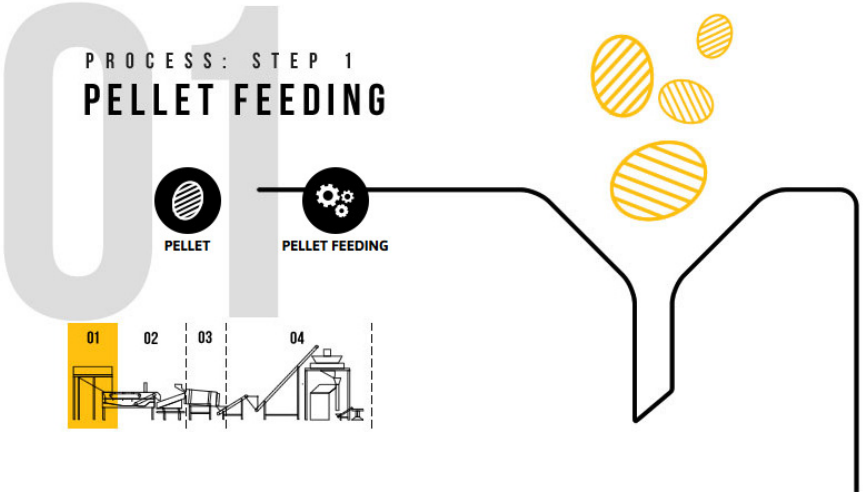
Crispness with the Italian touch

PRODUCTION FLOW

PELLET BASED SNACKS: ALL YOU NEED TO KNOW



THE PELLET

THE PELLET, a **semi-finished product,**

is the core of snack industry since its characteristics – shape, texture and partly the taste – determine the characteristics of the edible snack achieved after expansion. The inventor of pellets used the same expansion principle of "pop-corns", creating a starchy matrix with a vitreous structure, which "bursts" when submitted to powerful thermic treatment.

Raw materials with high quantity of starch are necessary to obtain an amorphous vitreous structure once it is gelatinised and dried.

In the past, pellets were manufactured in manual way, by means of dough vapour cooking, cut and finally sun-dried. Nowadays, highly sophisticated technologies are used to mix powder ingredients, to extrude and cook the dough, to shape the pellet. Die forming, stamping, piercing, are traditional systems of shaping the pellet, while the most recent technologies allow to obtain 3D and pillow shapes by conveying and cutting two sheets of dough together.

A pellet-based snack offers **SIGNIFICATIVE ADVANTAGES** in comparison with natural potato crisps, in terms of **Profitability** thanks to:

- **higher selling price**, due to the uniqueness of the snack;
- **reduced investments** for processing lines and manufacturing facilities;
- **easy transportation and handling of pellets** which have long term stability of their characteristics and do not need strict storing conditions. That is why pellets can be delivered everywhere world-wide;
- **absence of extra-costs for decontamination** of water wastes or potato scraps;
- **simple know-how required** for frying, flavouring and packing, which reduces the number of workers and the required skills to run the manufacturing operation.

Marketing opportunities thanks to:

- **the possibility of creating new, original and exclusive snack concepts**, by co-operating with the right partner: MAFIN SPA, the most experienced, innovative and creative pellets manufacturer in the world. We put at your disposal the widest assortment of original pellets, offering you the best quality and a know-how developed during more than 60 years of business in extrusion technology;
- **the possibility of offering customers an extremely wide variety of snack concepts** which satisfies even the most exigent snacks consumers looking for products 'low fat', 'high in fiber', 'high in wholegrain', 'low salt', etc….

PELLET FEEDING

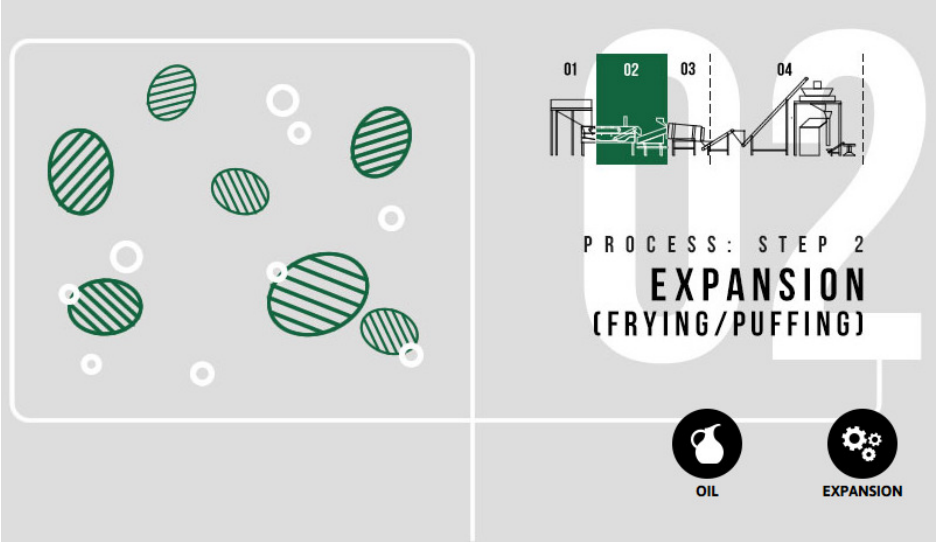
The aim of this section is to grant the feeding of a constant and uniform quantity of pellet to the following phase: normally the frying in an oil bath, but could also be the expansion by a hot air oven, or the expansion by a "puffing-press" machine for micropellets. We desire to point out that consistent feeding means consistent processing of the pellets themselves.

A good **DOSING UNIT** should grant:

- feeding of constant and uniform quantity according to process capacity;
- reproducible processing parameters;
- 'gentle' handling of the pellet in order to avoid breakage;
- reliability.

The pellet feeding can be performed by means of several **TECHNOLOGIES**.
The main are the following:

- **vibrating doser:** it is the most economical system, but does not allow to have precise feeding and information concerning production capacity and quantity processed;
- **volumetric doser:** it is a reliable way in terms of constant dosing but, similarly to vibrating doser, it does not give indications concerning the quantity processed;
- **weighing doser:** it is the most reliable system, and it allows knowing how many kgs of pellet are processed every hour. As a consequence, it is the most expensive one.



EXPANSION

Pellet expands because of the thermal flash occurring to the residual moisture of the pellet when the pellet itself is submitted to a powerful heat source.

In most cases, the heat necessary for the expanding the pellet is transferred through edible oil (**frying process**), but there are also other possible means to obtain expansion:

- hot-air;
- "puffing-press";
- microwave;
- infrared rays.
  (for unfried snacks, the most commonly used methods for industrial applications are the first two)

FRYING
This phase represents **the heart of the whole process as the immersion of pellet into the oil bath causes its expansion**: the final step is the edible snack.
The key principle is that the quick heating of the pellet (frying temperature ranges between 185-200°C) causes the softening of the matrix and the very quick transformation of its residual water in vapour, so that the consequent pressure produces the expansion of the pellet.

A good fryer for pellets should grant:

- **uniform treatment** of all pieces immersed into the oil;
- **constant processing time** into the oil bath for all pellets;
- **steady and uniform distribution of the heat** in all the different points of the oil bath;
- the **smallest possibility of oil deterioration.**

Some elements can positively influence the performance of the fryer, and the reaching of the above goals:

Oil recycling system
Forced oil turbulence in the bath, grants uniform distribution of heat. A quicker circulation results in a smaller possibility of oil deterioration because of the reduced time of contact with the heating surface. Furthermore, oil turbulence has a positive impact on the expansion of 3D and grid shapes, as oil can easily enter the inside part of the pillow, making the pellets expanding uniformly.

Conveyor system
Which provides the forwarding of the expanding pellet into the oil bath and keeps processing time consistent. One solution is a submerging belt, which forwards the pellet as soon as it starts expanding and floating on the oil bath surface; an alternative can be a belt with paddles or a wheel with cells, which encloses the pellets into closed cells, where they expand while they are forwarded. The latter solution grants very uniform processing time of the pellet, but can cause small % of breakage due to the impact of the product with the paddles of the belt.

Oil turnover
It suggested to not be longer than 3 hours, and it is influenced by the ratio between the dimensions of oil bath and production capacity, as well as from the % of oil absorption depending on pellet characteristics. Example: given 100Kg/h the output capacity of the fryer, 25% oil intake of the pellet, 75Kg oil capacity of the fryer bath, then the oil turnover is 3 hours long (75Kg divided by 100Kg/h*25%). The fryer has to be run always at the maximum capacity compatible with the pellet to be expanded, so that oil turnover is carried out in the quickest way. To this purpose the packaging system must be suitable for processing such capacity.

Vapour exhausting and oil filtering
Are recommended in order to eliminate dirt and scrapes as natural consequences of the frying and dropping process.

Oil dropping system
A good dropping system should grant:

- the most effective dropping in the shortest possible time. Indeed, many kinds of oil are not liquid at room temperature, so that the cooling of the fried snack may reduce its ability to loose the excess of oil;
- 'gentle' handling of fried products.

Oil dropping system
Technologies for achieving reduced fat snacks have been developed in these last years. There are two main methods applied industrially:
A) superheated steam counter flux injection;
B) centrifugation of the product.

HOT AIR
Most popular hot-air ovens are based on cyclone technology, drum technology and vibrating conveyors with orientable air injection system technology.
A good hot air oven should grant:

- a strong heat transferring in the very first step of the process, and a following gradual decreasing of temperature;
- uniform treatment of all pieces passing through it;
- constant and uniform permanence time;
- gentle handling of expanding pellets;
- steady and uniform distribution of the heat in all points of the expanding section of the oven.

The last above mentioned characteristic can be achieved by a strong airflow which lead the product to move as it was on a fluid bed.

"PUFFING-PRESS" TECHNOLOGY
Suitable for this technology is a mini-sized pellet with a spherical like shape (2-5mm, diameter). The working principle is based on heat transferring by contact to the micropellet which is placed into in a small sealed cell (created by a cylinder and a piston). Under a high-pressure and high-temperature regime, the micropellets melt in a few seconds forming a liquid gel. Then, pressure is steeply released and product matrix develops vapour very quickly, puffing the product up and giving the typical aerated crispy structure. Industrial scaled puffing machines are equipped with a number of 20-30 cells (cylinder/piston system) and the full puffing process lasts for 10-20 seconds.
A good "puffing-press" machine should grant:

- uniform distribution of pressure and temperature for all cells, for achieving a uniform heat treatment for the products processed by the whole press machine;
- high quality of cells construction, granting a good sealing, an appropriate mechanical resistance, and a low adhesion to the product.

FRYING OIL

Frying oil has **a strong impact on the shelf life of the snack**.
The frying temperature for pellets depends on their characteristics but typically, it ranges between 180 and 200°C, while in case of natural potato crisps it ranges between 160 and 180°C. Because of the high processing temperature, **it is necessary to use oils with high thermal stability**.

Triglycerides are made of saturated, mono-unsaturated, and poly-unsaturated fatty acids. **Oils rich of saturated fatty acids** are heat resistant, but give a fatty off-taste to the product and they are not recommended by the recent nutritional guidelines. **Oils rich of mono-unsaturated fatty acids** have a good thermal stability and they resist well to the frying process up to 195 ÷ 200°C. They have a neutral taste , and there are no concerns from nutritional point of view. They are less cheap and they are less used. **Oils rich of poly-unsaturated fatty acids**, do not have a good thermal stability (smoke point 150 ÷ 160°C only), they tend to form peroxides shortening products shelf life. Moreover, they tend to cause gumming in the fryer and on the conveyors.

As a general indication, a **GOOD OIL** for frying pellets should maintain during the process the following values:

- Free Fatty Acids: FFA 0.3 – 0.4%
- Peroxide Index Value: PIV < 7 – 8

Higher levels thereof are an index of a degraded oil which may lead to a shorter shelf life of the finished packed snack.

Main **TYPES OF OILS:**

Standard Sunflower Oil
It is known to cause gumming in fryers, due to the formation of high molecular weight polymers and as consequence it leads to an increase in oil viscosity. It needs regular cleaning, to avoid oil deterioration. Its stability is not sufficient for frying temperatures higher than 180°;

High-Oleic Sunflower Oil
It is a good quality oil of about 80% of oleic acid (mono-unsaturated) with a good thermal stability, a good oxidation resistance, and a neutral taste. Melting point is 0,5°C;

Fractionated Palm Oil (Palmolein)
Chemically and physically it appears to be particularly stable and clean for frying, as well as relatively cheap. Since it contains natural anti-oxidants, further chemical additions are not required. It is probably the most used worldwide for frying pellets, although it is object of recent concerns from nutritional point of view cause of its content of 30-40% of palmitic acid (saturated acid);

Maize or Corn Oil
It is not widely used for commercial frying and its problems are commonly related to a low thermal stability and consequent gumming in the fryer, and its relatively short life;

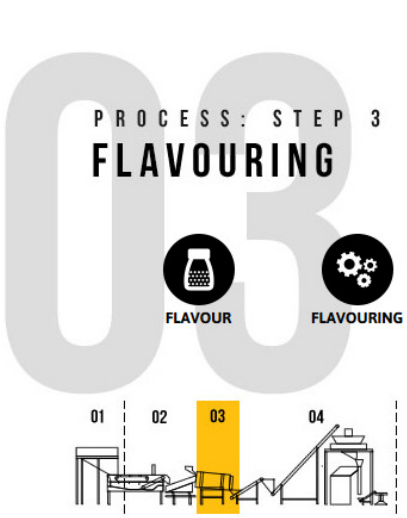
Other Oils
They are generally unsuitable for frying pellets, but in the past they were used after hydrogenation process. Nowadays, trans-fatty acids formed during the hydrogenation of oils are a major concern from health point of view.

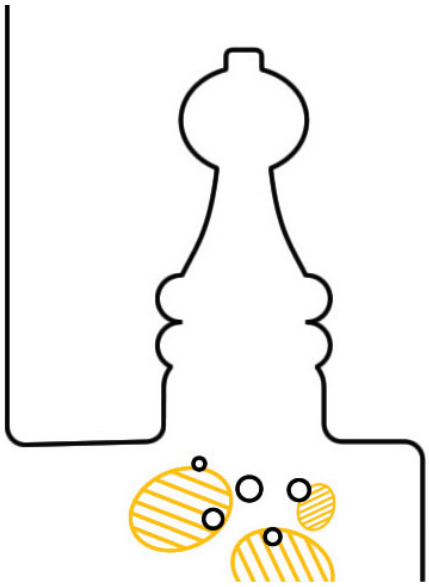
Pure Soya and Rape seed Oil

KEY ASPECTS

Other aspects which are essential for achieving an adequate shelf life of the fried product:

- **suitable design of the fryer** (heat exchanger characteristics, oil filtering system,…);
- **handling of the frye**r to ensure a short oil turnover time (running fryer at maximum output capacity,…);
- **good cleaning practices** to reduce to the minimum the formation of products with high molecular- weight;
- **using of anti-oxidan**ts in the frying oil (natural or synthetic);
- **nitrogen injection** into the snack's bag;
- **characteristics of the packaging** (bag film)





FLAVOURING

Fried snacks are flavoured according to consumer tastes and the type of pellet to be used. From the technical point of view, it is necessary that flavouring be made immediately after the frying process, so that the absorption of the oil in the surface is completed.

FLAVOURING SYSTEM
A good flavouring system should grant:

- **a uniform distribution of snack seasoning,** avoiding the forming of lumps;
- **reduced quantity of flavour wasted;**
- **gentle handling of snacks.**

Dispersion of the seasoning is generally made by means of a flavouring drum, where pellets are put into and are continuously overturned due the rotation of the drum. The flavour is sprayed on the pellet in order to avoid the forming of lumps. A system used recently is the electrostatic drum, by means of which flavour powder and the fried pellet get fed with the oppositte electrostatic values, in order to cause reciprocal attraction.

In the case of Hot-air expansion or “Puffing press” technology, it is necessary to spray first the oil and then the flavour on the pellets; as a consequence, the total oil content is normally kept under 10%.

Before passing to the packaging phase, the flavoured snack must rest for a few minutes, so as to become less oily and its tendency to oil the internal surface of the bag is reduced. Sometimes, there are pauses of the bag-maker, so it is necessary to add a by-pass phase between flavouring and packaging, in which the snacks are temporarily accumulated.

FLAVOUR

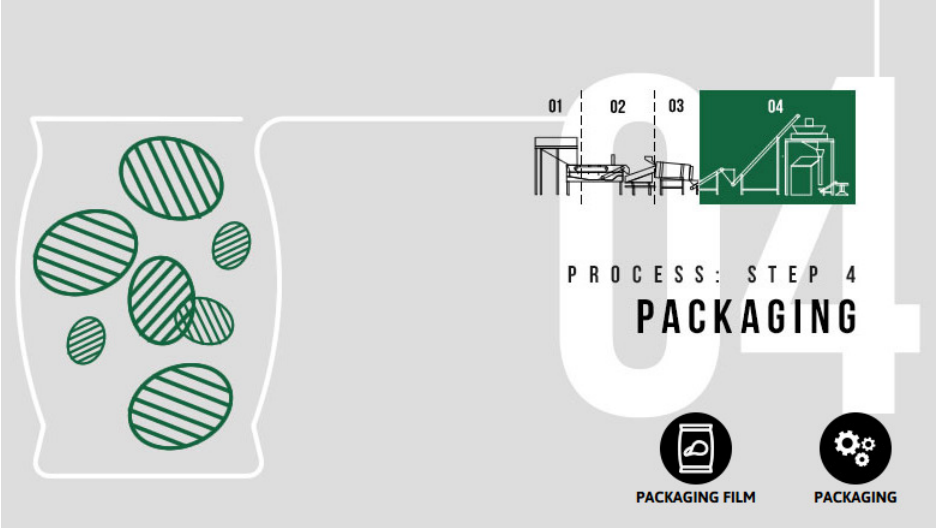
Taste and texture being the two basic organoleptic characteristics while eating a snack, it is easy to understand **how important the flavour is for the success of a snack**.

Flavours are natural or synthetic extract blends, added with salt and maltodextrins, which allow an effective distribution of seasoning powder on the pellet, while going through the drum.

Since tastes are related to the local gastronomic tradition, each country has its own preferred flavours, which may differ, even significantly, from those preferred in a neighbour country.

The most important flavour manufacturers can develop tailor-made flavours, by adapting ingredients and % of salt. Normally, flavour manufacturers give exclusivity for tailor-made products, which is fundamental to keep uniqueness of the snack in the domestic market.

When a new flavour is selected to be launched, it is wise to make at least limited market tests to evaluate in advance its acceptability by target consumers.



PACKAGING

Finally, the snack is conveyed to the packaging system, where it is packed with the bag size designed according to market demand.

Packaging process is split into two phases:

- **WEIGHING of the pellet**
- **FORMING AND FILLING OF THE BAG by means of a BAG-MAKER**

WEIGHING of the pellet
A good weighing system should grant:

- a high speed weighing, in terms of number of bags weighed/minute;
- high precision, even with small bag sizes;
- reliability;
- gentle handling of snack.

Normally, the best performances are reached with multi-head weighing machines, which grant high precision with different bag sizes, and an error margin of about zero. It is important to minimise the error margin, as flavoured snack has the major incidence on the cost of the bag and wastes can increase direct variable manufacturing costs.

FORMING AND FILLING OF THE BAG by means of a BAG-MAKER
A good bag-maker should grant:

- **speed according to weighing process**, in terms of number of bags per minute;
- **gentle handling of snacks and film**;
- **reliability**.

Generally speaking, bag-maker speed is measured in number of beats per minute, so that its production capacity depends on the weight of the bag. The bags being equal, production capacity of a bag-maker depends on the flowing speed of snacks.

It is commonly suggested that bag-maker production capacity is a little bit higher than the fryer capacity.

PACKAGING FILM

Pillow bags are the most popular packaging format for snacks world-wide.

Snacks are normally regarded as “impulse” products. According to recent survey, an attractive bag can weigh up to 50% when deciding to buy a bag of snacks for the first time.

Concerning the above, a BAG should offer the following characteristics:

- **capability to attract consumers’ attention** in terms of brand name, dimension, lay-out and colours;
- **high barrier to humidity** to keep the product fragrant and crispy the longest possible, as well as **high barrier to oxygen and UV rays**, which are required to start up oil degradation which brings rancidity. In other words, to grant the longest shelf life;
- the best **protection of product integrity**.

Generally speaking, the film is obtained by coupling different layers. Commonly used film is based on bi-oriented polypropylene, and can also have a metalized internal surface, as a protection from gases and light. The degree of protection offered by a film is the result of a combination of choices: **thickness** of **layers**, eventual presence of **gas barrier layers, metallization, windows, colours**.

However, given the design of the fryer, type of oil and process handling, the shelf life of a product mainly depends on the packaging film.

When the environment is characterised by critical conditions (high temperatures and humidity), it is recommended to place the packing machine in an air conditioned environment, and blow**nitrogen gas inside the bag** before sealing. To this purpose, a special device on the packaging machine and facilities for manufacturing nitrogen must be available.

Most typical shelf life for a packed pellet snack is about 6 months. Longer shelf life could be achieved by following all the suitable procedures mentioned here above.