

The Solanaceae: foods and poisons

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ABSTRACT The plant family Solanaceae contains important foodstuffs such as the potato, tomato and aubergine, together with powerful poisons including mandrake, henbane and deadly nightshade. In the first article in this short series on the family, the history and importance of the potato are described. It was first cultivated by the Inca people in the altiplano of the Andes in prehistoric times. Then it was translocated to Europe by the Spanish invaders. Originally reviled as 'peasant food', it was regarded with great suspicion as an evil plant and a potential cause of leprosy. Over several centuries it gradually became established throughout Britain, France and the continent, and in particular in Ireland, where its growth allowed the population to expand very rapidly between 1750 and 1850. In the late 1840s, nemesis arrived in the form of the potato blight and the Irish famine. The 'tatties' went black, a great hunger ensued and thousands died. Later, the causative fungus was isolated and steps were taken to avoid further similar disasters.

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It is not generally appreciated that potatoes can be poisonous if they are turning green or sprouting (chitting). The tuber is then producing toxic quantities of the alkaloid α -solanine. The clinical syndrome of potato poisoning is described briefly.

KEYWORDS Blight, famine, poisoning, potato, solanine, solanum

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The family of plants we have come to know as the Solanaceae is a fascinating one. It contains important sources of food such as the potato, tomato and aubergine, together with deadly plants, typified by the mandrake, henbane and nightshade.¹ The toxic plants came to be associated with the devil, witches and wizards and were, as a result, treated with fear (and awe) by the common peasantry.

In the nineteenth century, when scientists started to grapple with the complexities of the autonomic nervous system in the mammalian body, these plants (and the active alkaloids contained within them) became important tools in such studies.

In this series of articles I shall describe the history of four important members of the family; the potato, the mandrake, the henbane, and the deadly nightshade. I shall also try to establish those factors which led to their occupying such a pivotal position in modern day agriculture and medicine.

THE POTATO, *SOLANUM TUBEROSUM*

The great philosopher and traveller Alexander von Humboldt, after many years in South America, uttered his famous aphorism 'The continent has given us one great blessing and one great curse: the blessing is the potato and the curse is tobacco!'

THE HIGH ANDES

It is probable that the modern potato originated in the High Andes of Chile about thirteen thousand years ago.² Cultivating the tuber appears to have begun about seven thousand years ago on the northern Bolivian altiplano between Lakes Titicaca and Poopo. When the Spaniards arrived in this area, between 1510 and 1530, they observed an ancient ceremony of planting the potato. Early woodcuts portraying this event have survived. The people planted the seed potatoes with a special spade with footrests known as the 'tacla', meanwhile chanting rhythmically and drinking copious amounts of corn beer ('chicha')!

Why the potato? The plant and its tubers have definite virtues. First and foremost it can survive the wild swings of temperature associated with life on the altiplano. Also, there are prolonged periods of drought which render cereals such as wheat, corn and barley essentially unviable. Most of the natural vegetation is dwarf and scrublike. The potato not only survives but thrives at altitudes of up to fifteen thousand feet. The starch present in high concentration in its tubers will support the plant through drought (and other vicissitudes) for months at a time. Moreover, the Highland Andean people also developed a method of preserving the tuber which amounted to a primitive form of freeze drying.

Keeping and cooking food on the altiplano was difficult as all fuel was scarce. However the Andeans turned this difficulty to their advantage by developing a freeze dried



FIGURE 1 *Solanum Tuberosum*. From: *Transactions of the Royal Horticultural Society of London* 1824; Volume V. Plate Eleven.

preparation of potato called, in their language, 'chuno'. They would let part of the tuber harvest freeze overnight and then squeeze some of the water from the flesh. This preparation 'chuno' had the capacity to last in good condition for up to ten years when stored in a sealed room. It could be rapidly reconstituted by heating in boiling water.

Another property of the potato which would become of great importance later, but was unknown to the Andeans at that time, was that the fresh potato contains significant amounts of Vitamin C (ascorbic acid). Finally, the Andeans came to realise that one acre of potatoes would feed ten people for a year; a yield that far exceeded that produced by other staples such as maize, wheat or rice. This property of the tuber would ensure that, eventually, its potato would take its place amongst the great foodstuffs of the world. In fact at the latest count it is fourth in terms of tonnage in the world league table of crops.

TRANSLOCATION TO EUROPE

How the potato was transported to Europe is something of a mystery but it seems to have arrived in Spain about 1570, some fifty years after the colonists had discovered it in South America.³ It probably was transported by accident in somebody's baggage and was regarded as being of little importance. The Spaniards regarded the tuber as an inferior food and of very little significance when compared with their major preoccupation, the search for silver and gold. They were also prejudiced against the tuber because they regarded it as food fit only

for the poor. The general view of the colonists was that it belonged only to the 'conquered' and that these 'primitive' people were welcome to it! Moreover, the merchants in South America bought up all the available dried 'chuno' and sold it to the peasants and miners at highly inflated prices. This represented serious exploitation.

In addition, there was some confusion in Europe between two imports, the sweet potato (*Ipomoea batatas*) and the common or garden potato (*S. tuberosum*). The sweet potato had first been brought into Europe in 1493. Its reputation was greatly enhanced when King Ferdinand and Queen Isabella of Spain planted the vine that bears the sweet potato in the Royal Gardens in the early 1500s. Its tubers rapidly gained a reputation in cooking and as an aphrodisiac! As a result nearly every Spanish ship returning from the Caribbean to Europe would carry a cargo of sweet potatoes in the hold. It found its way to England, and became a favourite of Henry the Eighth. It is also mentioned by Falstaff in Shakespeare's play *The Merry Wives of Windsor*.

The ordinary potato, in contrast, was to have a mixed passage and for a period was veiled in obscurity. Up to the year 1600, *Solanum tuberosum* was grown only by botanists in Royal (and academic) gardens (see Figure 1). Abortive attempts were made to persuade the local peasants in Spain and France to introduce the tuber but they resisted stoutly. Their hostility to the common potato was based on a number of considerations.

First, they were used to dealing with plants that had seeds and using these to sow the next season's crop. The potato was propagated, in contrast, by these bizarre peculiar excrescences on the roots which came to be called tubers (see Figure 2). Moreover, the flowers and berries of the potato resembled those of mandrake and deadly nightshade, plants long associated with the devil and witchcraft!

Root vegetables had been regarded with suspicion for centuries. They were said to provoke menstruation and lust in women and overproduction of sperm in men! Even worse it was held that such vegetables (including the potato tuber) could encourage the spread of infectious disease. A particularly damaging calumny was to appear in 1620.⁴ The potato could cause leprosy. As this disorder was regarded as a disease of the lower classes rendering the sufferer untouchable, this was particularly damaging to the reputation of the tuber.

In the late sixteenth century, botanists began to classify plants in a serious and systematic way. The Swiss natural philosopher Bauhin included in the Solanum family the egg plant (aubergine), the tomato, tobacco, mandrake, henbane and deadly nightshade. It is believed that he suggested the name *Solanaceae* because it derived from

the Latin solamen which means quieting, and some of these plants could knock you out temporarily (the mandrake) or even for ever (deadly nightshade)!

The prejudice against the potato persisted for centuries as we shall see for France (below). Even as late as 1869 the English writer (and art critic) Ruskin would say that the potato is 'the scarcely innocent underground stem of one of a tribe set aside for evil!'

ENGLAND AND FRANCE

How did the potato move from Spain to England and France? The answer, in short, is with considerable difficulty.⁵ In both of these countries there was a traditional reliance on cereal crops such as corn, wheat, barley and oats.

The first move in England was taken in 1662 by a Somerset gentleman farmer who wrote to the newly formed Royal Society in London suggesting that the cultivation of potatoes should be encouraged. The Society supported this suggestion and it was also taken up by John Evelyn the famous diarist.

These proposals met with only limited success. In the period 1600 to 1700 the tuber was mostly fed to cattle and pigs. However the population of England began to increase sharply (three million more people between 1750 and 1800) and extra food was required. As a result potatoes began to be cultivated for human consumption in areas around the rivers Dee and Mersey in the North West of England where the weather was on the whole mild and wet. As the canal system expanded in the late 1700s, it became possible to ship potatoes and other materials such as coal, salt and pottery between Liverpool, Manchester, the Potteries and Birmingham.

The first serious set-back occurred in the 1770s. The virus of potato 'curl' struck the Lancashire potato fields; the crop failed and serious hunger resulted in some areas in the North. This disease of 'curl', where the leaves become deformed and the potato wilts and dies, is transmitted by aphids and can, at times, be a very serious problem.

After the Lancashire potato crop failure in the 1770s, further food shortages were to occur between 1790 and 1800 partially as the result of further poor harvests (which included the potato). In 1795 the Board of Agriculture was moved to publish a treatise entitled *Hints in Respect of the Culture and Use of Potatoes*. In fact the farmers went so far as to request a cash subsidy from the Government as an inducement to grow the tuber and to provide employment for the destitute. Needless to say an obdurate administration refused.

At all events, in the early nineteenth century only certain areas of the British Isles were heavily dependant on the potato. These included most of Ireland, Lancashire and

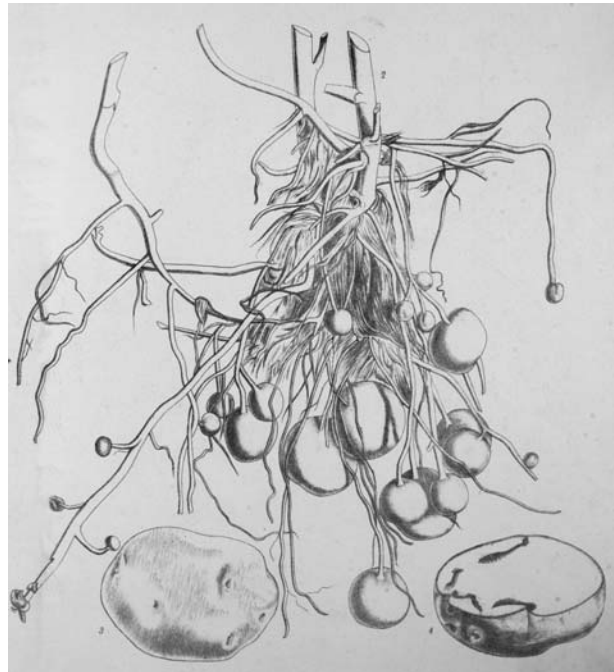


FIGURE 2 The roots and tubers of the potato. From: Duthie JF. *Department of Land Records and Agriculture, North Western Provinces and Oudh. India; 1893.*

Cheshire, the South West of Scotland and certain areas of the Highlands and Islands. As a result England would not be as vulnerable as Ireland to the impending nemesis of the 1840s.

I should mention one final point about England in the 1770s. Dr Budd reported that in an orphanage in London to which he was attached as a medical officer, the prevalence of scurvy dropped markedly when the diet began to include potatoes. He wondered idly whether the potato could contain an antiscorbutic factor similar to (or the same as) the one which had been suggested by James Lind to be present in citrus fruit. The full import of this observation was not appreciated until one hundred and fifty years later when ascorbic acid was isolated in the 1930s and its presence confirmed in the potato.

In France, in the period 1600 to 1850, the introduction of the tuber came to depend largely on the unremitting efforts of a single individual, Antoine Auguste Parmentier. Over a period of fifty years he became known as Monsieur Cartoufle (or Mr Potato) as a result of his single-minded obsession. The story starts in 1600 when Olivier de Serres appears to have been the first person to plant potatoes in France in the Burgundy area. They were not sold in Paris until 1665. Originally the French called the potato Cartoufle (note the similarity to the German Kartoffel) but later on they came to be known as pommes de terre (literally apples of the earth).

As noted earlier there was resistance by peasants all over Europe to the introduction of the potato – it was evil, it

caused leprosy, it was poisonous! Several prominent people in France attempted to change public opinion. One of the first was a magistrate named Turgot in the city of Limoges. In 1761 he made his local peasants sit down with him at a banquet which included several dishes made with potatoes. The Faculté de Paris issued a statement in 1771 that the potato was 'innocent and useful'.

The peasants remained obdurate, wedded to bread and bouillie (a sort of porage). The tuber was fit only for beasts, or people who lived like them. Diderot, a key figure in the establishment, opined that the potato caused an excessive amount of intestinal gas. As a result, people who ate these tubers must possess 'robust' internal organs to cope with the flatulent effect! This continued negative propaganda harmed the development of the potato in France and for many years it remained a marginal crop grown only in outlying areas of the country such as the Pyrenees and the Dauphine.

These serious objections would be overcome by the efforts of Parmentier but only after a long unremitting struggle (see below).⁶ In Prussia and Russia, people were also against the introduction (and cultivation) of the potato. It took a direct edict by Frederick the Great of Prussia and a ukase by Catherine the Great of Russia to overcome the hostility of the peasantry. Interestingly one of the main groups to oppose the introduction of the tuber in Russia was a group of fundamentalist Orthodox clergy. They based their antagonism to the plant on the fact that at no point in the Bible was the tuber mentioned! Nevertheless the potato was to be brought into these countries by a slow, almost invisible, process.

PARMENTIER (MR POTATO) AND THE DAGGER OF DESPAIR

One figure, above all others, stands out in the story of the potato and that was Parmentier who, as described above, became known as Mr Potato.⁶ He was largely responsible for the development of the tuber in France. After an initial training as a pharmacist, he joined the army. Captured by the Prussians in the Seven Years War (1756–63), he later claimed that he survived his incarceration by living on a diet composed solely of potatoes. He did not acknowledge that he also had supplies of gin and milk!

When he was repatriated to France he spent the next forty years promoting and popularising the potato. He was on good terms with the Royal Family, in particular Louis XV and XVI. The former appointed him to a sinecure in order that he would be able to pursue his campaign on behalf of the tuber. On one occasion he acted as host at a dinner for Arthur Young, the English agriculturalist, at which the menu consisted of twenty separate courses each based on the potato! Arthur Young was not overimpressed and commented that the French spent too much time on theory and not enough on practice.

When Louis XVI came to the throne, Parmentier persuaded the King (and his Queen Marie Antoinette) to wear button holes of the attractive blue flower of the potato. As a result the King awarded him a medal for his continued efforts. In 1789, just before the Revolution, he carried out quantitative analyses on the tubers of the potato and concluded that the results showed that the tuber did not contain any dangerous or soporific substances.

Then on the 14th of July of the same year the Revolution started with all its accompanying mayhem and bloodshed. Amongst all the committees that were set up by the Revolutionaries one was entitled the Commission on Subsistence and Provisions. This group was instructed to try and define methods to prevent the recurrent famines that had plagued France for years. Citizen Parmentier submitted a pamphlet which was gratefully accepted by the Committee. Indeed they issued an instruction that ten thousand copies should be printed and circulated. They also pointed out that Counter-revolutionaries at home (and abroad) were plotting against them hoping that famine would bring down the New Regime. They ended their homily on the tuber with the grandiose claim that the potato 'would plunge the dagger of despair into the hearts of any would be malefactors'. It was the patriotic duty of any Republican to grow the potato on land previously owned by the aristocrats. Areas such as parks, gardens and forests should be seized by the people for the purpose. After all, such land had very often only been used for frivolous pursuits such as hunting deer, hare coursing and rabbit snaring.

Parmentier was lucky to have avoided the guillotine. He had been closely associated with the Royal Family and, indeed, had received a medal from Louis XVI. This was for him a dangerous situation and Lavoisier, the famous chemist, who was in an analogous relationship with the deposed monarch paid the price with his head. When Napoleon assumed power Parmentier's advice on the potato would again prove useful. In 1806 Bonaparte, as Emperor, issued the Decree of Berlin which, *inter alia*, declared an economic embargo on Great Britain. This arrogant announcement provoked a counterblockade by the Royal Navy that immediately aggravated food shortages throughout Europe. Parmentier once again encouraged the French peasantry to plant potatoes. Production of the tubers rose sharply. He also advised that the sugar beet (*Beta vulgaris*) be cultivated actively. Supplies of cane sugar from the Caribbean had been cut off. As the end of his life approached, Parmentier was showered with awards including the Légion d'Honneur and he also was appointed as Minister for Health. He died in 1813 before the fall of Napoleon. Ironically, in the very same year, famine struck France again despite all his efforts over a forty year period.⁶ Now the name Parmentier is barely remembered except by chefs, when it is associated with the dish Crêpes Parmentier made using potatoes!

IRELAND 1600–1840

Any history of the potato is bound up irrevocably with the tragic story of Ireland.^{7,8} How did this come about? The answer lies in the particular (and peculiar) conditions, both climatic and social, which would set the scene for one of the great tragedies of the nineteenth century. The bitterness of this legacy resonates to the present day.

How did the potato reach Ireland? The commonly accepted story is that it was introduced by Sir Walter Raleigh to his estates near Youghal in County Cork. Like so many stories about Raleigh there is no definite evidence for this notion. It is more likely that it was taken by English emigrants to County Wicklow in the 1640s and became established there. It was then farmed out to the West where the mild damp climate suited it well. Oats had been the staple food of Ireland for centuries both in the Gaeltacht and in the Anglo-Norman areas. This basic cereal was supplemented by buttermilk in the summer and butter in the winter.

The potato was extremely well adapted to the Irish climate for several reasons. Paradoxically, it turned out that the potato, although it comes from the dry altiplano of the Andes, thrives in wet weather. As a result the tuber prospered in the local weather conditions when other crops (like cereals) did not. Moreover, in Ireland the potato was not subject to the damaging disease fungus 'leaf curl' which would cause trouble in England late in the eighteenth century (see above). The reason for this relative immunity was that the aphid which transmitted the disease 'curl' did not relish the strong winds and heavy rain of the West and South West of Ireland. Another important factor in the flourishing of the tuber is that frost is rare in these areas and severe frost almost unknown. By 1780, as a result of all these factors working together, the potato had become the staple crop in Ireland. If the staple crop should fail then there would be a disaster.

Further, the system of land management in Ireland was appalling. Most of the peasantry could not aspire to ownership. The best thing that could be hoped for was to be a tenant with a small farm (or small holding). This gave a subsistence income or something slightly above it. To compound this problem the moral and religious beliefs of the mass of the peasantry led to a population explosion from four million in 1785 to eight million in 1825 (a doubling in just forty years). The main food keeping this large population going was the common or garden 'spud', 'tattie' or 'lumpie'. Arthur Young made the famous observation that the average working man in Ireland at that time ate 10 lbs of potatoes daily with a pint of milk. This combination of an uncontrolled expansion of the population and a reliance on a single staple crop was a powder keg waiting to explode.

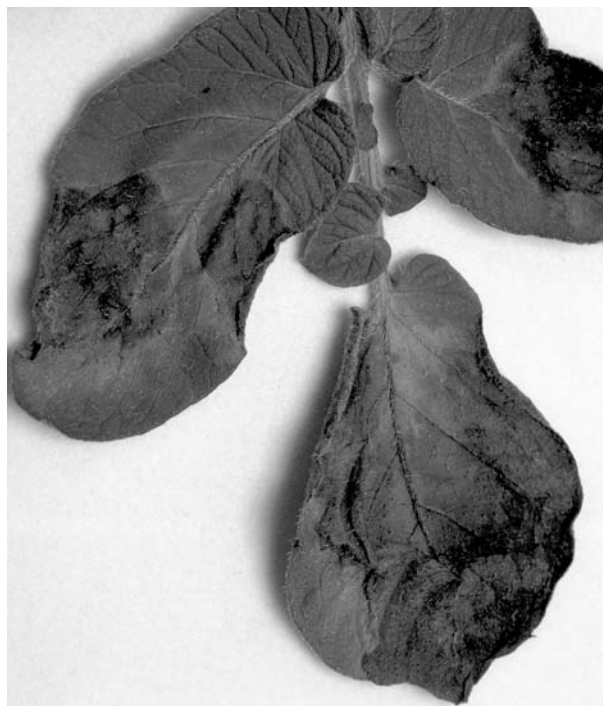


FIGURE 3 Potato blight, *Phytophthora infestans*. (Copyright © Scottish Agricultural Science Agency.)

THE GREAT HUNGER

The explosion, or rather the infestation, came in the 1840s. This devastating problem would prove to be a fungus called the 'late' or 'black' blight, now named scientifically as *Phytophthora infestans* (see Figure 3). It appears that this disease also originated in the Americas but this time in the highlands of Mexico rather than in the altiplano.

The Great Hunger (An Gorta Mór) between the years 1845 and 1852 would cause the death of approximately one million people and also result in the emigration of a further one and a half million (a total population loss of approximately two and a half million). It would take fifty years for Irish agriculture to recover.

The outbreak of blight appears to have originated in Philadelphia in 1843, and then to have passed to Europe in ships loaded with fertilizer. It was first reported in England on the Isle of Wight in August 1845 and reached Ireland in the September of that same year. There appear to have been two main sources of infection; contaminated seed tubers and also guano fertilizer imported from the Americas.

Each fungal lesion (the dark spot) on every leaf can produce immense numbers of spores – as many as 300,000 – over the course of four or five days (see Figure 3). The spores are readily spread by the wind and as a result a whole field can be devastated in a very short period of time. The leaves and stems of the plant rapidly decay and die. The underground tubers go black and turn into a foul smelling pulp.

The Irish population rapidly became seriously malnourished and as a result, diseases of many types took their opportunity to strike at the weakened peasants and tenant farmers. These afflictions included the avitaminoses scurvy and beriberi and the infectious diseases cholera, dysentery, typhus and relapsing fever. Several successive potato crop failures occurred between 1845 and 1847 and then in 1848 outright collapse ensued. Mass starvation was accompanied by mass eviction instigated largely by the absentee landlords from Britain. It is estimated that between 1845 and 1852 about half a million people were evicted from their homes (and farms) as they were unable to pay their rents.

The response of Britain (and the British Government) to the disaster was totally inadequate. Successive Tory and Whig governments were overly influenced by the doctrines of Adam Smith (and others) of *laissez-faire* (let it be or let it go). Ireland was easily forgotten in the turmoil of 1848 when political agitation seized Europe and to a lesser extent England. Individual organisations, like the Society of Friends (the Quakers), did what they could but in general the limited response helped only at the margins. The disaster left a long lasting impact on Irish politics which reverberates to this day and underlies a great deal of the anti-British sentiment of many Irish people. Belatedly in 1998, Prime Minister Blair stated that the British Government had failed the Irish people and apologised unreservedly for its fatal inertia.

Scotland was also affected by the blight but not to the same catastrophic extent as Ireland. Devine has estimated that approximately 150,000 Scots were caught up in the consequences of the blight, but it is not clear how many died and how many emigrated. The Scottish famine largely affected the Highlands and Islands but was ameliorated by several factors. Other foods such as grain and fish were more readily available. Moreover, steamships were chartered in Glasgow to supply the western Scottish archipelago with supplies. Finally the Scottish landlords, unusually, on this occasion adopted a more benevolent attitude to their crofters and tenant farmers.

Gradually over a number of years some control over the blight was achieved. There were two main factors in this; first new varieties of potato were introduced such as Champion which were relatively resistant to the blight and second, it was found that spraying the plants with dilute copper sulphate reduced the capacity of fungal spores to invade the plant. Nevertheless *Phytophthora* continues to be a substantial threat to growers worldwide.

THE NINETEENTH CENTURY AND THE BRITISH WORKING CLASS

Whereas Parmentier had been a doughty fighter for the potato in France over a number of years, and in Ireland

circumstances had dictated that it came to occupy a pre-eminent position, in Britain it faced a stern and respected opponent who helped to delay its widespread adoption. That opponent was William Cobbett, radical reformer, agriculturalist and pamphleteer. He was also author of the celebrated commentary on England entitled *Rural Rides*.

In 1818 he wrote that 'It is the fashion to extol potatoes ... everyone likes potatoes or pretends to like them which is the same thing in effect.' On another occasion he opined that 'I would rather see English labourers hanged and be hanged along with them than see them live on this lazy root!' On this occasion he was simply and plainly wrong which proves that even Homer can nod!

In fact the potato would give the English labourer a degree of independence, but Cobbett's opinion (and the views of other authorities) served to delay their introduction for some years, which in the light of the Irish devastation of the 1840s was to prove to be a fortunate set of circumstances. The potato could stretch the household budget, was a good food to store and gave the working woman more time. Until the potato came in, the cost of bread had swallowed up most of the money that labourers had whether they worked in agriculture or the factory.

Another cheap source of food was required. To fill this gap (and need) came the potato tuber and the allotment. Small parcels of land were often given to the agricultural labourer and rented cheaply by the factory worker. These proved metaphorically to be like Corn in Egypt! Home baking of bread went into decline. The use of the potato increased gradually as it could be roasted or boiled using an open fire. It needed no sophisticated equipment for its cooking and little preparation apart from peeling.

As a replacement for bread, the potato came into its own with the British working class in two particular forms – the baked potato and, the quintessential meal, fish and chips. The baked potato came first. Street vendors for the spud appeared in London about 1820 and lasted until the early 1900s. Mayhew asserted that, initially, potatoes were a speciality item and relatively expensive but later they became a staple of the working class diet.⁹ By the 1840s, the trade had expanded to such an extent that in London three hundred vendors were selling ten tons of potatoes daily starting in the middle of August of one year and lasting to the middle of April of the following year. This era has bequeathed one interesting catchphrase to the English language. The baked potato was often used by young women under their muffs as a handwarmer and as such was somewhat cheaper than an alternative chemical compound. Passing the hot roasted spud from the vendor's oven to the lady's muff could prove a somewhat tricky, even painful, manoeuvre. Hence the phrase a 'hot potato' persists to this day for a difficult problem in politics or business.

The baked potato would be overtaken in the 1880s by fish and chips. Winston Churchill referred to them as the 'good companions' and they have passed into British folklore, whether eaten out of newspaper in the street or at a 'posh' restaurant like Harry Ramsden's. They became regarded not only as a tasty dish but also an icon of the workers, as evocative of the labouring classes as ice cream cornets, Wakes Week, and day trips to Blackpool (or Southend) by train or charabanc.

How did this come about? It seems from Priestland's fascinating history of the dish that the fish component came first (by approximately thirty years.) Fried fish warehouses appeared for the first time in London in the 1830s and sold 'twopennorth' portions in paper bags. At this time there was no secure supply of ice and therefore frying was a way to disguise fish that had to some extent 'gone off'! A major step was the adoption of deep frying of both the fish and the chips. Various oils were tried including rapeseed, cotton seed and palm. Chipped potatoes first appeared in Oldham in Lancashire in the 1880s and rapidly became popular. As the demand for fish and chips increased, special equipment was developed which included ovens, peelers and chippers. A final important piece in the jigsaw was the development of fast steam trawlers which could go as far as Iceland and the Arctic Sea. In a twenty year period between 1880 and 1900, ports like Fleetwood, Hull and Peterhead expanded rapidly. It has been estimated that by 1910, the British Isles had twenty five thousand fish and chip shops! In some city areas there was one for every four hundred inhabitants! As the First World War approached the shops were consuming 150,000 tons of fish (one quarter of the total catch) and half a million tons of potatoes (10% of the whole crop).

The upper and middle classes tended to despise the fish and chip shop as being used only by the feckless lower orders who would not (or could not) cook for themselves. They regarded the shops as unclean. Moreover fish in the diet was bad for you. The availability of instant meals also encouraged wasteful behaviour and lack of thrift.

The cod fish and the humble potato were easy targets for the so called 'sophisticated'. They were not to know that fish was a good source of first class protein and essential fatty acids and the common 'tater' was a reasonable source of Vitamin C (apart from anything else.) The concept of a vitamin would only be described by Funk as late as 1912 and pure ascorbic acid would prove extremely elusive. In 1914, when the Germans initiated the submarine blockade of Britain at the beginning of the First World War, the agricultural economy of the country became vitally dependent on the production of the potato. In 1916, when the British potato crop failed, there was widespread malnutrition and serious outbreaks of scurvy. This illustrates once again how precarious the food supply of Great Britain was under the pressure of the submarine onslaught. By 1917 the convoy system and other measures began to overcome the threat from

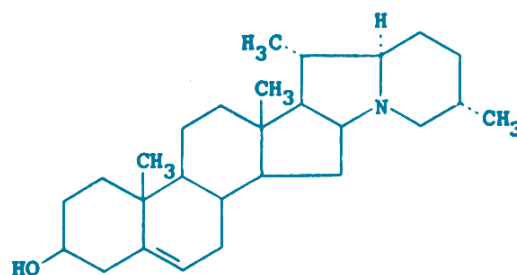


FIGURE 4 The chemical structure of the potato alkaloid α -solanine.

beneath the waves. It had been a narrow squeak! The British had neglected to learn the lessons of the Great Hunger in Ireland. Those who forget the lessons of the past are destined to repeat them.

THE POTATO AS A POISON

It will be recalled from earlier sections of this article that the potato was regarded as evil in many parts of Europe in the sixteenth and seventeenth centuries, and potentially poisonous because of its resemblance to the mandrake and deadly nightshade. As we shall now see, this suspicion was justified because under certain well defined circumstances the tuber is indeed toxic. Practitioners should be aware of this possibility and how potato poisoning may present.^{11,12}

Farmers had known for generations that livestock, in particular cattle and pigs, could be poisoned by potatoes, particularly if they had gone green or were sprouting at the 'eyes'. The clinical effects include drowsiness, trembling, weakness and finally paralysis.¹³ Other manifestations include nausea, vomiting and occasionally gastrointestinal haemorrhage. A skin disease called 'potato eruption' also occurs which begins as red papules and may progress to pustular crusted lesions. These tend to be distributed on the lower abdomen and inner parts of the thigh and can take several weeks to clear. Similar skin lesions occur in humans and can aid the diagnosis of potato poisoning.

Several important outbreaks of potato poisoning have occurred in humans and they include East Glasgow (1918), Cyprus (1933), North Korea (1952) and South London (1978). These large outbreaks tend to run to a pattern with most of the victims mildly affected and a few seriously poisoned. Death is rare.¹³

The clinical presentation is similar to that seen in animals and consists of headache, vomiting and diarrhoea. This is often followed by weakness and depression. In severe cases of poisoning there may be convulsions, respiratory depression and coma. Two helpful diagnostic signs are oedema of the face (and abdomen) together with the potato rash as described in the animal.

The main toxic compounds in the tuber are the alkaloids α -solanine and α -chaconine (see Figure 4). These compounds have anticholinesterase activity so part of the toxicity is due to the accumulation of acetylcholine in the nervous system and elsewhere.

Most potatoes bought commercially (or in retail outlets) will contain low concentrations of α -solanine of the order of 4–10 mgm/100gm of dry weight but if the concentration increases to 20 mgm/100g (or more) then the tubers present a toxic hazard.¹³

The highest concentration of alkaloid occurs in the periderm of the cortex, that is just under the skin (or peel) and in areas of high metabolic activity such as the 'eyes'. Normally there is a marked concentration gradient between the peel and the underlying tissue of the tuber. Hence peeling potatoes reduces their toxic potential.

Direct toxicity of solanine (and other alkaloids) may not be the whole story. Other poisonous compounds occur in the tuber known as steroid sapogenins which are direct haemolytic and cytotoxic substances.¹³ They may also contribute to the overall toxicity of the potato on the alimentary tract and other systems.

McGehee reported in 1998 that the solanaceous glyco-alkaloids are resistant to cooking and may stay in the body for several days.¹⁴ These compounds inhibit butylcholinesterase and acetylcholinesterase. As a result the metabolism of certain agents may be slowed including suxamethonium, mivacurium and cocaine.¹⁴ Consequently anaesthesia and muscle relaxation may be prolonged. Common solanaceous plants that have been implicated include the potato, the tomato and the aubergine.

For a detailed description and discussion of solanine and potato poisoning, I refer the reader to the article by McMillan and Thompson, who describe an outbreak in seventy-eight schoolboys at a South London day school.¹³

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In summary, greened or sprouting potatoes should be discarded. Peeling is an additional safety measure but boiling (or roasting) will not necessarily reduce the toxicity.

CONCLUSION

We have followed the potato from the High Andes of Peru to the dining rooms of Europe, a journey punctuated by disaster and widespread hostility. However, the potato is now fourth in the list of staple foods of the world in terms of tonnage. It has become part of the social history of Britain through the baked potato, fish and chips and Spud-U-Like! It also has a minor but interesting place in the history of scurvy. Paradoxically it can on occasion cause poisoning.

As we pick up our weekly bag of spuds in the supermarket, we should pause for a moment to reflect on this long trail of triumph and disaster and give thanks to all those (Parmentier in particular) who have made a significant contribution to the adoption of the humble tuber.² There is a large stone monument which honours the potato at Braunlage in Germany and it is entitled 'The Greatest Antidote Against Starvation'. It is no more and no less than the tuberous *Solanum* deserves.

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