Intro to Extrusion of Pet Food and Recipes with High Meat Inclusion

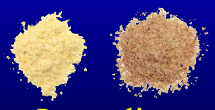
Brazilian College of Animal Nutrition (CBNA)
Pet Congress Online

September 21, 2021

Sajid Alavi, Ph.D.
Professor
Dept. of Grain Science & Industry
Kansas State University
salavi@ksu.edu

Pet Food Extrusion

Processing



Ingredient Functionality

Product Quality and Palatability

Pet Food Product Properties

- Nutritional quality
- Palatability
- Bulk density
- Shelf life
- Owner appeal

Wenger Mfg., Inc.

Pet Food Extrusion

Processing

Ingredient Functionality

Product Quality and Palatability

Premium Dry Dog: Eukanuba® Adult Maintenance Formula

Chicken, Chicken By-Product Meal (includes White Meat, Dark Meat, Liver and Other Internal Organs), Rice Flour, Corn Flour, Ground Grain Sorghum, Fish Meal, Chicken Fat (preserved with Mixed Tocopherols, a Source of Vitamin E, and Citric Acid), Dried Beet Pulp, Chicken Digest (a Natural Flavor), Dried Egg Product, Brewers Dried Yeast, Monosodium Phosphate, Flax, Potassium Chloride, Choline Chloride, Salt, DL-Methionine, Vitamin E Supplement, Ascorbic Acid (source of Vitamin C), Copper Sulfate, Zinc Oxide, Ferrous Sulfate, Manganese Sulfate, Manganous Oxide, Biotin, Lecithin, Rosemary Extract, Vitamin A Acetate, Calcium Pantothenate, Vitamin B12 Supplement, Niacin, Thiamine Mononitrate (source of Vitamin B1), Riboflavin Supplement (source of Vitamin B2), Inositol, Pyridoxine Hydrochloride (source of Vitamin B6), Vitamin D3 Supplement, Potassium Iodide, Folic Acid, Cobalt Carbonate

Two Types of Ingredient Classification Systems

I. According to nutritional roles and chemical structure

II. According to functional/ physical role in the extrusion process and final product (Guy Classification System)

I. Classification according to nutritional roles and chemical structure

- Major components -

1. Carbohydrates
2. Proteins
3. Lipids

- Minor components -

1. Vitamins and minerals
2. Pigments
3. Flavors
4. Preservatives/ Anti-oxidants
5. Other additives

Carbohydrates

• Starches – polymers of glucose

• Sugars
- sucrose (glucose + fructose); high fructose corn syrup, etc
- granulated, powdered, brown, syrups
- viscosity thinning effects
- hydrophilic effects

• Fiber – cellulose, hemicellulose, lignin, pectin, inulin; obtained from seed coat (example, rice bran, wheat bran, oat fiber) or plant fiber (example, sugarcane bagasse); dietary role (soluble fiber), structural role (insoluble fiber)

• Hydrocolloids – gums and other substances that act as viscosity builders, binders, stabilizers; e.g. guar gum, xanthan gum, sodium alginate

Proteins

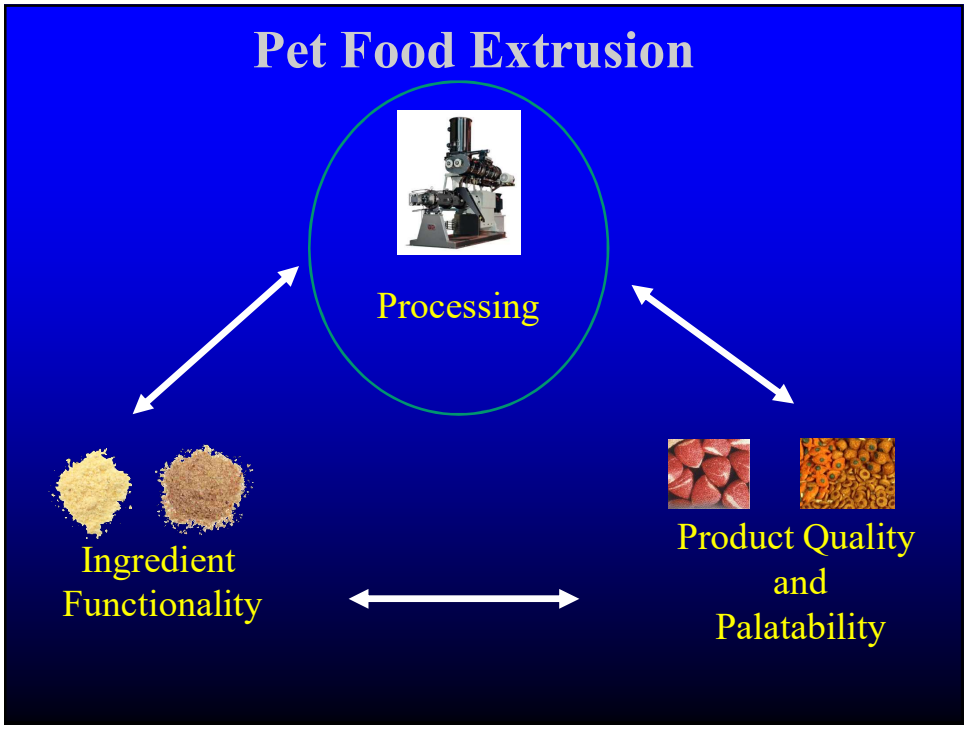
- polymers of amino acids
- broad classification – fibrous, globular
- classification by source – plant, animal
- plant proteins – cereal grains (wheat gluten, corn zein, etc.), legumes (soybean and other oilseeds, beans, peas); lower cost, greater functionality, poor amino acid profile
- animal proteins – meat, fish, poultry, dairy, egg; higher cost, poor functionality, good amino acid profile, high palatability

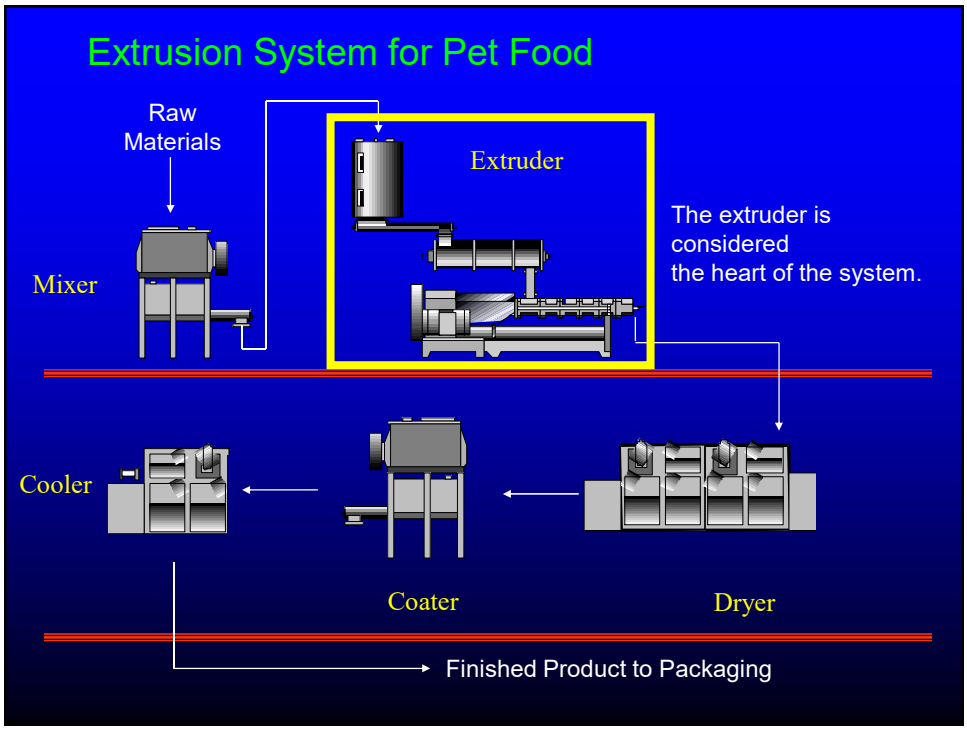
Lipids

- fatty acids; high caloric density, flavor and palatibility; e.g. corn oil, soybean oil, cottonseed oil, poultry fat, beef tallow; emulsifiers (soy lecithin, glycerol monostrearate, monoglycerides)

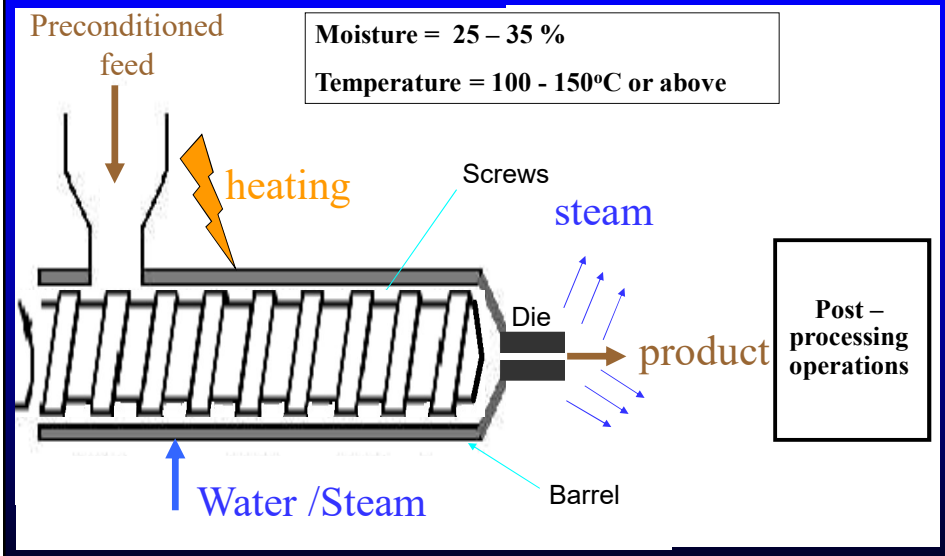
II. Guy Classification System – classification according to functional roles

1. Structure forming – primarily cereal flours and starches; in some cases, wheat gluten, oilseed and other legume proteins
2. Dispersed phase fillers – animal and plant proteins, bran, cellulose
3. Plasticizers and lubricants – water, oil, emulsifiers
4. Nucleating agents – sodium bicarbonate, baking powder, bran, etc
5. Flavoring agents –salt, sugar, animal digest, spices, natural and artificial flavors
6. Coloring agents – milk powder, reducing sugars/proteins, natural and synthetic colors
7. Others – example, dicalcium phospate, tricalcium phosphate, trisodium phosphate, BHT, glycerol, etc.

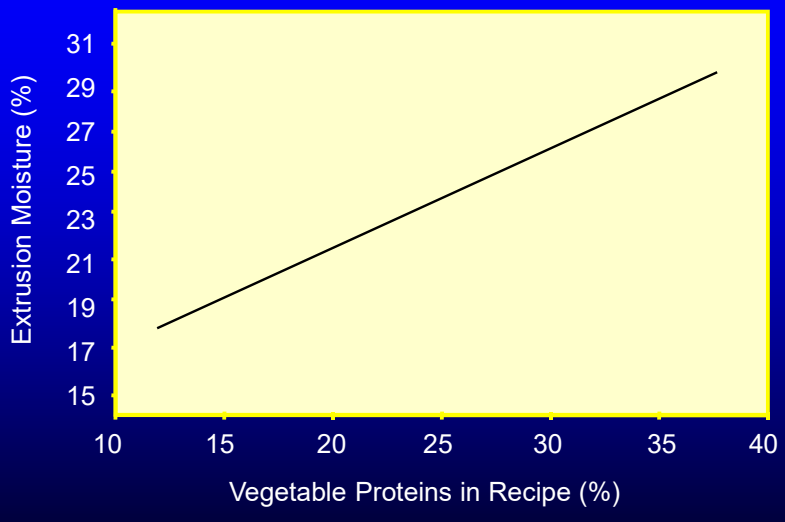

Pet Food Extrusion
Processing
Ingredient Functionality
Product Quality and Palatability


Extrusion System for Pet Food
Raw Materials
Mixer
Extruder
The extruder is considered the heart of the system.
Cooler
Coater
Dryer
Finished Product to Packaging

Extrusion Process for Pet Food



Effect of Vegetable Protein Levels On Extrusion Moisture Requirements*



* Maintaining same density and binding characteristics

Protein Ingredients

- Balanced amino acid profile required for proper growth and body maintenance
- Proteins comprise 25% or more of formulation
- Proteins require more water for processing
- Proteins are typically dispersed phase fillers
- Protein sources: animal vs. plant
- Plant protein sources - soybean meal, other legumes, corn gluten meal, etc

Protein Ingredients

- Animal protein ingredients increase palatibility (flavor function)
- Animal protein sources - meat and bone meal, poultry meal, fish meal, blood meal, gelatin, fresh meat slurries
- Fresh meat slurries have better functionality than meals

Addition of Slurries to Extrusion System

- Maximum particle size not to exceed 1.5 mm
- Slurries can be pumped into into preconditioner or extruder barrel
- Moisture is limiting factor for most slurry additions
- Enzyme treatments reduce viscosity

Pumping fresh meat slurries into preconditioner and extruder barrel

Pumping fresh meat slurries into preconditioner and extruder barrel

Dog/ Cat Palatability

Addition of fresh meat

Ingredient and Process Condition	Palatibility Index
No added fat or fresh meat	1.00
Fat added by premixing	2.13
Fat added to extruder	5.58
Fresh meat and fat added to extruder	11.35

(Wenger Mfg.)

Maximum Wet Slurry Addition to Single Screw Extrusion Systems*

% moisture in wet slurry	Maximum slurry addition (% of total)	Maximum slurry addition (% of dry)	% slurry in final dried product
66.7	25.0	33.3	10.9
40.0	41.8	71.8	32.4
50.0	33.4	50.0	21.8
60.0	27.8	38.5	14.6
70.0	23.9	31.4	9.5
80.0	20.9	26.4	5.6

* Maximum moisture addition to Single Screw Systems is 16.7%

Maximum Meat Addition to Twin Screw Extrusion Systems*

% moisture in wet slurry	Maximum slurry addition (% of total)	Maximum slurry addition (% of dry)	% slurry in final dried product
66.7	30.0	43.0	13.7
40.0	50.0	100.0	40.0
50.0	40.0	66.7	26.3
60.0	33.3	50.0	18.1
70.0	28.6	40.1	11.8
80.0	25.0	33.3	6.9

* Maximum moisture addition to Twin Screw Systems is 20.0%

Thanks!

Acknowledgement: Wenger Mfg., Inc.