



GRAIN-FREE PET FOOD PRODUCT FORMULATION & PROCESSING USING DRIED POTATO INGREDIENTS



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PetfoodIndustry

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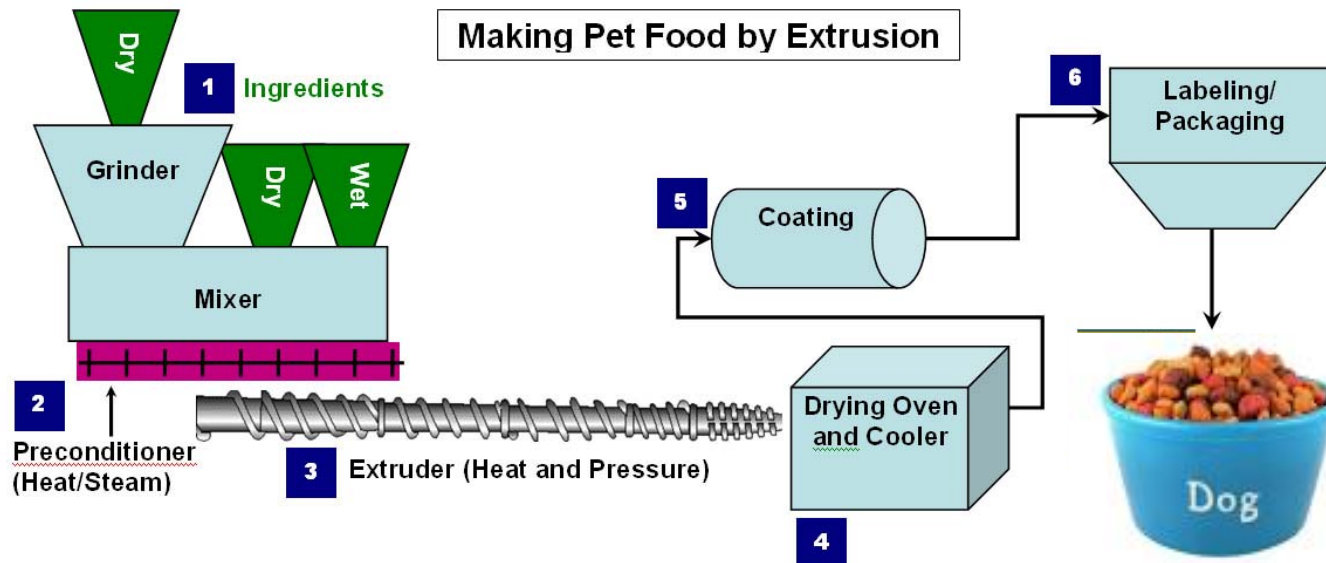


MARKETING/PACKAGING CLAIMS PETSMART MARKET SURVEY POTATO BASED PET FOOD FORMULATIONS

- Salmon & Potato Formula
- Turkey & Potato Formula
- Fish Meal & Potato formula
- Venison Meal & Potato Formula
- Duck & Potato Formula
- Chicken & Potato Formula
- New Zealand Venison & Potato Formula
- Natural Salmon & Potato Recipe
- Natural Chicken & Potato Recipe



Lack of Uniform Nomenclature in Pet Food Potato-Based Grain-Free Formulations ... Potatoes, Dried Potato, Potato Starch



Presentation Overview



- Potato Based Grain Free Formulations & Processing Challenges
 - Besides ingredient price fluctuations & COGS implications
- The need to understand Starch Structure-Function Relationships in Product Formulation & Processing
- Overcoming Potato-Based Pet Food Formulation and Processing Challenges Through Scientific Approach
- The Need for Formulation & Processing Optimization Design of Experiment, Standard of Identity and Uniform Nomenclature
- Advantaged Performance Pet Food Grade Dried Potato Standard of Identity



Potato-Based Pet Food Formulation & Extrusion Manufacturing Challenges



- Challenges are more in grain-free products due to potato processing methods
- There is need to distinguish between dried potatoes based on cooking and drying processes
- Grain-free formulation & processing challenges are similar to those of fabricated potato snacks



Examples of Grain-Free Pet Food Product Formulation & Processing Challenges

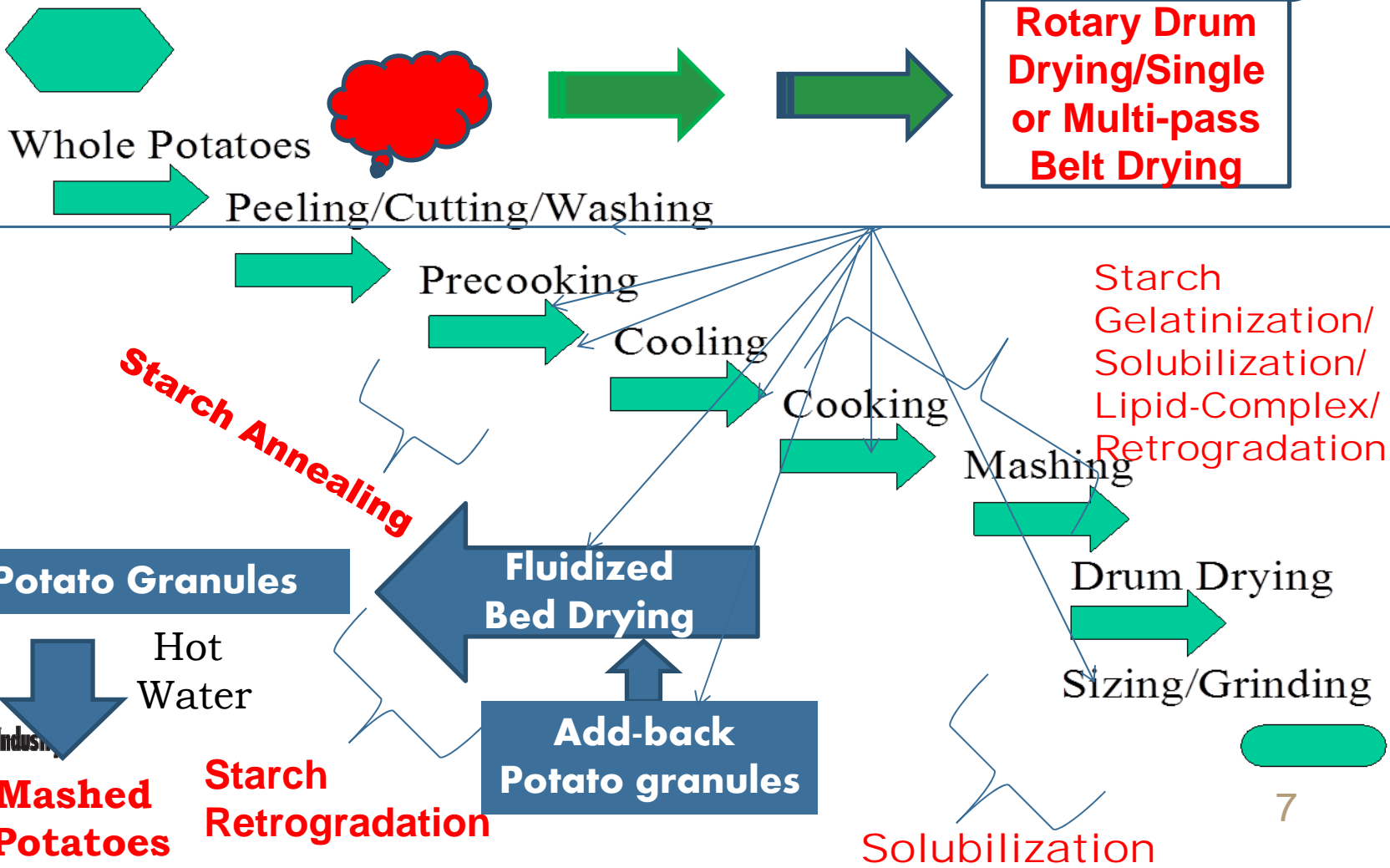
- Frequent Breakdowns & Downtime, Reduced Throughput, Poor Quality = High COGS
- Lack of scientific knowledge and understanding of starch functionality of dehydrated potatoes
- Lack of knowledge of the thermal history due to multiple processing options, sourcing and blending practices
- Lack of product and process driven raw material specifications of dehydrated potato ingredients





Overcoming Processing and Product Formulation Challenges Requires Scientific Understanding of Starch Functionality in Dried Potatoes

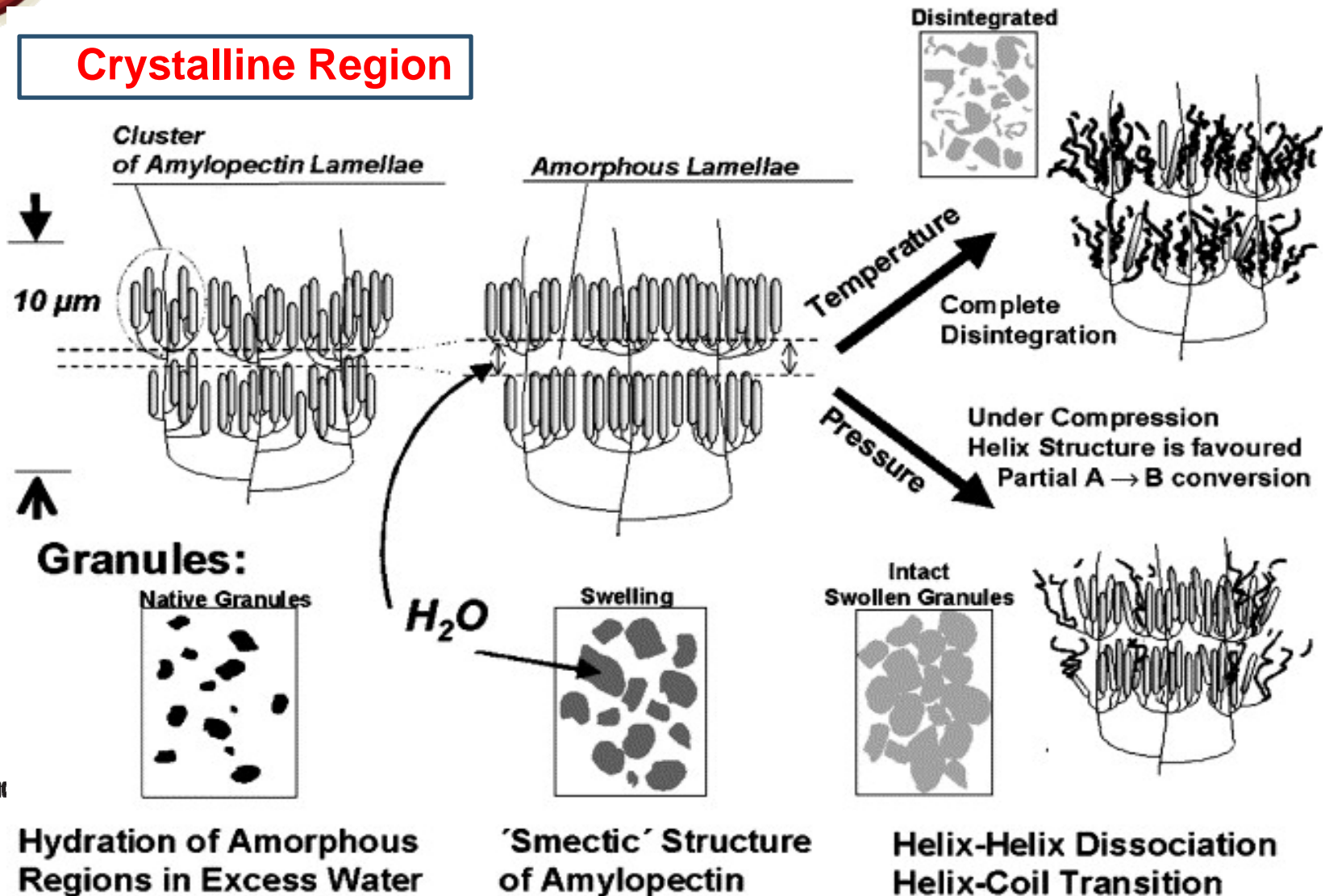
Dehydrated Potatoes Processing Flow Chart





Starch Granular and Molecular Structural Changes Occurs During Thermal Processing of Potato & Cereal Based Pet Food Product Formulations

Crystalline Region



Starch Granular & Crystalline Structures Drives Viscosity & Dispersion Behavior of Starchy Ingredients During Food Processing

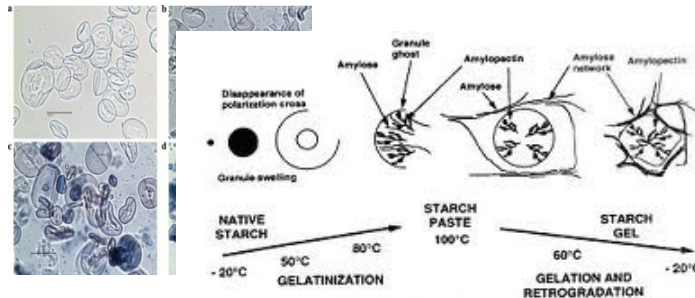
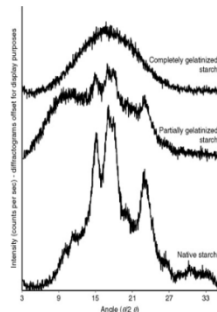
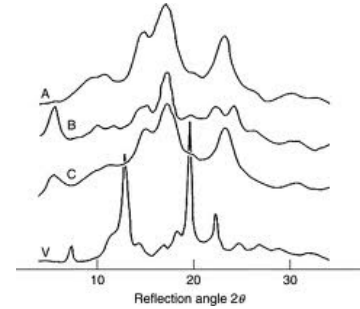
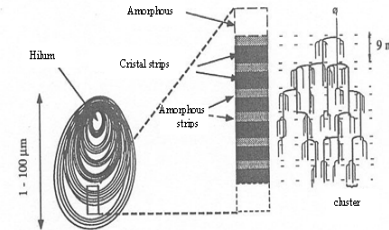
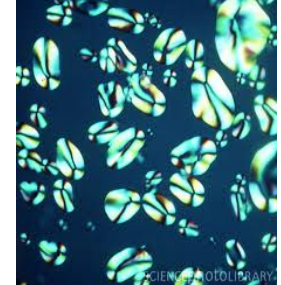
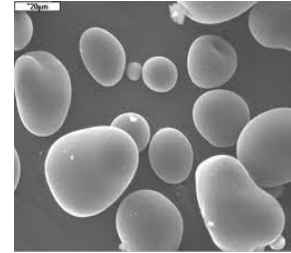
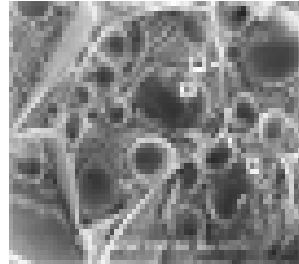


Fig. 1. Influence of hydrothermal processing on physical starch characteristics.

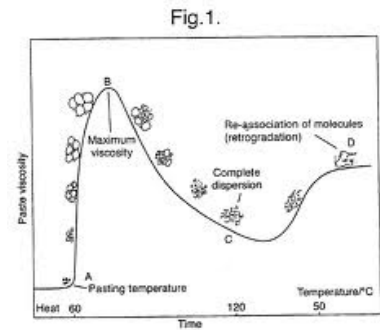
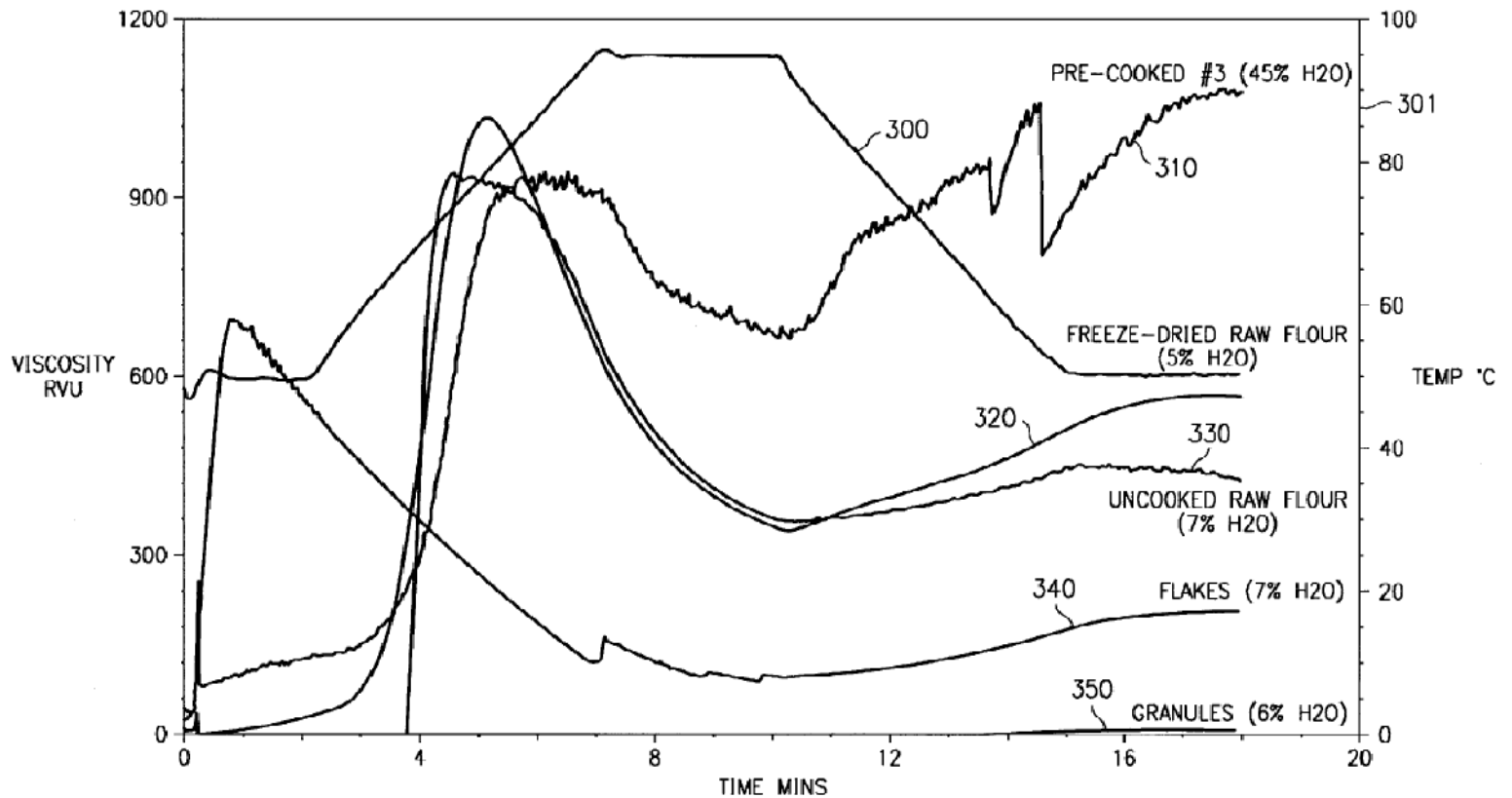


Fig. 1.



The Rapid Visco-Analyzer (RVA) is a Useful Tool for Measuring Changes in Starch Granular & Molecular Dispersion Behavior During Cooking in Excess Water





Experimental Dried Potato For Making Grain-Free Pet Foods Shows Darker Color Than Regular White Potatoes



Discoloration of new specialty dried potato was a marketing challenge, but not in the extrusion processing performance & finished product quality



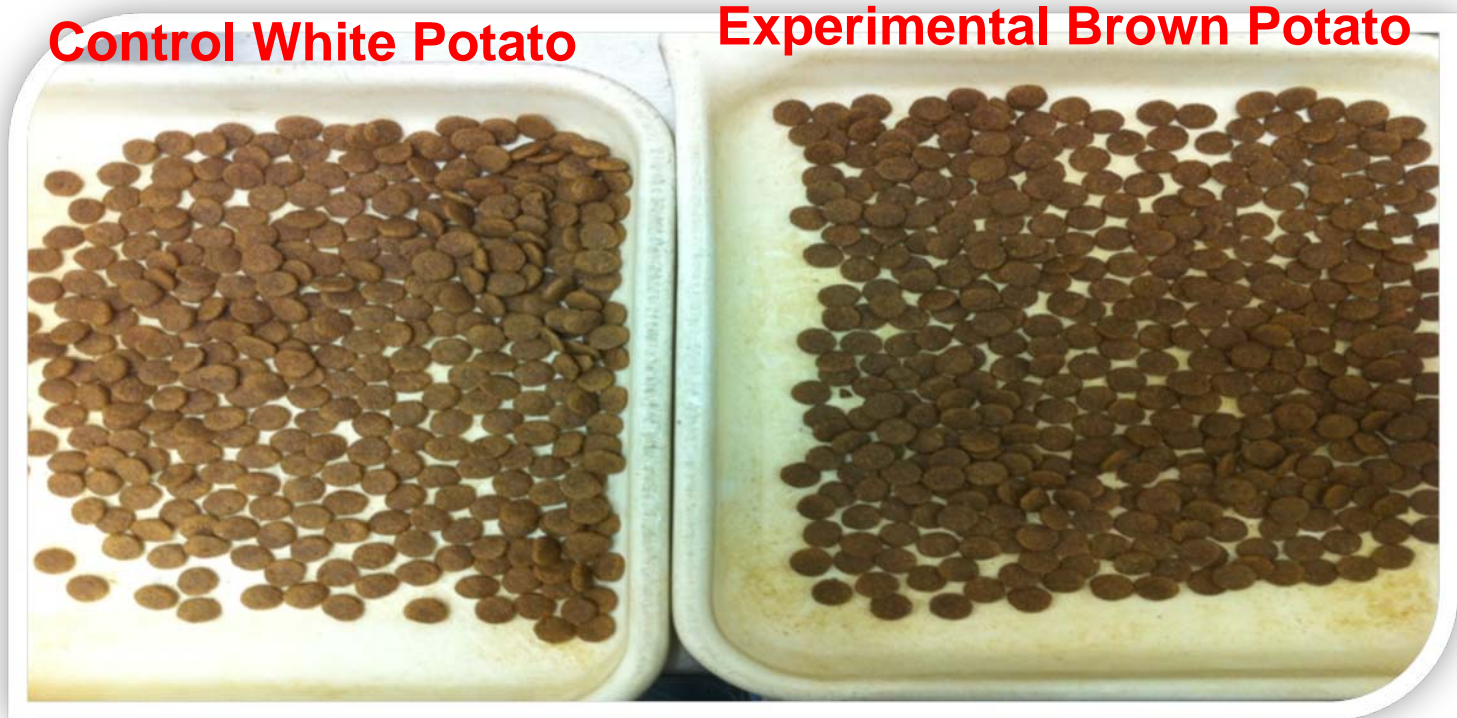
GRAIN-FREE PET FOOD REFERENCE PRODUCT Shows Mixture of Dark & Ultra Brown Color Hues



Amount of added water, cooking expansion and finish drying conditions are key drivers of extruded snacks processing and product quality performance



Experimental Dried Potato Product Initially Showed Darker Color in Grain-Free Pet Food Product – A Marketing Challenge



But added water, preconditioning, cooking and cooling temperatures are known to be the primary drivers of color and texture in extruded baked snack foods



Design of Experiment Yielded Parity or Better Color at Significantly Higher Throughput with Brown Potato Than White Potato Formulas



**1.5X Target
Throughput**

**1X Target
Throughput**

**1.5X Target
Throughput**



Experimental Dried Potato Pet Food Product Formulation & Processing Optimization Test Results Highlights

**“Our large Kibbles production testing today
matched control product color and appearance**

**Our keys to success were the improved
functionality and higher extrusion throughput ... ”**

**“For comparison, photos of finished products
showing a range of product colors are attached to
underscore the competitive advantage potential ...”**

Additional Cost of Ingredient Manufacturing by Treating Raw Potato with Chemicals to Improve Color was Avoided for Experimental Product



The cost of merchandize manufactured is significantly lower without cooking and mashing with additives of regular dehydrated potatoes



Discoloration of Uncooked Potato Raw Pieces is Due to Enzymatic Oxidation of Phenolic Compounds into Dark Pigments



Mild Food-Grade Acid Wash Process is Conventionally Used to Prevent Discoloration of Food Grade Potato Ingredients for Snacks



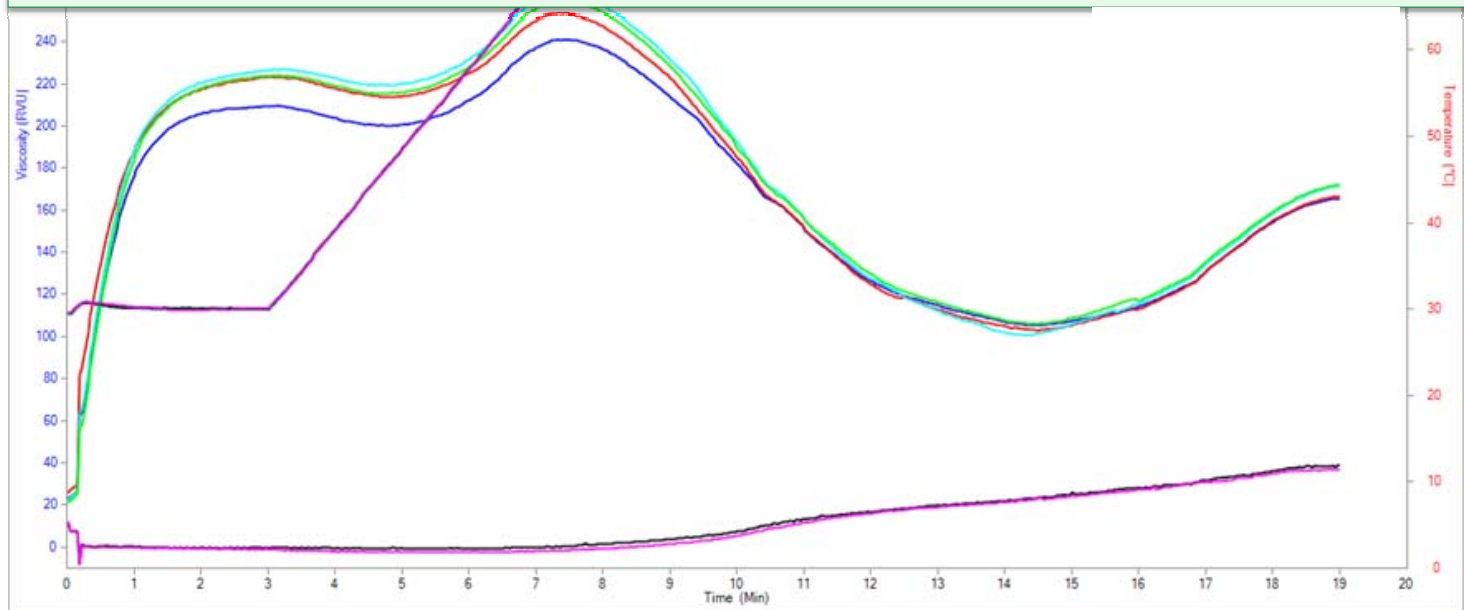
There is Need to Establish Standard of Identity Based on Processing Performance of Potatoes for Pet Foods Similar to Food Grade Dried Potatoes

Potato Sources	Potato Dehydration Processing	Raw Material Specification Opportunities
Potato Flakes, Flours and Granules	Sizing, cooking, mashing, additives, drum drying, grinding, etc.	RVA-cold swelling starch, soluble starch, retrograded starch, lipid-starch complex, reducing sugars, microbe count (micro), PSD
French Fries Process Off-Grades	Sizing, add-back, rotary drum drying or multi-pass / single-pass belt drying, grinding, etc.	Native starch, annealed starch, soluble/retrograded starch, reducing sugars, Hunter Color, mirco, PSD
Fresh Pack Whole Potato Off-grades	Sizing, add-back, rotary drum drying or multi-pass / single-pass belt drying, etc.	Native starch, annealed starch, soluble starch, reducing sugars, Hunter Color, mirco, PSD

RVA Starch Viscosity Profile of Experimental Pet Food Grade Dried Potato Ingredient Versus Potato Flakes



A specialty dried potato ingredient shows lower cooking starch viscosity profile and exhibit significantly better extrusion processing efficiency and pet food product quality than regular flakes, granules and blends of flakes/granules at reduced COGS





Experimental New Dried Potato Ingredient Product & Processing Performance Claims

“Potential competitive advantages include formula simplification and process simplification in addition to improved product color uniformity and palatability”

Formula simplification may result in the use of a single source potato flour versus current formulation

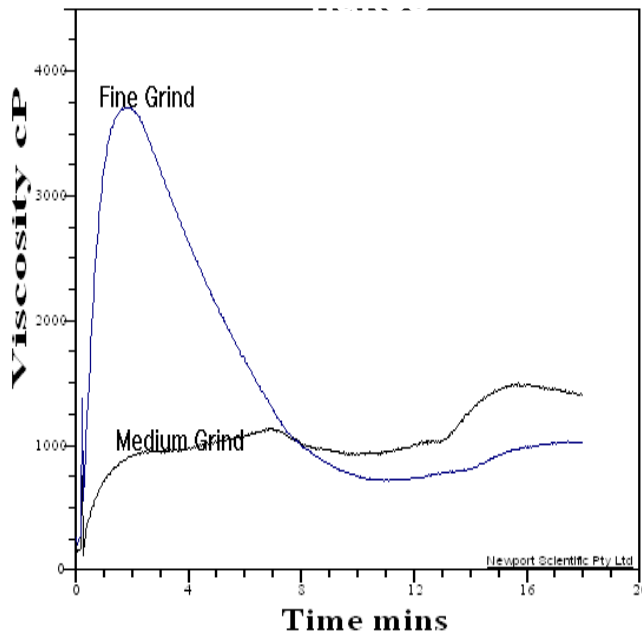
Processing simplification can result in significantly increased throughput and minimum start-up and ramp-up times.”

July 20, 2011
Dr. Tony Bello

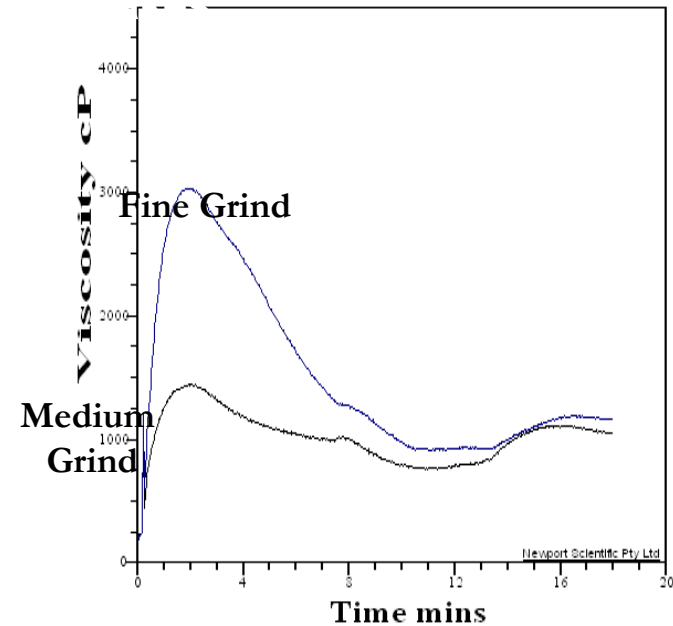


Lower Starch Viscosity of Larger Grind than Fine Grind Potato Flakes is Due to Less Granular Starch Swelling Tendency

RVA profiles of low leach potato



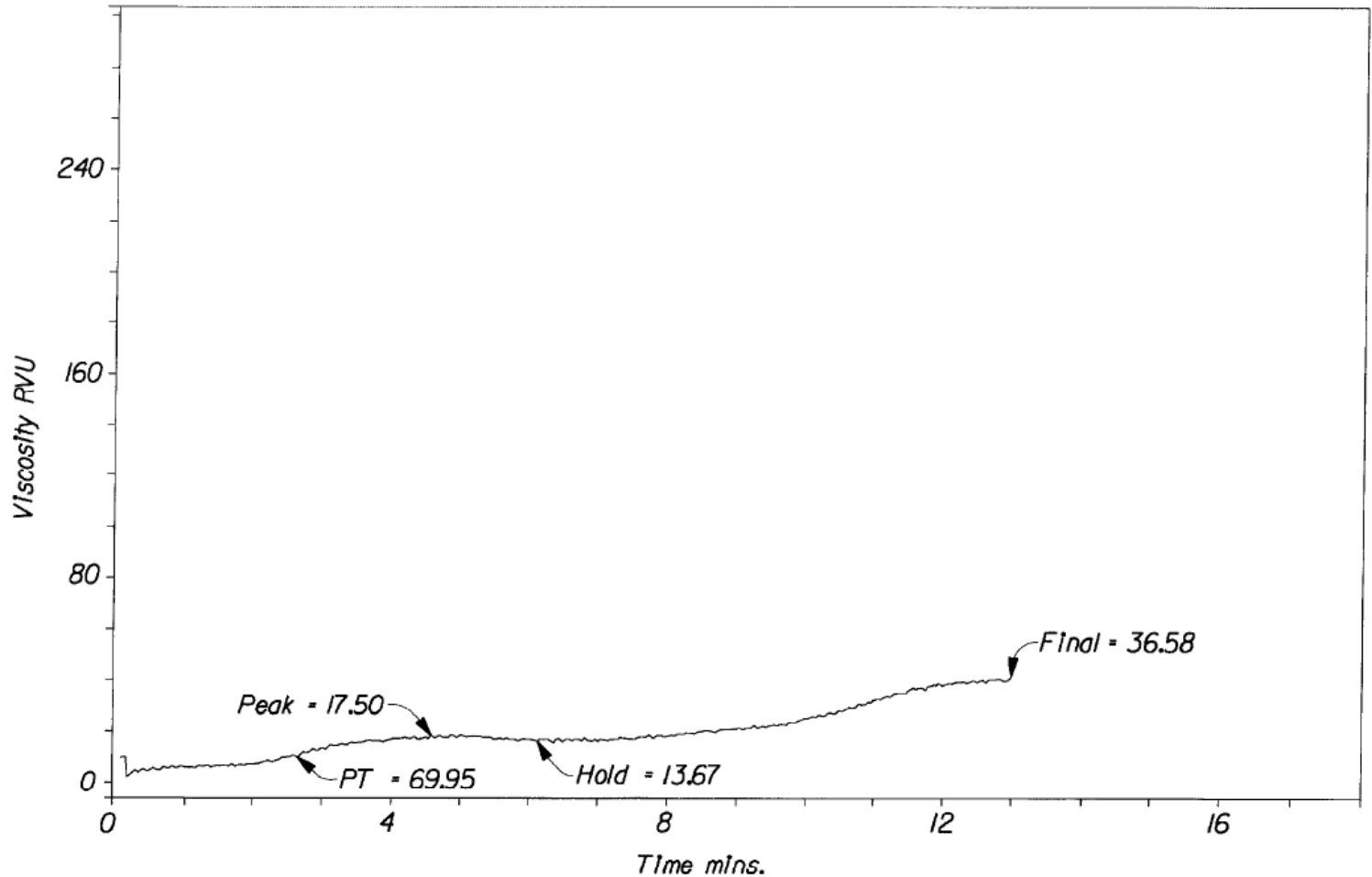
RVA profiles of full cook potato



Conversion of retrograded and lipid-complexed starch into soluble starch contributes to higher viscosity and therefore more stickiness and other challenges



The RVA Has Been Used to Define and Specify Standard of Identity of New Dried Potato Raw Material (US Patent 6,287,662) (2001)





IS YUCCA FLOUR THE NEXT FRONTIER IN GRAIN-FREE PET FOOD FORMULATIONS?



Work is ongoing to re-apply potato science and technologies to Yucca Flour in Nigeria

Q & A

Thank You!

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