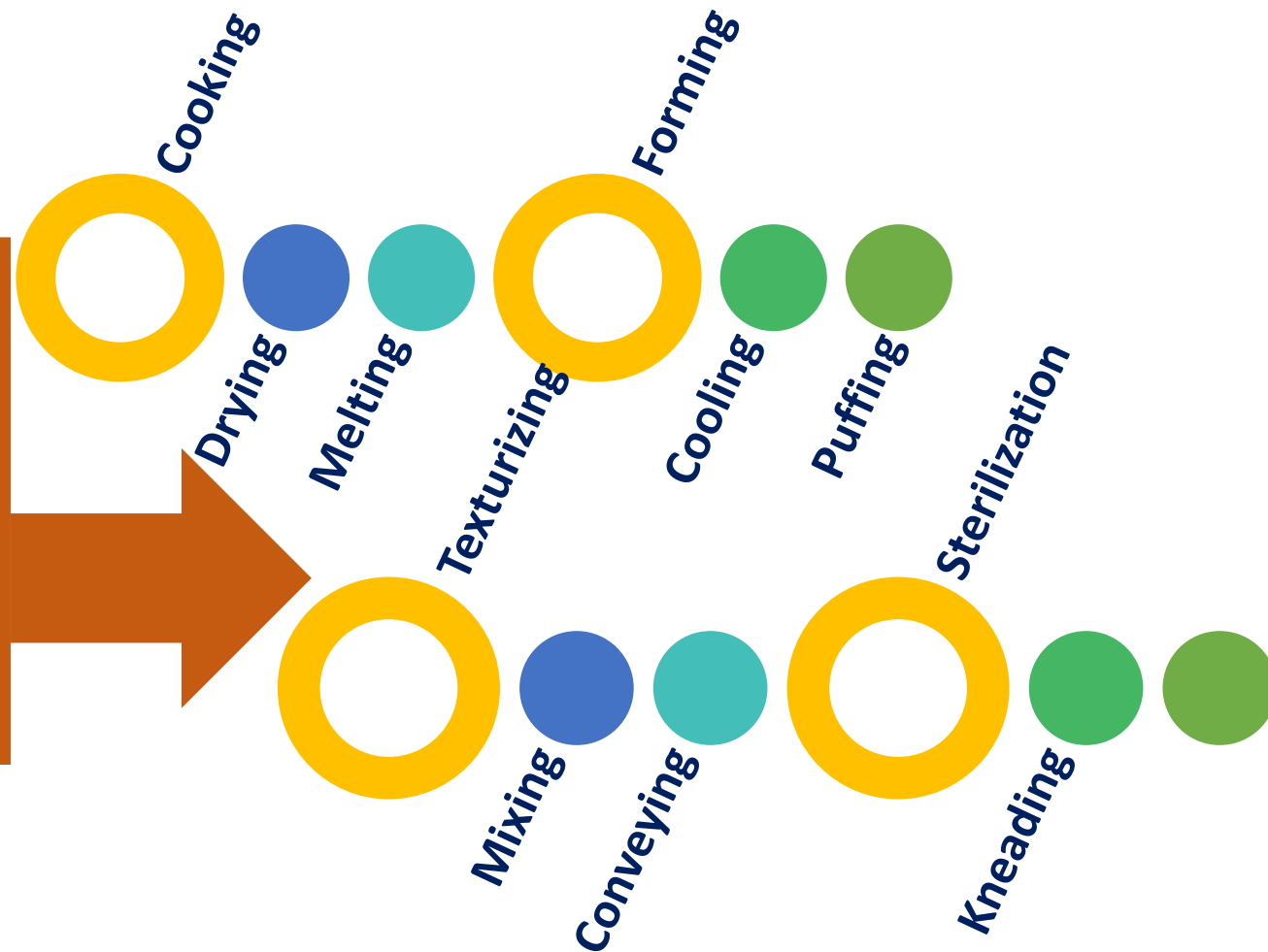


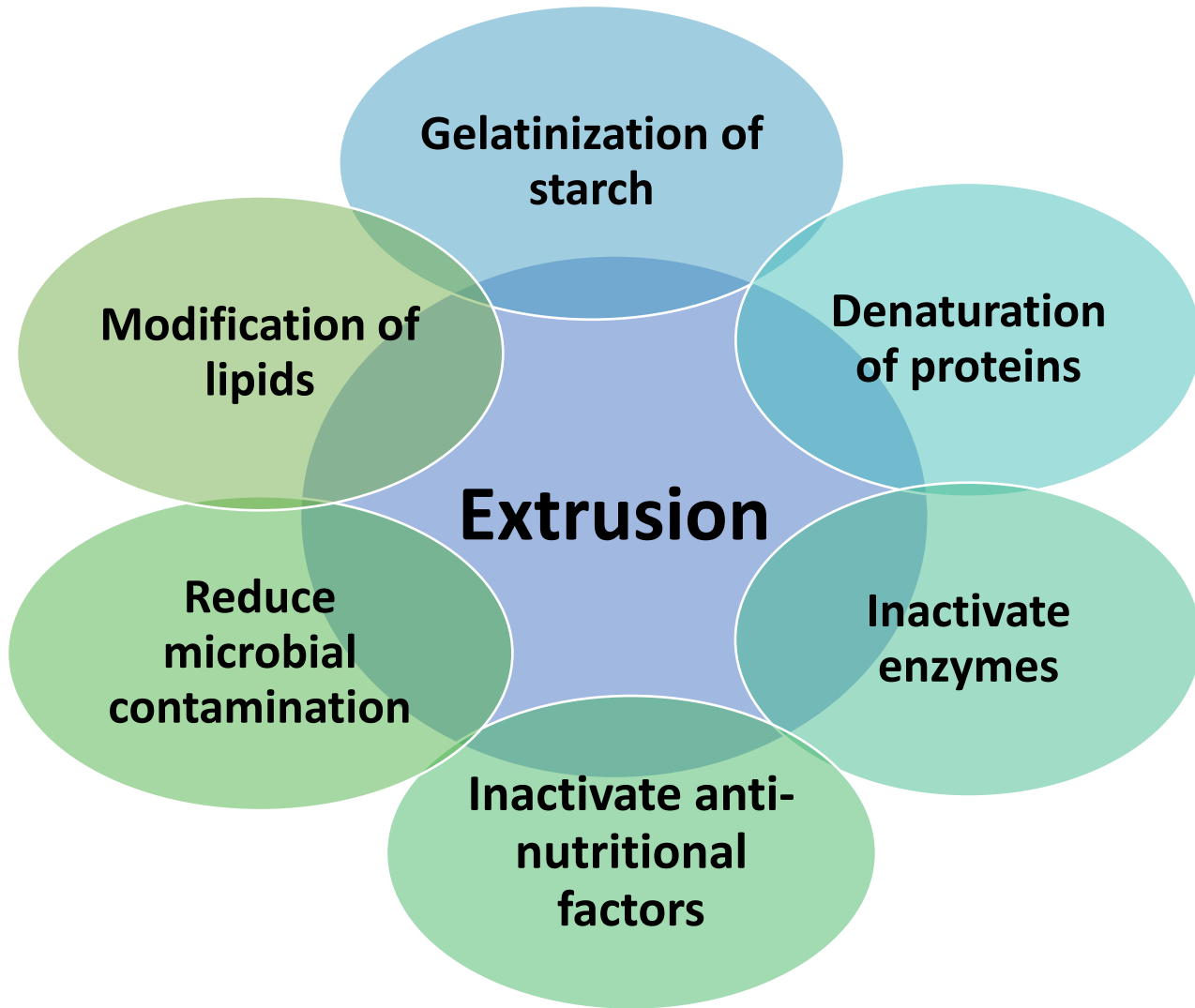
# Ready-to-eat Snacks





**Extrusion cooking** is a modern cooking process (thermo-mechanical process) in which heat transfer, mass transfer, pressure changes and shear are combined to produce effects such as,.....





Extrusion cooking is a high-temperature short-time (HTST) cooking process

The water activity of the product is  $0.1$  to  $0.4a_w$

It is important food process in the manufacture of ready to eat foods and snacks

Extruded snacks in India is projected to grow at a CAGR of more than 15% during 2019-2024

The snack food processes, which use extrusion cooking, include the production of

direct expanded extrudate and indirect extruded pellets or half products of the third generation snacks

The extruded half products require a secondary puffing step. Prior to consumption,

the third generation snacks are puffed in a fryer, or expanded in hot air or a microwave oven.

Snack food technology of direct expanded, and shaped snacks is similar to RTE cereals processes,.

but normally performed at lower moistures, so that a higher energy input from mechanical sources occurs

Other categories of the direct expanded foods are crisps or flat breads which are produced using the twin-screw extruder technology.

Also, twin screw extruders can be used for cracker production.

## 1<sup>st</sup> Generation Snacks : Simply extruded snacks

In this category all the natural products used for snacking, nuts, potato chips & popped popcorn are included

## 2<sup>nd</sup> Generation Snacks: Expanded snacks

The majority of the snacks fall in this category

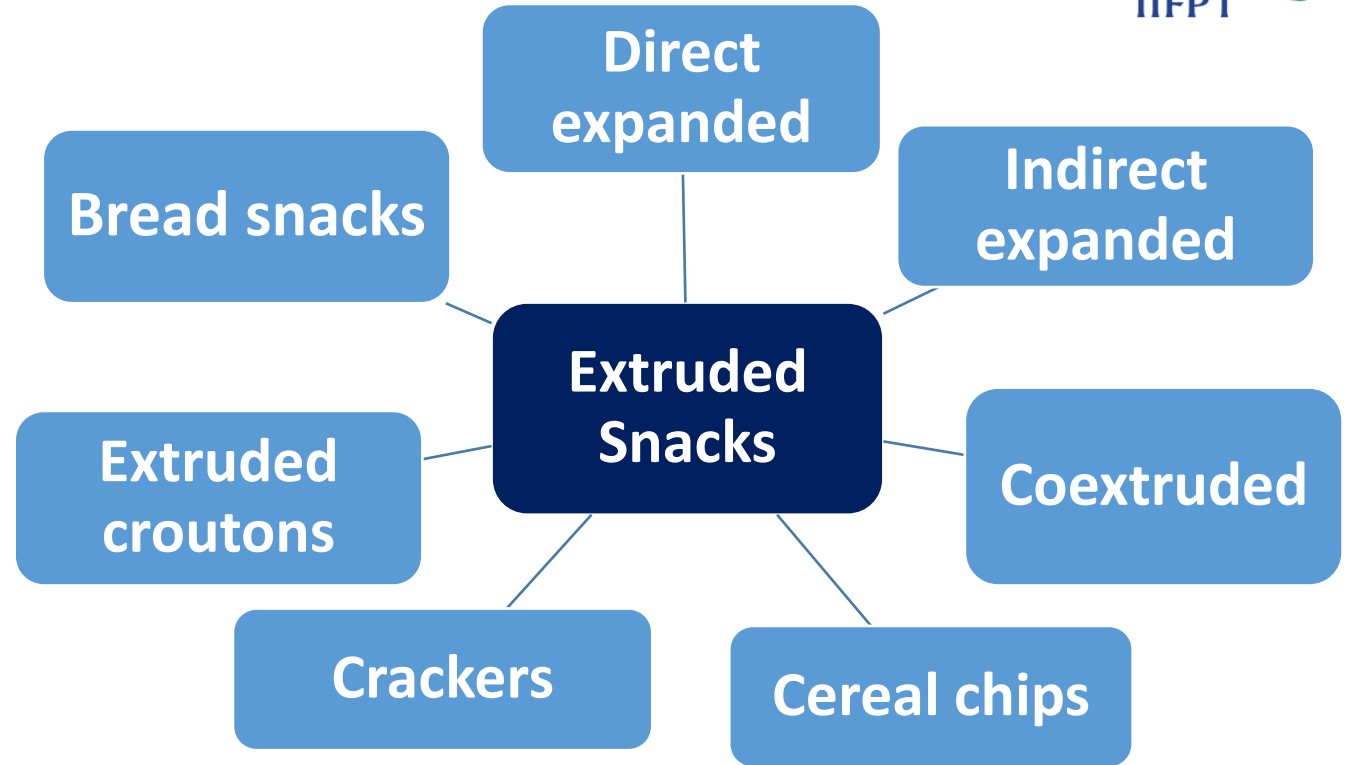
All the single ingredient snacks, simple shaped products like corn tortilla chips & puffed corn curls & all **directly expanded snacks** are included in this category

## 3<sup>rd</sup> Generation Snacks : Half products” or pellets

In this category, multi ingredient formed snacks and **pellets**, made by extrusion cooking are included.

Features: wide ranges of shapes & texture, various coatings, fillings (sweet & savory)

Nutritional products in fiber, vitamins and minerals



**Flow sheet for the production of 2<sup>nd</sup> and 3<sup>rd</sup> generation snacks**

**Blending of raw material**

**Preconditioning**



**Drying**

**Direct expansion (2<sup>nd</sup> generation)**

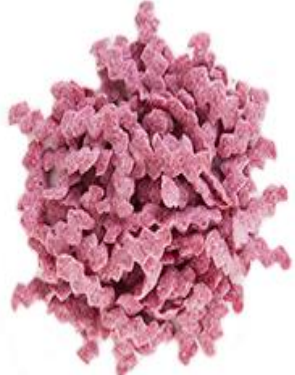
**Extrusion**

**Pellets (3<sup>rd</sup> generation)**

**Cooling**

**Drying**

**Flavoring**

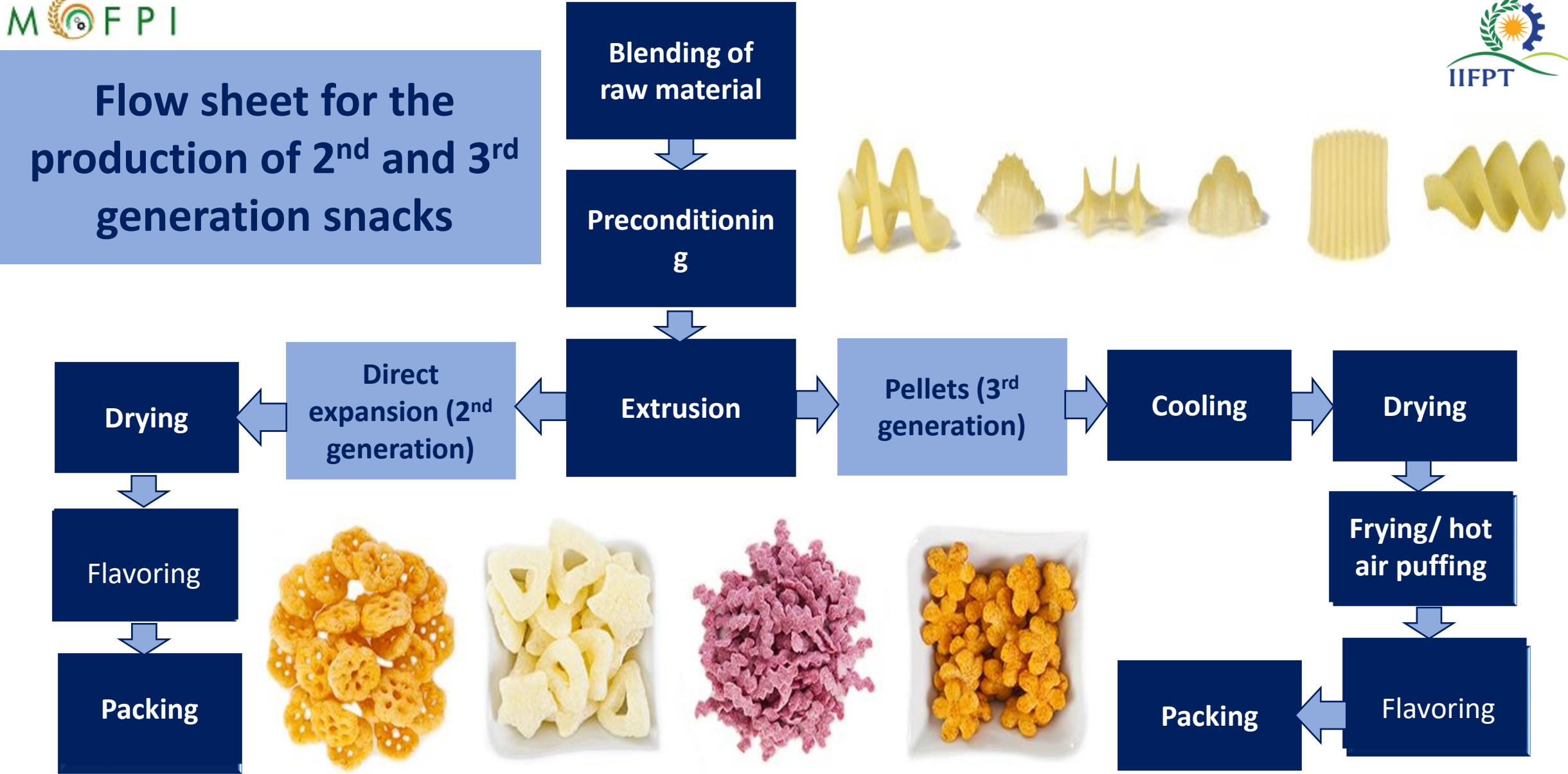


**Packing**

**Frying/ hot air puffing**

**Flavoring**

**Packing**



## Simply extruded snacks

- This category has the greatest potential for growth among snack foods.
- These snacks can be made to produce innovation, which captures consumer imagination
- Some examples are three-dimensional snacks, a variety of animals, cartoon, and alphabets shapes etc.
- Raw material costs play an important role in the finished product's selling price.
- Therefore it is advantageous to use the lowest cost raw material to produce a successful snack.



## 2<sup>nd</sup> Generation snacks - Expanded snacks

- The majority of extruded snacks are in this category
- This group is also referred to as “collet” or second generation snacks”
- Expanded snacks are made on high-shear extruders,
- These are high-fiber, high-protein and low calorie snacks
- Some examples are corn curls, onion rings, three dimensional snacks and potato sticks
- These types of snacks can be seasoned with a variety of different flavors, oils, salt and sugars etc.
- The quality of an expansion-cooked product depends upon the conditions of operation of the extruder and the main raw material used in the formulation.

## 2<sup>nd</sup> Generation snacks

- Second generation snacks or expanded snacks, where most extruded snacks are classified, are usually low in bulk density and are often marketed as high-fibre, low-calorie, high-protein and nutritional products.
- Different raw materials used to produce these kinds of snacks (i.e. flours and/or cereals and tubers starches and proteins) are processed in a extruder resulting in a continuous mass, that is cut into pieces of uniform size, being afterwards dried, flavored and stored.

## Fried collets

- These are the most familiar extruded snacks in the market
- A special die arrangement gives the product a twisted, puffed shape
- The collets are made on collet extruders
- The product is then fried in vegetable oil, and coated with cheese and some other flavor.
- During frying, the moisture level in the product reduces from 8% to 1 to 2%.
- The most common material used for fried collet is corn meal
- Some other cereal grains can also be used for this type of product.

## Baked collets

- Baked collets are another example of extruded snacks
- This includes products such as baked corn curls, onion rings and potato sticks
- Baked collets can be made with different cereal grains and tuber flours
- Protein, fibers, cellulose and bran can be blended with cereal grain up to 20% to make healthy snacks
- Potato sticks are usually made by mixing potato flour with corn or rice flour

## Direct Expanded Snacks

- These snacks are typically puffy, crispy or crunchy cereal or starch “finger foods” that come in a variety of shapes and sizes and which are textured and often coated to make them convenient, tasty and fun.
- They are eaten at all times of the day and can be sweet or savory.
- Snacks are eaten for pleasure, but increasingly, they need to be healthier as well

## Crispy Flat Breads

- Flat crispy bread are generally square or rectangular, with a wide range of possible dimensions, from small flat biscuit-size breads popular at snack time, to large flat breads that conveniently replace toast for breakfast or bread for lunch and dinner.
- They offer great taste, are nutritious and benefit from a long shelf life.



## Filled Crispy Flat Breads

- Crispy flat bread manufacturing to develop new filled products made with co-extrusion systems.
- Filled crispy flat breads are an interesting variation because they combine two textures: a crispy outer biscuit and a soft filling. The filling provides the dominant flavor to the product, complemented by the toasted taste of the biscuit.
- They are popular within a wide range of consumers, but are particularly appreciated by children and young people. Since they require no cooking nor preparation, they are handy to eat at home or to take to school or work.

## Filled Snacks

- Filled savory snacks are an interesting variation because they combine two textures: a crispy outer biscuit and a soft filling.
- The filling provides the dominant flavor to the product, complemented by the taste of the biscuit.



## Bread Snacks (Croutons)

Bread snacks (also known as “croutons”) are lightly toasted and dried mini-breads, traditionally used as a crispy garnishing in soups and salads.

They are gaining in popularity worldwide as tasty, healthy and sophisticated alternatives to traditional snacks such as potato or corn chips.

## Multigrain Chips

Multigrain extruded chips have gained significant market share as healthier and tasty alternatives to regular potato chips or corn chips. These new-generation chips which are rich in whole grains and fiber and low in fat (average fat content of 20%, compared to 30% in expanded snacks and 40% in traditional chip).



## Third-generation snacks

- These are extrusion cooked, and formed at low pressure to prevent expansion, and then dried to a final moisture content of about 10% to form a glassy pellet
- To create formed or pelletized products, a high moisture dough is used at a lower temperature
- When the extrudate is forced through the forming die, the product takes the shape of the die, instead of expanding
- The result is dense intricately-shaped pellet.



## Third-generation snacks

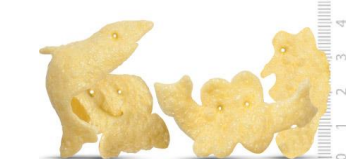
- Third generation snacks or pellets are produced almost the same way as second generation snacks, however, when the product exits the extruder, it has the form of the die, that is, it is not expanded, being dried in this form.
- The expansion of the product occurs afterwards through frying, heating by hot air or in microwave oven.
- This kind of product presents a low moisture content (between 7 to 10%), high density and stability to be stored for a long time without microbial damage.

# Snack Pellets

- Snack pellets are intermediate non-expanded products made with raw materials that include cereals, potatoes or vegetable powders.
- These semi-finished products are generally sold to snack manufacturers who then process them, using different methods (frying, hot air baking, etc.) and adding various taste ingredients to create ready-to-eat snacks.
- The market for these types of products is growing fast, mainly due to the great diversity of products in terms of shapes, textures, colors and flavors.
- Snack manufacturers throughout the world greatly appreciate pellets because of their long shelf life and their high-density features, simplifying storage and making them convenient and economical to transport.



- Pellets become ready-to-eat snacks once they have been expanded.
- Snack pellets can be made with a wide variety of grains – corn, wheat, rice, tapioca – or potatoes and other vegetables. They can also incorporate aromas and colors in their recipes.
- Food makers can thus cater to new consumer trends, including the use of vegetables and multi-grains for flavor enhancement in healthy snacks.



## Co-extruded snacks

- This is a relatively new technology introduced in 1984 to the snack industry
- Coextrusion is a process that combines two different extruded streams to obtain two-component products characterized by a dual texture and /or colour
- The two materials can come from two extruders or from one extruder and one pump.
- This process can produce a snack with two different flavors, or two textures or two colors
- The most common snack produced by co-extrusion is a cereal-based outer tube with a cheese filling inside.

## Co-extruded snacks

- Fats and oils play an important role in frying, coating and filling of the extruded snack foods
- Coating with oil and seasonings is the final processing step in the production of snack foods
- The seasonings allow the manufacturer to create a variety of flavours
- The oil is the carrier of seasonings and gives the extrudate a better mouth feel. The oil and seasoning coating usually makes up to 35% of the finished product
- The shelf life of these snacks is limited, because of migration of moisture and /or oil from the filling to the outer shell.
- There are three basic types of co-extruded snacks in the market;
  1. Cereal based tube with cereal-based fillings
  2. Cereal based tubes with fat-based fillings, and
  3. Cereal based tubes with water based fillings

## Sources of Ingredients

Most common source of ingredients are cereals (corn, wheat, oat, barley, rice, potato, tapioca). A major ingredient in snack formulation is starch

Other source of ingredients are whole gains & / or mixture of grains, ancient grains (amaranth, quinoa etc.), roots & tubers

Almost any cereal can be extruded, but if expansion is a major objective, the numbers of functional cereals are limited to de-germed corn/ grits and rice

Cereals that have high amounts of lipids are more difficult to expand due to dough slippage within the extruder barrel.

This type of cereal usually requires high moisture and high temperature before significant puffing will occur.

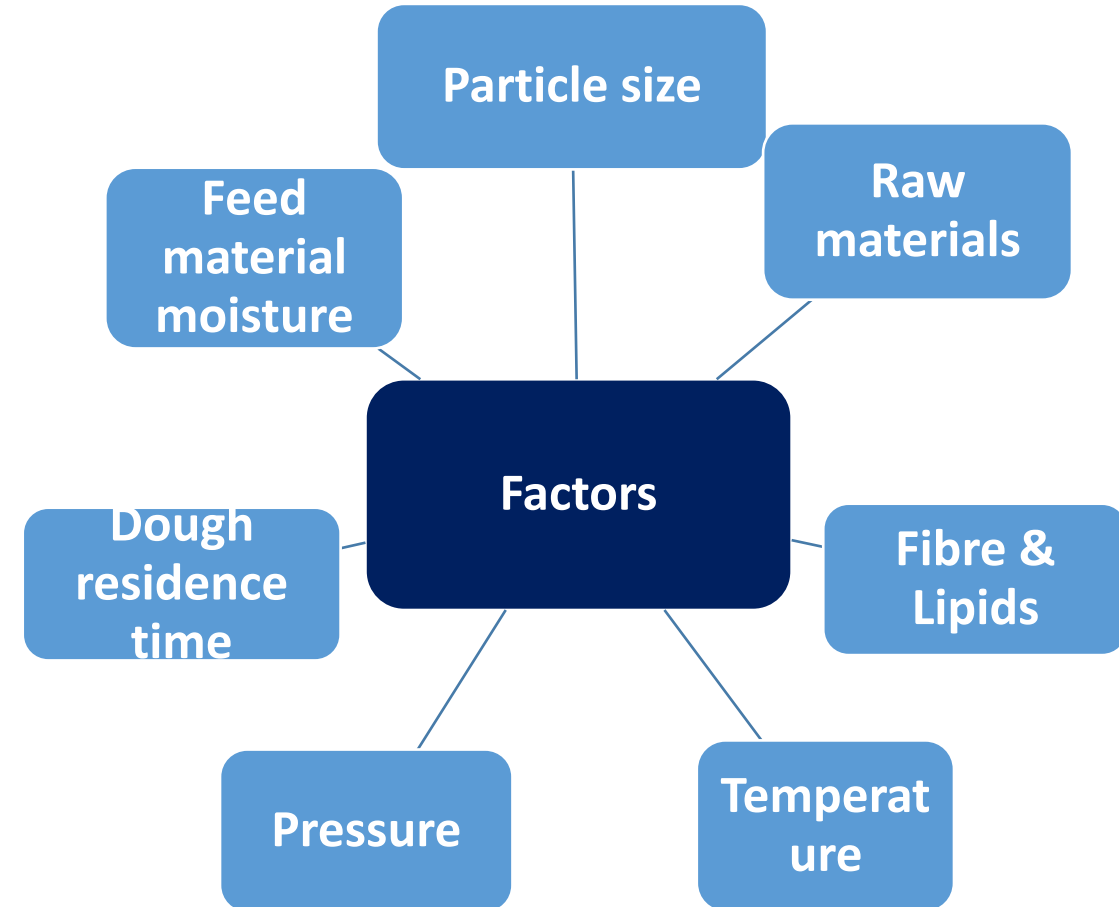
In general, starches with 5 to 20 % amylose content will significantly improve expansion as well as the texture of snack foods.

# Typical process parameters

Process	Temp. °C	Max. Pressure (bar)	Moisture (%)	Max. Fat (%)	Cook (%)
Pellet press	60 - 100	-	12 - 18	12	15 - 30
Expander/pellet press	90-130	35 – 40	12 - 18	12	20 - 55
Dry extrusion	110 - 140	40 - 65	12 - 18	12	60 – 90
Wet extrusion					
Single screw	80 – 140	15 - 30	15 - 35	22	80 – 100
Twin screw	60 - 160	15 - 40	10 - 45	27	80 – 100

## Factors influencing the degree of puffing of snacks during extrusion

- The amount of moisture in the feed material, dough residence time in the extruder barrel and cereal particle size
- To manufacture expanded products, the pressure and temperature are increased, while the moisture level is accurately controlled.
- When the product exits the extruder through the forming die, the change in atmospheric pressure causes the internal moisture to turn to steam. This puffs the fully-cooked dough into an expanded product



## Major players operating in India extruded snacks market

PepsiCo

ITC

Prataap  
Snacks

DFM Foods

Haldirams



## Extruded snacks market in India

In terms of distribution channel, the extruded snacks market is categorized into traditional grocery stores, supermarkets/hypermarkets, convenience stores, online, and other distribution channels.

Traditional grocery stores accounted for the majority share of India extruded snacks market in 2018 followed by Supermarket/Hypermarket.

The convenience stores and online portals are also witnessing a healthy growth in the market.

The market for India extruded snacks in North India was the largest in 2018 on account of presence of a large customer base, especially the young population.

Thank You

