What is Extrusion?

- Extrusion: Process of Extruding
- Extrude: to force, press, or push out: to shape by forcing through a die.

Definition of Extrusion Cooking

A continuous process by which moistened, expansile, starchy, and/or proteinaceous materials are plasticized and cooked by a combination of moisture, pressure, temperature, and mechanical shear.

Definition of Extrusion Cooking

A tool used to introduce thermal and mechanical energy to food and feed ingredients, forcing the basic components of the ingredients, such as starch and protein, to undergo chemical and physical changes. Meanwhile, forming a predetermined shape.
Advantages of Extrusion Cooking

Adaptability
- Ample variety of foods are feasible
- Only changing the ingredients
- Operation conditions of the extruder
- Extrusion process is remarkably adaptable to accommodate the demand by consumers for new food products

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**Product Characteristics**

A variety of

- Shapes
- Texture
- Color
- Appearances

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**Energy Efficient**

Extruders operate at relatively low moisture while cooking food products, so less re-drying is required.

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Low Cost

Extrusion has lower processing cost:
- 19% raw material
- 14% labor
- 44% capital investment.
  Extrusion processing also need less space per unit of operation

New foods/feeds

Extrusion can modify
- Protein (vegetable and animal)
- Starches (all sources)
- Other food material to produce a variety of new and unique food products

High Productivity & Automated Control

- An extruder provides a continuous high-throughput
- Fully automated controls extruders

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High Product Quality

- Extrusion is HTST heating process, minimizes degradation of food nutrients
- Improving the digestibility of proteins (by denaturing) and starches (by gelatinizing).

Quality -- Continue

Extrusion cooking at high temperature destroy the antinutritional compound,
- Trypsin inhibitors
- Gossypol,
- Hemagglutinings,
- Undesirable enzymes, (lipases, lipoxidase and microorganisms

No effluent

Very few process effluent produced
Paper presented by Dr. Mian Riaz at the 2nd Annual "Feed to Food" Conference

Raw Materials Cost Effect on Profits

- 1% Savings
- Raw Materials Cost

is worth
16 X more in profits

- 1% Savings
- Utility Cost

Know Your Raw Materials!

They may be your best friend,
OR BECOME YOUR WORST NEIGHBOUR

Formulation

- Carbohydrate
- Protein
- Lipids
- Minor Ingredients

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Lipids
- Level of indigenous or added lipids affects:
  - Binding and texture of product
  - Quantity of energy mechanically added to product

Minor Ingredients
- Minerals
- Vitamins
- Pigments
- Flavors
- Processing Aids

Note: Vitamin, Pigment, and Flavor Potency is affected by energy (in the form of heat, moisture, and retention time in the process).
Applications in Food

- Breading
  - A broad range of products with various shapes and particle sizes
  - Product Properties
    - Bulk density
    - Particle size and shape
    - Oil absorption

- Breakfast Cereals
  - Direct expanded
  - Flakes
    - Texture
    - Flavor
    - Bowl life
    - Nutritional quality
    - Bulk Density
Breakfast Cereal

Snacks
- Expanded snacks (2nd generation)
- Snack pellets (3rd generation)

Product Properties
- Texture
- Flavor
- Nutritional quality
- Bulk density

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Applications in Oilseeds

Sterilization & Detoxification

Destruction of antinutritional factor

- Urease
- Proteases (Trypsin Inhibitor)
- Gossypol

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Stabilization

Rice Bran:
- To inactivate the enzymes
- To improve the oil quality
- To get better extraction

Extrusion cooking is...

A very flexible processing tool that uses the proper raw materials, hardware, and processing techniques can produce a wide range of food and feed products.