Noodles of different kinds together with boiled rice have been the staple food of almost all Asian countries. Since noodles are always in the form of long strands, they are symbolic of longevity and are always present in Chinese birthday parties. There are different ways of consuming them as well as different recipes available at different countries. Most of these noodles are consumed hot as in soup, like a pasta plate or stir-fried with meat, shrimps and vegetables. Others are consumed cold like in the case of some soba dishes in Japan. Also, there are numerous types that depend on the raw materials, product shapes, processing methods and the way of preparation and serving. However, they have also undergone changes driven by technical innovations and consumer demands.

The manufacture of noodles can be traced back about 1,200 years ago and still an object of debate whether the Chinese or the Italians invented it first. Nowadays, different kinds of oriental noodles can be found in almost every parts of the world, from North America to South America and from Africa to as far as the Oceania. However, the most popular of them is the instant ramen introduced by Momofuku Ando of Nissin Food Products as chicken ramen in 1957. The global market for ramen noodles alone according to the International Ramen Manufacturer’s Association (IRMA) is worth 15 billion US dollars (as of Nov 2001) or equivalent to 48 billion servings with China as the biggest market worth 15.9 billion servings/annum followed by Indonesia at 9.3 billion servings and then Japan at 5.2 billion servings. This market is continuously expanding. One of the main reason for this is the demographic changes which can be attributed to the fact that the world is getting smaller and smaller due to the great progress in transportation and telecommunication. More people nowadays have been exposed to the Asian culture either by going to Asian countries to conduct business or simply for pleasure or it can also be due to the immigration of Asians to the occident bringing with them part of their cultures. Economics plays also an important role since food based on noodles can be easily afforded by people in the low-income bracket. Moreover, a dish containing oriental noodles can be a complete and nutritious meal.

Noodles can be classified according to different parameters such as type of raw materials used in their manufacture, the type of manufacturing method used, the form of the product on the market and the size of the noodle strands.
Raw materials used

1. Wheat flour based
   a. Japanese type
      Japanese noodles such as somen, hiyamugi, udon, and hiramen are generally white or creamy in colour and have a rather soft texture. They are made from soft wheat flour of medium protein content of about 8-10% and with about 0.33-0.45% ash (0.36-0.40% ash for a more intense colour), water and salt.
   
   b. Chinese type
      There are many types of Chinese noodles such as miantiao, namamen, ramen, chukamen, and chuka-soba. They are mostly light yellow in colour and have a rather slightly stiff or springy texture. Hard wheat flour is the main raw material and is used together with water and "kansui" (a mixture of alkaline salts). There are other noodles such as dan mien, chow mein and lo mein which uses eggs together with the flour to have an added flavour, colour and body to the product. Hard wheat flour with about 10.5-12.0% protein and about 0.33-0.38% ash is the preferred main raw material.
   
   c. Buckwheat noodles
      These noodles also known as soba (from sobaku which means buckwheat) with a very unique taste and very popular in Japan and Korea are made a mixture of buckwheat flour, wheat flour and water. Ratios of wheat flour to buckwheat flour varies according to the type of product. Buckwheat is actually not a wheat variety but a plant of the annual broad leaf crop originally from Central Asia. The flour is obtained by milling the seed which has a very good nutritional value such as high digestibility, lysine content which is about threefold of that of wheat, high mineral content, and unusually high lecithin content.

2. Non-wheat flour based
   a. Rice vermicelli
      There are many non-wheat base noodles existing in Asia. The most common and most popular especially in Southeast Asia is the rice vermicelli; mi fen or mee fun in China, bifun or maifun in Japan, beehoon in Singapore and Malaysia, sen mee in Thailand, bahn hoi in Vietnam and bihon in the Philippines. Rice is the main ingredient used however, not all types or varieties of rice will give a good quality product. Rice with a rather high amyllose content is preferred. In some countries like the Philippines, corn starch is either added to the rice or used completely to substitute the rice used for the production of this noodle. The process for making this type of noodles differs from that of the wheat-based noodles. Primarily, extrusion of the wet dough rather than
Sheeting is used during processing. The extruded noodles will then be fully cooked by steaming from about 60 up to 120 minutes. After cooking, they are allowed to cool down at room temperature. During this process of slow cooling, retrogradation of starch occurs which will lead to a noodle with very low cooking losses. After cooling the noodles are then rinsed with water and then folded and portioned. The portioned noodles will then be dried to about 11% moisture. They can be served in hot soup or soaked in hot water and then stir-fried with meat, shrimps and vegetables.

Rice sticks

Rice sticks or ho fun in China, sen lek in Thailand, kuey teow in Malaysia, and bahn pho in Vietnam are basically the same as rice vermicelli only that they come in many shapes and sizes and can be classified as thin, medium, and wide. The thinner ones are normally used for soup while the wider ones for stir-frying. Like the vermicelli they should be soaked in hot water until they’re soft before use.

b. Glass noodles

These types of noodles also called as bean threads, cellophane noodles, shining noodles or crystal noodles, are so-called as such due to their transparency very similar to that of glass. They are widely used throughout China and Southeast Asia. They are made from mung-bean starch or potato starch (to lower the price) and called as fen si or fen szu in China, woon sen in Thailand, tanghoon in Malaysia, bun tao in Vietnam, su un in Indonesia or sotanghon in the Philippines. Some even use sweet potato starch called as dangmyun or tangmyon in Korea. The process principle is very much similar to that of the rice noodles. The starch has to be fully cooked, cooled to retrograde, and then dried.

Other noodles that are quite similar to the glass noodles are seaweed noodles, yam noodles or sirataki in Japan, tapioca sticks or hu tieu bot loc in Vietnam, and the tofu or soy noodles called gan si in China.

Manufacturing methods used for wheat flour based noodles

1. Hand-made

Hand-made or hand-pulled noodles are those unique Chinese noodles whereby the process is purely manual which includes the repeated stretching and swinging of the dough by hand to form the strands. They normally remain firm and have less cooking losses. It is believed that the resting or maturing is the main reason for the improved cooking qualities of these hand-made noodles. One speciality, is longxu mian or the dragon beard noodles which is hand-pulled but are made extremely fine. They are so fine that it has been calculated that a dough with 1.5
kilograms of wheat flour can make 144,000 hair-thin noodles each 17 cm long for a total length equivalent to two kilometers. The difference between manually and mechanically made so-men noodles have been studied by Ogawa (1975, 1985) while the mechanism involved during maturing has been studied by Niihara et al (1980, 1981, 1984).

2. Machine-made

The development of noodle making machine by T. Masaki in 1884 revolutionized the manufacture of noodles. The basic process for wheat noodle making using machineries consists of the mixing of the raw materials, dough sheeting, the combining of two sheets, rolling and cutting. During the mixing process, 100 parts of flour flour is mixed with about 2-3 parts of salt or “kansui” and from 28 to 45 parts of water. In some countries gelling agents such as food gums, alginates, and potato starch are added to control the texture of the finished products. “kansui” is a mixture of sodium carbonate and potassium carbonate with about 10% sodium phosphate and it gives the noodles a characteristic bright yellow colour. However, an improper ratio of sodium and potassium carbonates can lead to an undesirable reddish or greenish colour. Normally salt and/or “kansui” is dissolved in water and the quantity depends on the type of product. For example dry noodles need more salt than boiled noodles. During winter, less salt is added to the dough. During mixing, the salt or “kansui” solution is mixed thoroughly into the flour and continuously kneaded to obtain a uniform dough. Mixing should be done in a way that gluten develops properly and the temperature of the dough does not increase significantly. After mixing, the dough is allowed to rest for stress relaxation to be able to roll it smoothly.

The rested dough is then divided and each allowed to pass through a pair of rolls to form a sheet. The two sheets are then combined and passed though a second roll by which the gap has been adjusted to get the original thickness of a single sheet. The purpose of this sheet combination is to further develop gluten during the compression of the dough. The sheet is then allowed to pass a series of rolls (from three to five pair of rolls) with decreasing roll gaps for the gradual reduction of the sheet thickness which varies according to the type of noodle being made. It can be about 2 to 4 mm for Japanese noodles and 1.3 to 2 mm for Chinese noodles. The reduction of the thickness should be gradual since abrupt reduction can damage the gluten network. The sheet is then cut into strands for further processing when necessary.

*Types of noodles in the market*

The noodle strands coming out from the pair of cutting rolls are processed into different kinds of noodles such as:
a. Uncooked wet noodles (*nama-men*)
   These are the most popular form of Chinese noodles which are normally sold to retail shops and restaurants fresh and uncooked.

b. Dried noodles (*kan-men*)
   These are the dried version of the uncooked wet noodles more popular in Japan rather than in China. Drying of the noodles is done through strictly controlled conditions. Normally they are dried at a rather low temperatures, say 35-40°C with relative humidity of about 70-75% and long drying times of several hours, say up to 5 hours in case of Japanese udon. After drying the noodles are cooled to room temperature.

c. Boiled noodles (*yude-men*)
   There are basically two types of the boiled noodles.
   1) Completely packed boiled noodles
      These are noodles that are obtained by cooking wet noodles in boiling water at a pH of about 5.5-6.0 for about 10-25 minutes depending on the textural requirements of the product. They are packed either in a very simple way giving the product a very limited shelf-life or in a completely packed version with the addition of organic acids such as lactic or acetic acids. Subsequent post-packaging treatment for more than 40 minutes at a temperature more than 90°C is also applied for a much longer shelf-life (more than three months).
   2) Frozen boiled noodles
      These noodles are obtained through the process of very rapid freezing of the noodles immediately after cooking using a temperature of about –30°C or even –40°C. With this process the fresh taste of the boiled noodles are kept for a long period. At the noodles restaurants where the frozen noodles are delivered, the dishes are prepared by thawing these noodles for 1 minute in a specially designed boiling pot.

d. Chinese-type steamed noodle
   Chinese-type steamed noodles require very efficient steaming since the final quality of the product is very much dependent on this operation. Steaming times depends on the type of noodles and can vary from about 100 seconds to as long as 240 seconds for the instant noodles and even up to as long as 60 minutes for the non-instant noodles like Chow Mein. Most of these noodles are then packed in polyethylene bags. However, especially designed cups or bowls made of materials with very low thermal conductivity have also been used particularly for the instant types.
   1) Seasoned fried instant noodle
These are noodles that have been sprayed with some seasonings before drying by frying. Frying temperature is usually within the range of 135°C to 150°C and for about 2-3 minutes. The seasoning is absorbed by the noodles giving it a unique internal flavour.

2) Non-seasoned fried instant noodle
These noodles are fried without the application of seasonings. Sachet of flavours, oil and even soy sauce are added to the pack of noodles during packaging. Oil content varies from 18-22%.

3) Non-fried instant noodles
These noodles are basically the same as the noodles mentioned previously but dried by hot blast drying instead of frying. In this way, the fat content of the product is maintained at a very minimum level.

**Size of the noodle strands**
Noodles are generally flat due to the processing type which uses rolls to form the sheet from the dough. Round versions are also available particularly with the non-wheat based type but wheat-based noodles for which special rounded cutters have been used can also be found. Nisshin Flour Milling Company of Japan even developed a noodle which requires very short cooking time. They have made some depressions on the cross-section of the noodle strands which close during boiling. Thus allowing the boiling water to penetrate easily into the core of the noodles allowing it to cook faster.

1. Very thin - width varies from about 1.0 – 1.2 mm
2. Thin – width varies from 1.3 – 1.7 mm
3. Standard (Udon) – width varies from 2.0 – 3.8 mm
4. Flat – width varied from 5.0 – 7.5 mm

**Manufacturing method used for non-wheat noodles**
1. Rice Noodles
The manufacturing method for the production of rice noodles starts with the overnight soaking of the indica type rice grains. The purpose of this operation is to loosen the crystalline structure of the starch agglomerates so that each starch granule will separate during the wet milling operation. During this operation the rice grain together with the soaking water are fed to horizontal stone mill which grind the grain to get the rice slurry. This slurry then passes to a sieve to separate the non-starch component such as protein, non-soluble fibers and other impurities from the starch component. The starch slurry is then fed to a vacuum rotary filter to obtain a cake with a reduced moisture content of about 40%. This rice cake is either extruded to form small cylindrical pellets and subsequently passed through
a steaming tunnel or broken into very small chunks and then fed to a mixer whereby steam are injected. In both cases, the purpose of this hydrothermal treatment is to provoke the partial gelatinisation of the starch granules. This partial starch gelatinisation is a very important step and must be done under controlled conditions since under steaming will lead to noodles that will not hold during extrusion. On the other hand over steaming will lead to excessive shear stress and die swelling during extrusion. Extrusion is done at a very low pressure using a cold extrusion press fitted with a horizontal die having holes of about 0.50-0.55 mm in diameter. The extruded strands are then hanged in canes or folded in pre-formed containers for a second steaming. Steaming to fully cook the starch granules is done either by batch in closed atmospheric chambers or in continuous steaming tunnels from about 60 minutes up to 120 minutes. After this hydrothermal treatment, the strands are allowed to slowly cool down to room temperature. During this cooling or aging process, the swollen starch granules reorganize among themselves through the process of retrogradation. Too rapid retrogradation will give a very stiff structure of the strands while a much slower rate will give a very elastic structure that you can bend or compress them without breaking. After cooling, the strands are rinsed with tap water and then removed from the canes for portioning. After portioning, the nests of noodles are then dried using high volume and speed of air at a temperature of about 60°C for about 60-90 minutes. They are then packed as bundles into big bags or in small pouches together with sachet of flavours and oil or soy sauce.

In some places rice noodles particularly the flat ones are still made semi-manually by spreading very thinly (say about 1 mm) a rather liquid slurry on a flat belt conveyor. This conveyor enters then into a steaming chamber to allow the cooking of the slurry. The cooked slurry now in the form of a very thin sheet is then allowed to cool down and then transferred into cooling trays for further aging. This process will allow further retrogradation of the starch granules. The retrograded sheet which at this moment has acquired a very good consistency and firmness is then rinsed and cut into the desired width through slitting rolls and then hanged on canes or folded for drying.

2. Glass noodles

The process for making glass noodles is basically the same principle as that for making rice noodles. The process starts by soaking overnight the mungbeans (vigna radiata L. Wilczek) to loosen the pericarp. The soaked beans are then ground by wet milling process using horizontal stone mills. The ground slurry is then filtered to remove the protein and the non-soluble fibers. It is then partially dried into a cake with about 40% moisture through a vacuum rotary filter. In some cases, the cake is further dried to a moisture content of about 12% and then
hydrated to about 40% on the time of use. The wet cake is then broken into small chunks of dough and subsequently extruded at low pressure with the extruded strands going directly into a water bath with hot water (about 98°C or more). During this process, the starch granules are fully cooked. The cooked strands are then quenched with cold water in another water bath. The strands are then hanged on canes and frozen to fully retrograde the starch granules. After this process, the strands are cleaned and rinsed with tap water and then dried.

From what we have mentioned, we can consider that noodles are quite unique yet versatile compared to other cereal products. The wide variety in taste and preparation makes it very interesting to Asian diets. These Asian diets particularly the “New Japanese-style diet” is continuously attracting consumers all over the world and is being considered as among the secret of longevity. Although noodles are traditional foods, the technical and technological innovations are continuously evolving to adapt them to the global consumers of all ages. Recipes have been modified and continuously adjusted to suit the taste of the consumers in many countries. Production equipments have been improve, modernized, and up-graded to guaranty efficient productivity. Production costs have been optimised to make it affordable also for people in the developing nations. Product size has been modified and continuously being adjusted to the tradition of the western world. New packaging designs, new recipes and new way of preparation continuously appear on the market to satisfy the eternal desire of consumers particularly the younger generation for something new, something fulfilling and something good.

Luisito Virtucio
Pavan SpA
New Product Development Manager
R& D Center