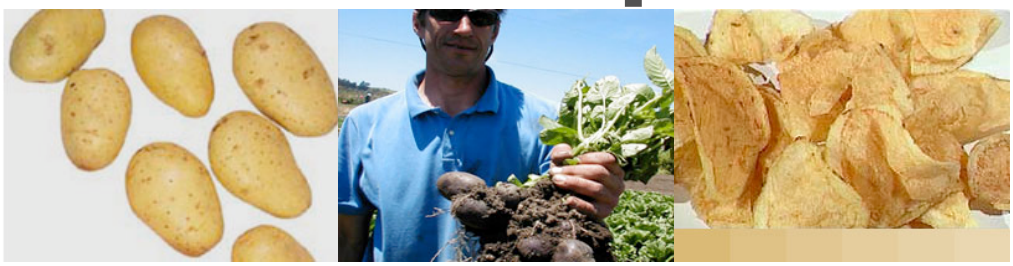
How are Crisps made?



August 2005

Tayto make crisps our customers want to buy

The key is to set a high standard of quality, achieve it, and achieve it constantly

What do we require to produce good crisps?

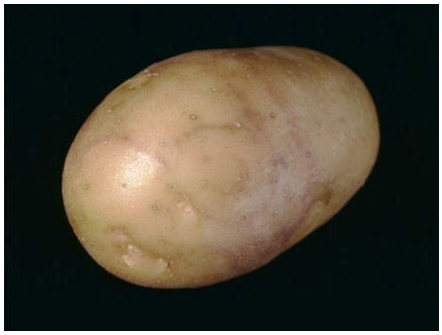
1. Excellent quality raw materials - potatoes, vegetable oil, flavourings and fresh water.

2. Excellent processing techniques and equipment.

3. Excellent teamwork.

4. Customers who want to buy them - demanding high quality products and service.

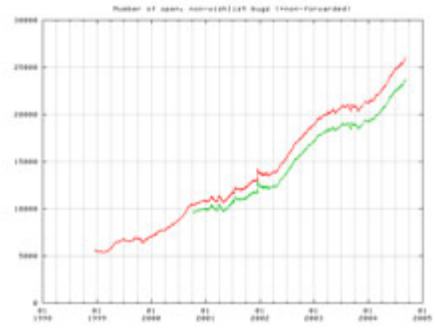
How are crisps made?



1. Potatoes are picked, cleaned and sliced before frying.

2. The frying process boils off the water in the potato slices and replaces it with vegetable oil, giving colour, texture and flavour to the crisp.

How do we get consistency?



1. Using "Best Practice" in growing and storing the right variety of potato.

2. By ensuring the slicing machines are working properly and changed at the correct frequency.

3. The frying machinery operates to the correct programme.

4. Constant recording of the key measures - moisture, colour, slice thickness and temperature.

What do we start with?

We start with the best quality potatoes available.

Potatoes are a vegetable crop whose quality varies throughout the year. Potatoes are picked from July to October and stored.

The Potato grower:

The potato grower's job is to ensure the maximum amount of starch is stored in the tuber, as this will produce the greatest yield. His next job is to store the potatoes correctly so that the starch does not break down into simpler sugars that produce dark crisp colours. Not only are different storage conditions required throughout the year, but processing requirements also differ during the year in order to keep the crisp flavour and colour consistent. In order to understand the importance of storage and processing in quality we need to understand how the crisp making process works.

The crisp making process.

Potato varieties:

The two main crisping varieties are *Lady Rosetta* and *Lady Clare* although there are others.

The secret of a good crisp potato depends on using:
1, good quality seed
2, having good planting, growing and harvesting disciplines
3, the correct storage conditions
4, good weather throughout the growing season (August - September).

The potato quality manager must liaise closely with the growers to ensure they carry out the correct farming procedures (drilling, spraying, fertiliser application, irrigation) that will produce a consistent, high quality potato throughout the year. The choice of grower and storage method are key elements in good quality potato production.

Potatoes are harvested from late July through to October and are used directly from the fields. The best quality potatoes are then stored for use throughout the year.

What is a Potato?

A potato (also called a tuber) was first brought to Europe by Sir Walter Raleigh and is widely consumed throughout the world.

The potato plant uses the tuber for storing sugars that it can use to grow, repair it, and stay alive. If we can store the harvested tuber in the best condition possible it gives us the best quality crisp. If tubers are badly handled they will give problems during processing through disease, bruising, discolouration, or dark brown colours.

In the field, the potato plant traps sunlight energy (by photosynthesis) to form simple sugars (glucose and fructose), which it then converts into the more complex sugar storage material called starch. It uses the starch as its energy reserve that will keep it alive once picked in the potato store. The Potato Quality Manager has to ensure storage conditions are perfect.

Percentage solids:

A potato is made up of starch, water, and other materials and the amount of starch it contains is called its "percentage solids".

A percentage solids of, say, 23% means 23% of the potato's weight is starch, 76% is water, and there will be about 1% of other materials. (23% + 76% + 1% =

100%). A 20 % solids mean the water content of the potato is 79% (20%+79%+1% =100%)

If you looked inside a potato with a microscope you will see millions of potato cells. Each cell contains water, starch and other materials.

What is starch and why is it so important?

Starch gives the crisp its taste, texture and colour. Starch is made up of thousands of

molecules of a simple sugar (sucrose) linked together In a chain-like pattern. Sucrose is made up of two even simpler sugars (glucose and fructose)

S-S-S-S-S-S-S-S-S-S-S-S-S-S
x 000's = Starch (a chain of sucrose molecules)

S=Sucrose (a combination of glucose and fructose)

Glucose and fructose are called "reducing sugars"

Why is this important?

The perfect potato has a high starch content and a low "reducing sugar" content. It is the "reducing sugars" (glucose and fructose), that give the darker brown colours during frying.

To get a golden crisp colour, the Potato Quality Manager must ensure the potatoes are stored correctly. This in turn depends on:
1. how well they grew in the field
2. the weather (wet, dry, cold or hot)
3. the quality of the potato seed variety that year.

Crisp taste and texture

This is dependent on the starch content and the way the potato is sliced and processed.

If the % solids are high then the potato contains a lot of starch and it can be sliced thinly and still produce a good texture and flavour.

If the potato has a low % solids then there is less starch, and in order to produce a good crisp taste and texture the potato must be sliced thicker - to leave as much flavour in the slice as possible. (Tayto Rough Cuts are sliced thicker still - on purpose).

If the frying temperature is too high, the slices may become overcooked and brittle. If too low, the slices will be soft and unpleasant to eat.

If the flow through the fryer is too fast, slices may be uncooked. If the flow is too slow the slices will be overcooked.

Potato size

The potato grower will grade the potatoes before putting them into storage. The intention is to remove the potatoes that are too small and those that are too big. Removal of small potatoes is important because:
1. they are generally immature
2. they discolour easily
3. they do not cook evenly
4. they produce a mass of small bits when sliced.

Large potatoes have the opposite problem and they may well be too big to pass down into the packing machines. This causes blockages and a considerable amount of machine delays.

Tayto have a machine that grades the potatoes. The larger ones ride over the graders onto a series of knives that cut them into smaller pieces. The small potatoes are simply removed.

At the inspection table staff can remove diseased, green, or oversized potatoes.

Slicing

Is the crucial step in producing a fantastic crisp. It delivers...

1. An evenly cooked crisp because potato slices are cut evenly, (a thick slice will cook differently from a thinner slice).

2. An even slice reduces crisp breakage from overcooking thin potato slices.

3. Evenly sliced potatoes retain a lot more taste than badly sliced ones.

The slice thickness must be set accurately using sharp slicer blades. Changing the blades every hour keeps the cutting even and gives a better quality of crisp.

The Fryer

Fryers are drying systems, reducing the moisture in the potato slices from around 76% down to around 1.6%. This cooks the potato slices to give a crisp with a good flavour and golden colour.

Fryers usually have three sections:
1. The first section has a set of *paddles* that drive the slices forward.
2. The second stage is a *submerger belt* which pushes the slices under surface of the oil.
3. The third stage is the *take-off belt.*

Fryers use hot vegetable oil to fry the potato slices. The oil is heated to around 182°C which drives the moisture out of the cells in the potato slices. The oil replaces the water to produce a crisp.

Fried crisps are removed from the fryer by the take-off belt.

Tayto crisps are fried in rapeseed oil, an vegetable oil that is naturally lower in saturated fat. Rapeseed oil is also a good source of Omega 3 and Omega 6 oils that are essential for maintaining a healthy heart.

Frying Temperature

The texture and colour of the crisps is dependent on the frying oil temperature.

The time that a crisp is in the cooker will be about 3 minutes 50 secs. In that time, slices must cook uniformly.

It is possible to measure the crisps exiting the fryer using an infrared detector. This gives the cooks information about the fryer's performance.

The fryer performance can be predicted from the number of crisps displaying "saddles" or fold-overs. If the crisp is sliced too thin it will bend over on itself and look like it has been folded over.

Why is it important that the exit temperature is set at 162-165 °C?

Earlier we saw how the potato plant breaks down starch into reducing sugars; glucose and fructose, which when fried produce darker colours.

At around 160°C a chemical reation called the "Maillard Reaction" occurs.

At this temperature, sugars in the potato combine with nitrogen compounds to form complex browning compounds. It has been found that every degree above 162°C adds significant colour to the crisp.

At 162°C the crisps are white with a hint of gold-ness whereas they are a more golden colour at around 164°C. Taking the temperature much beyond 164°C can produce some very dark colours that are unacceptable to the consumer.

Crisp Quality - A Summary

There are four key determinants of quality:

1. Colour

The first thing that a consumer sees when they open a bag of Tayto is the colour of the crisps. Colour therefore is a key quality measure. Tayto test colour on a crisp colour chart that has a series of 5 pictures scaled from 1 – 5 based on colour.

2. Texture

This depends on the starch content of the potato and the way crisps are sliced and fried. The crunchiness derives from the final moisture content and is best tested by eating the crisps.

3. Oil Content

Salt and fat content are often quoted as the two most desirable characteristics of potato crisps. The factors affecting oil content of crisps are:

- The specific gravity or % solids
- Partial drying of potato slices in air prior to frying
- Slice thickness
- Type of oil used
- Temperature of frying
- Frying time

Different potato varieties use different amounts of oil based on the nutrients in the potato.

4. Flavouring

Finally we add the best quality flavourings to produce a top quality crisp. Many taste panels and consumer research sessions are carried out to ensure we choose the most popular flavours on all our crisps.