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Effect of rework inclusion on processing and final product characteristics of pet food

BACKGROUND

When manufacturing pet food, a certain portion of the product does not comply with specifications. This material is called "rework." If not utilized, it represents an economic loss. Thus, rework is commonly added back into diet formulation in the pet food industry.

The American Association of Feed Control Officials has no restrictions for the use of rework, so pet food companies determine their own levels of rework used during formulation of diets. Since pet food formulations are proprietary, inclusion levels of rework are unknown and little research has been published in this area.

OBJECTIVE

The purpose of this study was to examine how increasing levels of rework impacts processing and final product characteristics.

MATERIALS AND METHODS

Rework was added to a base diet at 5%, 10%, 15%, 20% and 50%. A 100% rework treatment was also prepared. The base diet also served as the control and contained no rework. This was done to simulate an ideal pet food and allow a baseline comparison to the rework treatments. The formulation of the base and rework portion of the treatments were identical (see Table 1). Additionally, the kibble used as rework was ground to the same particle size as the fine meal used as the base.

Table 1: Canine maintenance diet

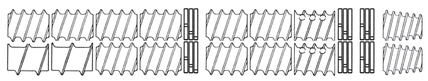
The formulation of the base and rework portion of the treatments were identical.

Ingredient	% of formula
Chicken by-product meal	42.86
Brewers rice	30.05
Corn	25.55
Salt	.715
Potassium chloride	.55
Vitamin premix	.165
Mineral premix	.11

Extrusion: A Wenger TX-52 Co-Rotating Twin Screw Extruder located at the KSU Extrusion Lab was used and the screw profile (Figure 1) and processing parameters were set to produce typical dry expanded pet food kibbles. A 5.5 mm circular die opening was used.

Figure 1: Screw configuration – TX-52 (6-head barrel configuration)

A Wenger TX-52 Co-Rotating Twin Screw Extruder was used with a screw profile designed to produce typical dry expanded pet food kibbles.



Drying: A Wenger Model 4800 Double Pass Dryer was used to reduce the moisture content of the kibble from approximately 29% moisture (wet basis) to 6-8%.

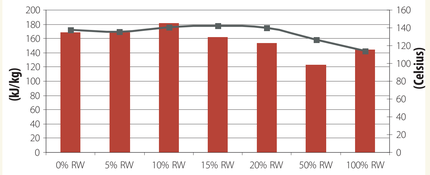
RESULTS AND DISCUSSION

Specific mechanical energy and level of macromolecular degradation in rework diets:

- **A decrease in specific mechanical** energy (SME) was observed as rework inclusion increased (Figure 2). This is likely due to decrease in melt viscosity, as was evident from phase transition data. A lower thermal flow temperature typically corresponds to lower melt viscosity in the extruder barrel.

Figure 2: Specific mechanical energy and thermal melting temperature

Specific mechanical energy (SME, kJ/kg) trend was complemented by phase transition analysis data. As rework was added to the diet, the thermal flow point (Tf, °C) decreased indicating lower melt viscosity in the extruder barrel..



- **Processed diets typically exhibit macromolecular** degradation as compared to raw diets. This was confirmed by rapid visco-analysis; wherein, the control diet had an average hot paste viscosity of 186.4 cP, and a decreasing trend was observed as level of rework increased with substantially lower hot paste viscosity of 82.8 cP for 100% rework (Table 2).

Table 2: Average hot paste viscosity of diets (prior to extrusion) with various levels of rework inclusion.

The control diet had an average hot paste viscosity of 186.4 cP, and a decreasing trend was observed as level of rework increased with substantially lower hot paste viscosity of 82.8cP for 100% rework diet. Thus it was apparent that the rework portion of the diets was highly degraded due to the prior extrusion processing

	Peak viscosity (cP)
Control-0% RW	186.4±16.4
5% RW	138.1±9.7
10% RW	129.6±1.2
15% RW	135.0±0.4
20% RW	148.4±19.4
50% RW	113.4±7.5
100% RW	82.8±5.1

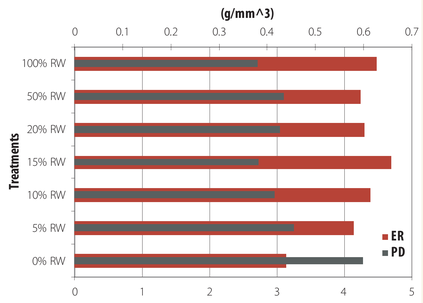
- **SME trend was complemented by** phase transition analysis data. As rework is added to the diet, the thermal flow point decreased indicating lower melt viscosity in the extruder barrel.
  - **For example, thermal flow temperature** for the 100% rework treatment was 115°C with a SME of 148 kJ/kg. Conversely, the control treatment has a flow temperature of 138°C with SME of 168 kJ/kg
- **This indicates that the extruder** torque requirements were lower for processing diets with rework, due to higher level of macromolecular degradation.

PHYSICAL CHARACTERISTICS

- **Expansion ratio (measurement of sectional** or radial expansion) increased as rework level increased from 0% to 15%. (Figure 3).

Figure 3: Expansion ratio and piece density of pet food produced from various levels of rework

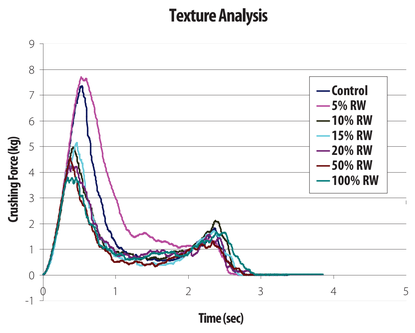
Expansion ratio (dimension-less quantity; measure of sectional or radial expansion) increased as rework level was increased from 0% to 15%. Piece density (g/mm3) of all treatments with rework was lower than that of the control (0% rework).



- **Piece density of treatments with** rework was lower than that of the control (0% rework). This indicated higher overall or volumetric expansion with rework, possibly due to greater retention time in the extruder and correspondingly higher thermal energy input. Lower melt viscosity can be the cause of higher retention time (not measured). Thermal energy typically has the predominant role in extrusion of pet food, as compared to mechanical energy.

Figure 4: Texture analysis of pet food produced from various levels of rework

Kibble strength (measured via texture analysis) decreased as rework inclusion level increased.



- **Kibble strength (measured via texture** analysis) decreased as rework inclusion levels increased. Typically mechanical strength of expanded products decreases with higher expansion and macromolecular degradation. (Figure 4).

CONCLUSION

Pet food manufacturers need to be cautious when using rework. In this study, when rework inclusion was increased, the piece density of the kibble is decreased. This may lead to the inability of being able to fill fit the designated amount of product into its packaging. Additionally, Increasing levels of rework also led to a more brittle kibble, which would have an impact on product palatability. Additionally, customer complaints of fines present in a bag of pet food may increase due to the higher product brittleness when rework level exceeds 15%.

Future work is needed to understand the nutrient availability of a formula with rework present. Feeding trials will also help gain a better understanding of how much rework can be added to a diet before negative affects are observed with regard to palatability. Shelf life studies will offer more insight on how quickly a pet food product will oxidize when rework levels are increased.

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