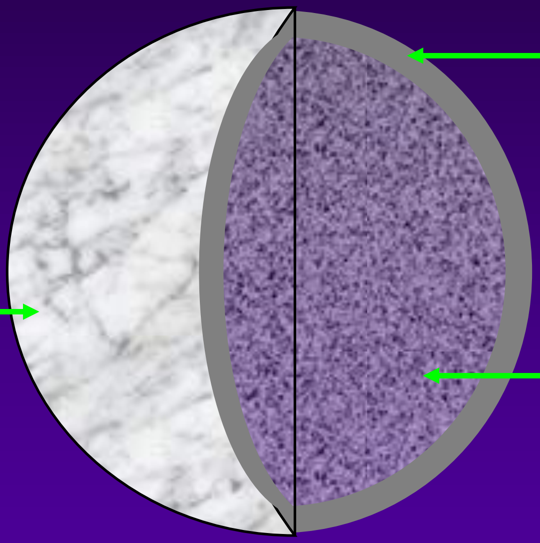
Picture courtesy
www.foodsubs.com



Picture courtesy
www.kanbou.maff.go.jp

Sorghum/ Milo

Sorghum protein body schematic

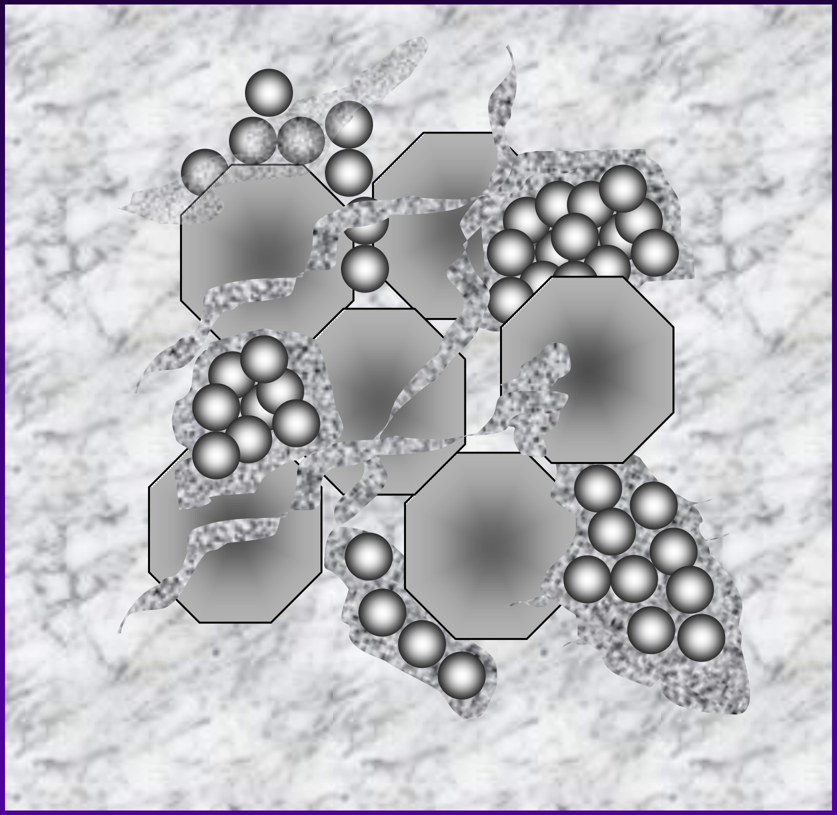


Outer "shell" composed mainly of crosslinked β- and γ- kafirins

Interspersed glutelin matrix material coating the protein body

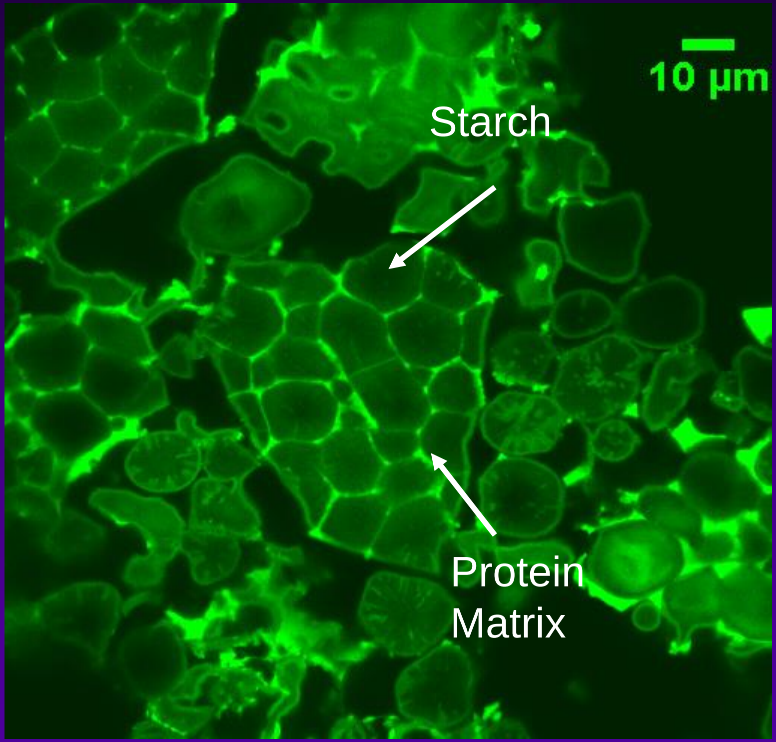
Interior composed mainly of α-kafirin

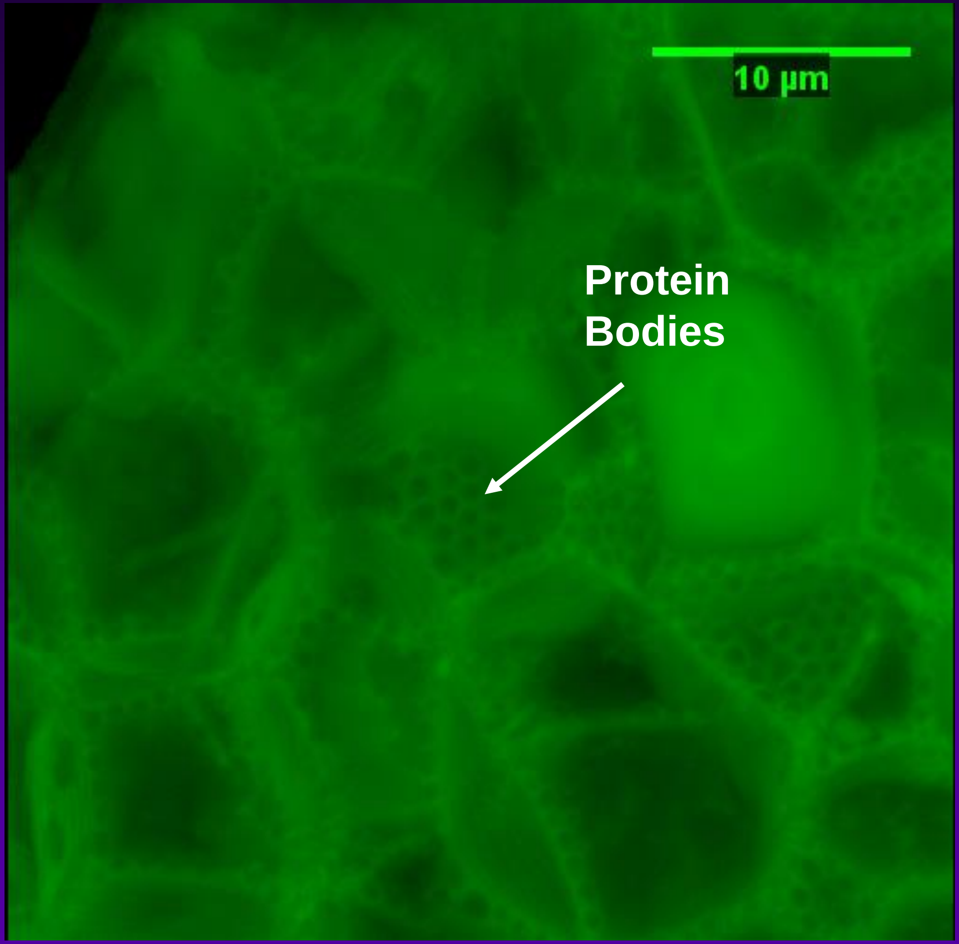
Protein bodies and starch granules are embedded in the glutelin matrix.



Protein bodies — Starch granule — Glutelin protein matrix

Raw Sorghum Flour





Diet formulation

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

Key Findings

Sorghum based diets appear to have lower glycemic index as compared to control corn and rice based diets and require correspondingly a more ‘muted’ insulin response, which is potentially more beneficial for diabetic dogs.

Blood Insulin Response in Dogs (time to peak)

Grain/ Particle Size (mm)	Rice	RS		WS	
	0.8 mm	0.8mm	1.6mm	0.8mm	1.6mm
Time to peak (min)	120.0±22	162±29	204.0±55	228.0±18	220.0±25

Key Findings

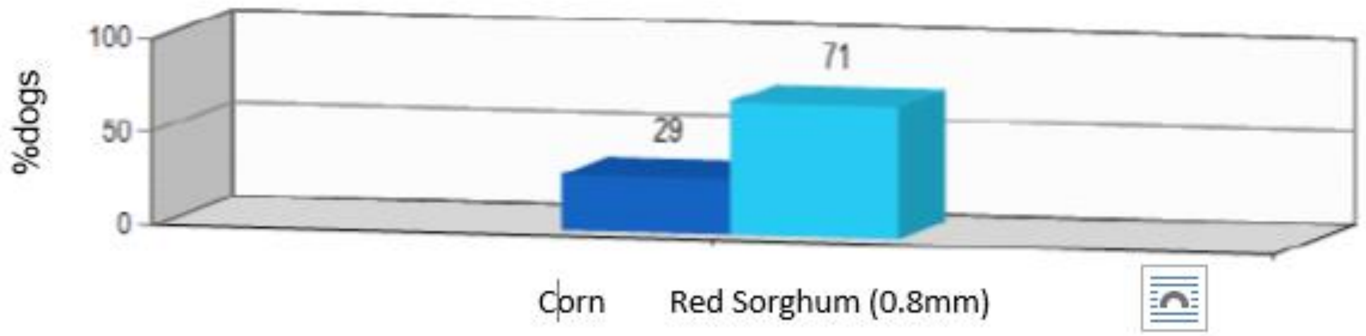
Coarse ground sorghum based diets had potential prebiotic effect with beneficial implications on intestinal and general health of the dogs, including production of butyric acid from colonic fermentation. Prebiotic resistant starch can be generated during processing of coarse ground sorghum based diets without extra costs, at the same level (0.5 to 1.0 % dry matter basis) as commercial prebiotics.

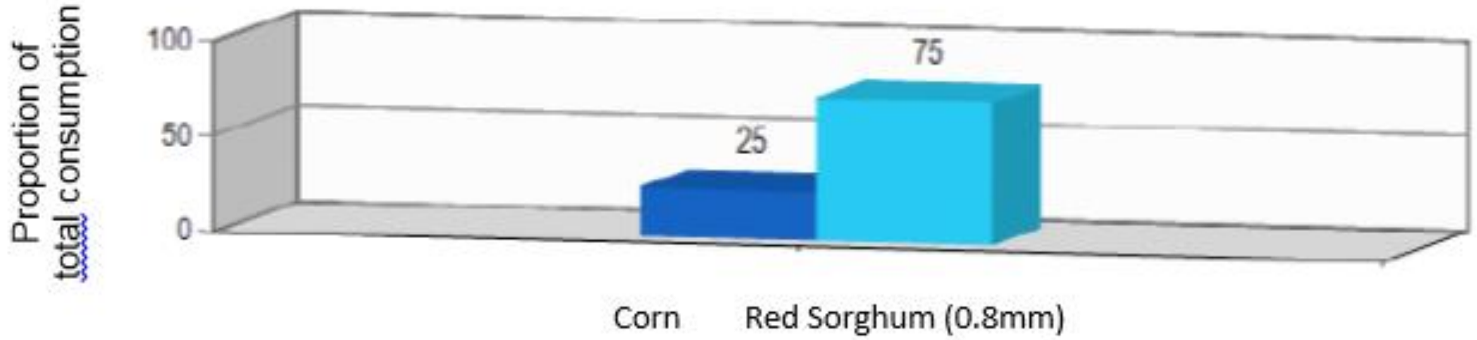
Short-Chain Fatty Acid, mmol/g of DM

	Experimental Diets				SEM	*P* value
	Corn	Rice	RS1.6	WS1.6		
Butyric acid	59.5 ^{b}	57.1 ^{b}	73.5 ^{ab}	84.8 ^{a}	2.5	0.004

Key Findings

Palatability





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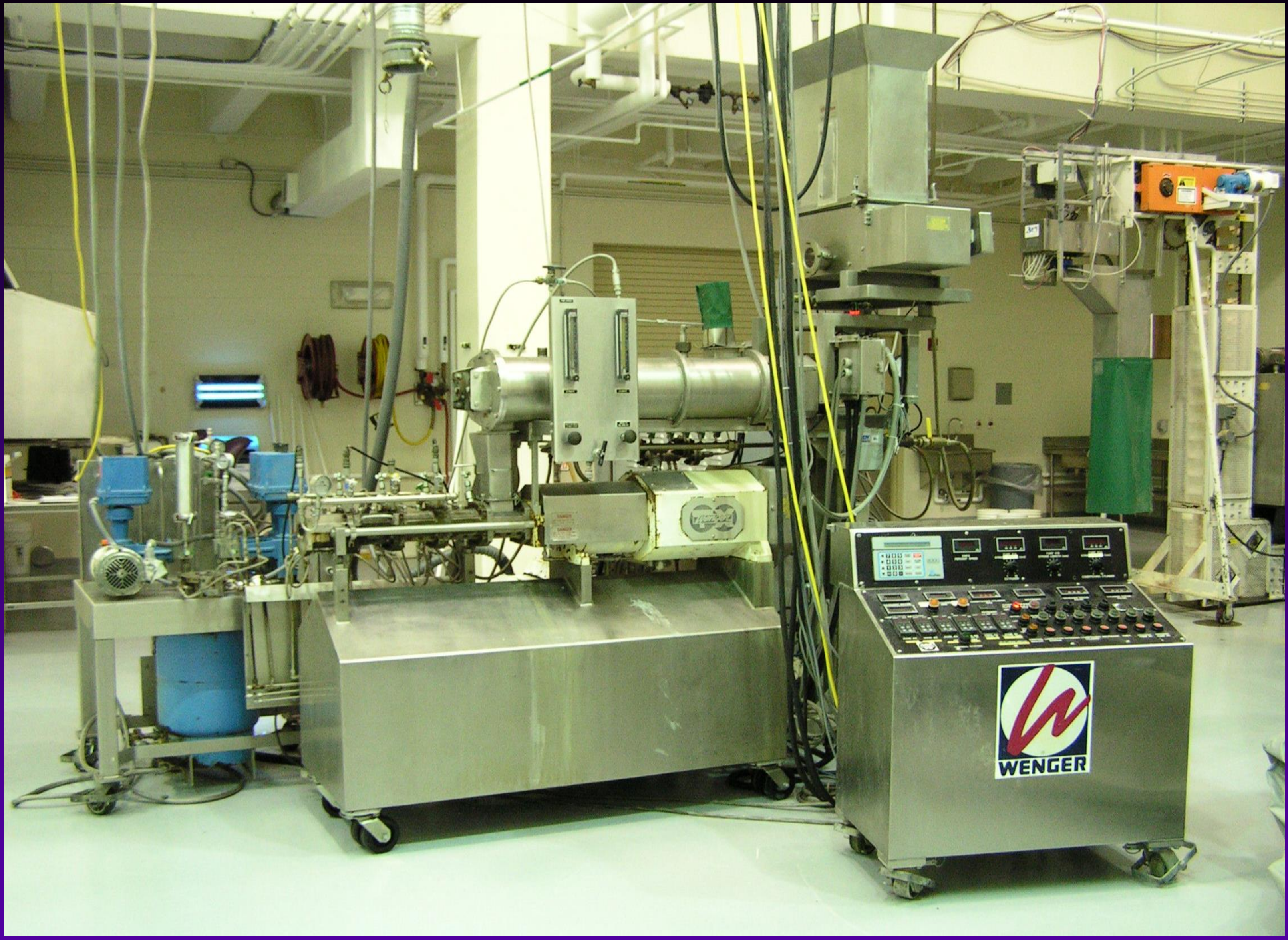
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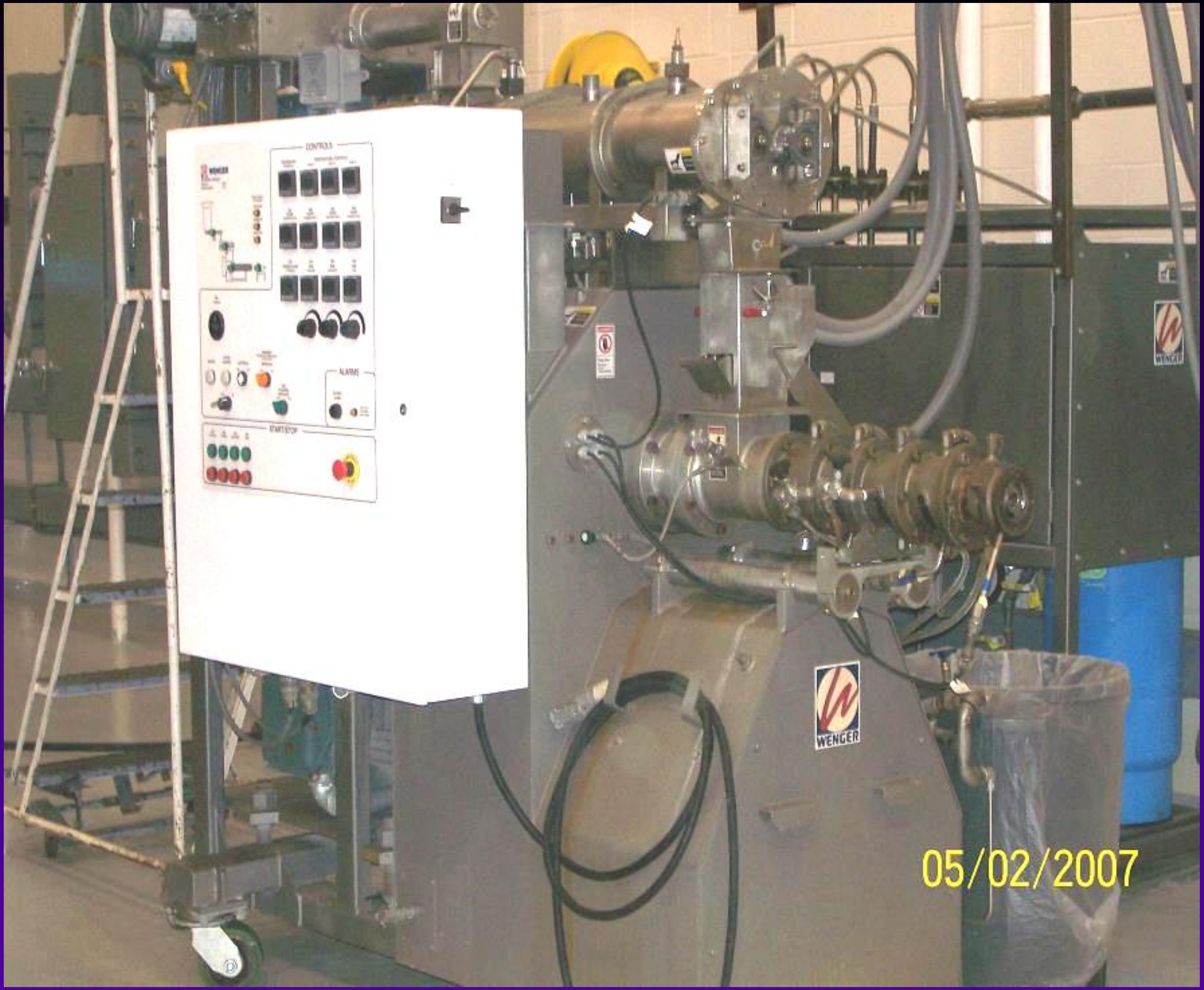
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Acknowledgement

United Sorghum Checkoff Program