THE MIGHTY SOYBEAN

Raw, dried, cracked, sprouted, ground, roasted, pressed or fermented – soybeans are eaten in a wide variety of forms by both humans and livestock. They have been grown in China for thousands of years, but did not arrive in North America until the early 19th century and reached Quebec just over 25 years ago. Soybeans are nutritious, easy to grow and highly versatile, hence their ever-growing popularity. Today they are found everywhere around the globe, from our tables to animal feed troughs.

Welcome to the story of this mighty bean.

Transformation

Milk

Soybeans belong to the *Fabaceae* family. They are the only legumes that can be processed and made into milk. Soymilk has a nutty flavour and is completely lactose free, making it a good alternative for individuals with an intolerance to this sugar molecule in cow's milk. It is an excellent source of high-quality protein, B vitamins and iron. It is important to choose enriched formulas in order to meet daily calcium and vitamin D requirements.

1. The beans are first sorted to remove any that are unripe or less than perfect.
2. The beans are soaked in water for several hours.
3. They are then ground with a stone turned using a wooden handle.
4. Once it has been filtered and heated, the milk is ready to drink.

Tofu

The Chinese were already making *doufu*, or bean curd, some 2,000 years ago. Buddhist monks took this foodstuff to Japan a thousand years later, where it was called *tofu.*

Around 1850, Chinese immigrants brought it with them to the American West during the Gold Rush and went on to spread the recipe across the continent.

Tofu can be prepared in countless ways. It is rather bland on its own, but because it absorbs other flavours, it is excellent when combined with other ingredients. Mashed, grilled, smoked, frozen or fresh, it appears in appetizers, soups, main courses and desserts. It is a wholesome food, high in protein and iron, but low in sugar and cholesterol free.

The first three steps in making tofu are the same as those for soymilk: sorting, soaking and grinding the beans. Then, to turn the milk into tofu:

1. The milk is boiled with a coagulant. This may be a salt – traditionally *nigari*, extracted from seasalt – or an acid like vinegar or lime or lemon juice. For industrial production, the salt may be magnesium chloride (extracted from *nigari*), calcium sulphate (gypsum), magnesium sulphate (Epsom salts) or calcium chloride.

2. After about fifteen minutes, once the curd has formed, the whey (known in Chinese as the tofu flower) is skimmed off.

3. The tofu is then wrapped in cheesecloth, drained and pressed until it reaches the desired consistency. The longer it is drained, the firmer the tofu.

4. Less than an hour later, with no fermentation or aging, the tofu is ready.

Sauce
Genuine soy sauce is made from soybeans and wheat fermented with microscopic mould for anywhere from 12 to 24 months. Tamari is a similar sauce containing only soybeans and no gluten, a common allergen. Many commercial brands of soy sauce are actually unfermented blends made from defatted soybean meal, with added caramel and food colouring.

1. First, the soybeans are sorted, soaked and drained. They are then poured into a wooden pail.

2. The pail is not airtight, so the beans are steamed when set over the fire.

3. Microscopic mould (*Aspergillus sojae*) is added to begin the fermentation process, which takes several months.

4. The fermented mixture is then shaped into small cakes with a cloth.

5. The cakes are dried in the sun, then pounded into a powder in a mortar and pestle.

6. The powder is poured into a large jar and saltwater is added; it will be stirred frequently on warm days, all summer long.

7. The mixture is strained through a cloth filter into another jar.

8. This kind of sauce is called tamari, because it contains no wheat, an ingredient in soy sauce.

Oil
Soybean oil has many virtues. The oil is extracted under pressure and contains mainly polyunsaturated fatty acids, which are healthier than saturated fats. It is high in vitamins A, D and E (vitamin E is said to help protect skin from ageing) as well as prized omega-3 fatty acids and lecithin, both of which help lower the risk of high blood pressure.

1. The beans are sorted.

2. The unsoaked beans are then ground with a thin, heavy stone, turned manually.

3. The cracked beans are roasted over a hot fire.

4. The mixture is wrapped in straw, forming rectangular bundles of different thicknesses.

5. The bundles are stacked under a huge wooden beam and struck repeatedly with a log, like a battering ram.

6. This crushes the bundles containing the mixture and extracts the oil, which is collected in a wooden pail.

Derived products

They're everywhere!
Soybeans are used in so many different foods that it is impossible to list them all here. Take a look at these examples of foodstuffs that contain soybeans in one form or another. You may be surprised.

Candy, chips, ice cream, coffee, pastries, flour, frozen desserts

Not just in food
When you think that soybeans are used in making printing ink, candles, clothing, biodiesel fuel and a host of other unexpected items, it's easy to see why soybean production has expanded so quickly in recent decades.

Soap, resins, lubricants, paint, varnish, ink, food colouring, adhesives, linoleum, solvents

History and tradition

Tofu to the rescue

Soybeans have a 5,000-year history, while tofu has been around for a little over 2,000 years. Its story begins at Jianmen Pass, a well-guarded strategic spot in the northern part of Sichuan Province. During the Xihan Dynasty (206 BC to 23 AD), General Jiang Wei's army found itself trapped there, starving and exhausted. The soldiers were ordered to grind soybeans and make *doufu*, giving both men and horses renewed strength so that they could courageously fend off the enemy.

This food, long reserved for the Imperial household, gradually became widely popular during the Three Kingdoms period (220 to 280 AD). Production techniques were improved and spread throughout China. But tofu from the village of Jianmen is still said to be the best.

The secret is in the water

The superb reputation enjoyed by tofu from Jianmen is based on its snowy white colour, delicate texture and delicious flavour. But what are the secrets behind this ideal combination of factors? The soil is fairly dry and well aerated and the methods used for growing the soybeans and making the tofu have been perfected over time. But the real secret lies in the water quality. Farmers in Jianmen get their water from a well atop a spring fed by runoff from the many local peaks.

Today, the Chinese landscape is dotted with many such wells. The one shown here is in Xiba, another village in Sichuan Province and that is equally famous – not for its brave armies, but for its annual tofu festival!

A tofu-fest!

Every year, the villages of Xiba and Jianmen, like many others across China, hold large festivals devoted to tofu. Local residents and tourists enjoy dragon-boat races and re-enactments of battles from the Three Kingdoms period. Meanwhile, famous chefs compete to create imaginative tofu dishes.

Botany

A season on the land

Today, the only known soybeans are the cultivated variety, for any trace of their wild ancestors has disappeared. While soybeans came to Quebec only relatively recently, farmers were quick to adopt them, often growing soybean crops in rotation with corn. Let's take a look at the growing cycle, from seeding to harvesting.

Germination

Around mid-May, a disc seeder cuts down plant stubble, marks out rows and sows the seeds. The seeds are planted 2.5 cm deep – slightly more in sandy soil – and will germinate when the soil temperature reaches 10°C, by which time they will have absorbed 50% of their weight in water.

When a seed germinates, the main root grows downward, anchoring the plant firmly in the soil. This happens quickly, just a few days after the seeds are sown.

Growth

One to two weeks after sowing, the plantlet emerges from the soil. This is a critical time, for a late frost could kill the plant. Once this risk has passed, the roots continue to spread and photosynthesis begins as the first leaves are exposed to sunlight. The plant is now able to grow on its own.

Soybeans have the ability to fix nitrogen from the air as a result of a symbiotic relationship that forms between bacteria in the soil and the plant's root system. This makes them suitable for growing in rotation with grain (corn, for instance), because they leave large amounts of nitrogen in the soil, where it is available to the subsequent crop.

Maturity

By this time, the entire plant is covered in fine grey or brown fuzz. It has tiny white or purple flowers grouped in clusters of three to five. Late-flowering cultivars bloom when the days begin to get shorter, in July. Only 20 to 50% of them will produce pods, and half these pods will produce two to four seeds per pod.

Once the pods have reached their full length, the seeds will fill out. At this point, good growing conditions must all come together for an optimal crop yield. The size of the seeds, the number of seeds per pod and the size of the pods on each plant will all suffer if conditions are not just right. When everything goes well, a single plant will bear 60 to 80 pods.

Harvesting
The crop is harvested in mid-September, precisely when the seeds have 13 to 14% moisture content. By this point, the leaves have dropped, the stems are dry, the pods are brown and the seeds are hard – they rattle inside the pod when shaken. Great care must be taken when shelling the pods and storing and drying the beans, to ensure a high-grade crop.

Vital statistics
Soybeans belong to the *Fabaceae* (or Legume) family, which includes over 8,000 species around the globe. Soybeans are also known as soya beans, especially in Britain, and *da dou* in Mandarin. Their scientific name, understood internationally, is *Glycine max* (L.) Merrill.

Each seed contains about 38% protein, 26% carbohydrates, 18% oil, 7% fibre, 5% minerals and 6% water. Their high protein content and the fact that they have all eight essential amino acids make soybeans a good meat substitute.

Production and animal consumption

Soybeans around the globe
While soybeans have been grown on a large scale only recently, today they are one of the world's leading agricultural crops. Their widely recognized nutritional properties as food for both humans and livestock, along with their many non-food uses, have made soybeans the main oilseed crop internationally. Take a look at the figures here.

World oilseed* crops in millions of metric tonnes (2004)

Soya	47 %	206,5	Soybean
Coprah et coco	12 %	53,8	Copra and coconut
Colza	11 %	46,9	Rapeseed
Arachides	8 %	36,4	Groundnut
Coton	7 %	29,0	Cottonseed
Tournesol	6 %	26,3	Sunflowerseed
Olive	4 %	17,3	Olive
Palme	4 %	16,6	Palm kernel
Sésame	1 %	3,2	Sesame
Lin	0,4 %	1,9	Linseed

Source : FAO (Food and Agriculture Organization) 2004
* Any of various seeds from cultivated crops yielding oil (*The Canadian Oxford Dictionary*, 1998)

Historically, China was the largest soybean supplier on the world market. But things changed after the Second World War, and farmers in the United States soon took over this position.

Soybean producing nations in millions of metric tonnes (2005)

États-Unis	39,0 %	83,4	United States
Brésil	24,8 %	53,1	Brazil
Argentine	17,9 %	38,3	Argentina
Chine	7,9 %	16,8	China
Inde	2,9 %	6,3	India
Paraguay	1,6 %	3,5	Paraguay
Canada	1,5 %	3,2	Canada
Autres	4,4 %	9,5	Other countries

Source : FAO (Food and Agriculture Organization) 2005

People in most countries around the globe eat soy products, but the Chinese are the top soy consumers by far. To meet their needs, China today imports huge quantities of soybeans, approximately equivalent to annual soybean consumption in Japan.

Soybean consumption in millions of metric tonnes (2004)

Chine	18,9	China
États-Unis	7,6	United States
Inde	6,0	India
Brésil	4,2	Brazil
Japon	2,6	Japan
Canada	0,3	Canada

Source : FAO (Food and Agriculture Organization) 2004

A mark of quality

While relatively little cropland in Canada is planted in soybeans, certain varieties grown here are highly popular with demanding buyers in Asian export markets. In Ontario, home to 90% of Canadian soybean crops, a special variety developed by Agriculture Canada is known as “Asian Pearl.” These premium “Harovinton” beans are used in making top-quality white tofu.

In Quebec, too, researchers have been working with the most promising soybean varieties for years now. Since there are no mills producing soybean meal for fodder, the

focus is on other techniques for converting soybeans into animal feed, including roasting, micronization and extrusion.

From the field to the trough
Most soybeans are fed to livestock around the world. They are high in protein, amino acids and excellent quality calories. In fact, they contain three times more protein than wheat and four times more than corn. Soybeans, usually in the form of meal – the dry residue left over after oil is extracted – are fed to animals of all kinds, from cattle to aquarium fish!

This plant-based source of protein has a promising future, because it offers an attractive alternative to the use of animal meal, which can carry bovine spongiform encephalopathy and scrapie (mad cow and sheep diseases). The use of animal meal as feed for ruminants is now forbidden in Canada and the United States. Such regulations are even more stringent in Europe, covering cat and dog food as well.

The negative aspects

Mighty but ...

Biodiversity at risk
Brazil and Argentina have now overtaken the United States as the world's leading soybean producers. Although this might seem like grounds for congratulations, in fact it is a sad example of unsustainable development, for their record crop yields point to the use of huge volumes of fertilizer. Even more importantly, as more and more acreage is devoted exclusively to soybeans, other crops disappear and rainforests are destroyed to make way for farmland.

Are you allergic?
While soybeans may be an attractive alternative for those with allergies to cow's milk or wheat gluten, they are actually a major source of allergies themselves. In fact, they figure among the top nine allergens in Canada. People with severe soy allergies should avoid eating not only soybeans but all soy by-products and items that "may contain" soybeans. The list is lengthy and may be confusing, for soy appears in many different guises and under a variety of names: edamame, miso, natto, okara, tamari, tempeh, yuba, etc.

GMOs on the menu?
The number of genetically modified plants is constantly growing, and soybeans have not escaped this trend. Around the globe, over half of all cropland used for growing soybeans is planted with herbicide-resistant, genetically modified varieties. Although a large proportion of these crops is intended for animal fodder, they are quite likely to eventually end up on our plates in one form or another.

Not a miracle food
Some people believe that a diet high in soybeans, and thus in isoflavones (estrogen-like molecules), may reduce hot flashes during menopause. Their benefits for heart health and in reducing bone loss among menopausal women, in any case, have been clearly demonstrated.

Overall, study findings regarding the impact of eating soybeans on various types of cancer are very contradictory. In the end, the key to healthy eating remains a balanced diet: moderate servings of a wide variety of foods.

The hidden cost of biofuel
The future seems promising for biodiesel fuel, which is already available, in fact. Many people see this blend of soybean oil with alcohol – either ethanol or methanol – as an environmentally sound solution to our reliance on fossil fuels. But large-scale soybean production to meet all our gas-guzzling needs would require twice as much acreage as at present and prove very costly in terms of biodiversity and its environmental impact.