Gourmet salt (NaCl or halite): origins and culinary variety

Introduction

In 2019, total world production of salt (halite) from both rock-salt and sea-salt was around 300 million tonnes, the top six producers being China (68 million), the United States (42 million), India (29 million), Germany (13 million), Canada (13 million) and Australia (12 million) (Figure 1). In industrialised countries the proportion that is food-grade (edible or table salt) is smaller, generally less than 10% of total production. Worldwide, food usage accounts for some 18% of total salt production. Salt's primary non-food use is as a feedstock to the world's chemical industries, including its use in the manufacture of polyvinyl chloride, plastics, paper pulp and many other industrial products. Other non-food usages include water filtration, de-icing, and a variety of agricultural uses.

Manufacturing food-grade salt

Salt production is one of the world’s oldest chemical industries (Salty Matters, May 13, 2015). Today, there are two main manufacturing methods; 1) Production from brine (marine or continental): this requires solar evaporation in arid regions or artificial heating of brine in cooler climes, 2) Mining of ancient salt deposits with subsequent processing of extracted ore (Figure 2).

To produce salt from seawater, which has a salinity around 3.5%, requires seawater to be concentrated to around ten times its original salinity (to a value of 35% or 350,000 ppm). Accordingly, the world’s oceans hold a virtually inexhaustible source of salt. The evaporation of seawater is the production method of choice for edible salt production in countries or regions with climates characterised by high evaporation and low precipitation rates (such as Mexico, Australia, India or Chile). Sea-salt evaporation ponds are first filled with seawater, then cut off from the source. In arid to semiarid climates, the ponds then start to desiccate, often as mother brine is pumped through a series of increasingly saline ponds. Salt crystals are harvested from ponds once the brine has reached halite saturation. Sometimes solar pond waters and the raw salt produced can have vivid colours (pink, green or purple), due to various halotolerant and highly pigmented algae and other micro-organisms such as halophilic archaea that thrive in conditions of high salinity (Warren, 2016: Chapter 9).
Elsewhere, in countries and regions with less arid climates salt is extracted from the vast buried sedimentary deposits crystallised by the evaporation of seas and lakes many millions of years ago. These deposits are either mined directly (conventional mining) producing rock salt, or are extracted in solution by pumping water into the deposit and processing the recovered brines (solution mining). In either case, the produced salt can be purified by subsequent dissolution of the rock salt followed by mechanical evaporation and processing of brine. Traditionally, brine processing was done in shallow open pans, but more recently, the process is performed in kettles under vacuum (a process known as vacuum evaporation).

Refining of rock salt and converting it to varieties of edible salt is done to purify, better control crystal texture and moisture content, and improve storage and handling character. The mechanical brine refining process usually involves recrystallisation during which the brine solution is treated with chemicals to selectively remove most impurities from the brine (mostly magnesium and calcium salts) prior to crystallising the final salt product. Multiple stages of mechanical evaporation are then used to collect pure sodium chloride crystals, which are kilndried. Some types of edible salt are produced using the Alberger process, which involves vacuum pan evaporation combined with the seeding of the solution with cubic crystals to create a coarser grainy salt marketed as of type flaked salt which has a price premium.

The Ayoreo, an indigenous group from the Paraguayan Chaco (a huge region of dry scrub forest, rivers and swampland) obtained their salt from ash produced by burning the timber of the Indian salt tree (*Maytenus vitisidaea*) and other trees. Several hundred years ago, the burning of plant material to make ash was how lye, a hydroxyl form of potassic salt use in soap manufacture, was made. That method gave its name to what today is a broad group of fertiliser salts known as the potash salt, dominated by potassium chloride or potassium sulphate salts, but not including potassic forms of lye (Warren, 2016; Chapter 10)

**Types of Culinary Salt**

Common-usage edible salt (NaCl) is sold in forms such as sea salt and table salt and usually contains an anti-caking (anti-clumping) agent. Table salt may be iodised to prevent iodine deficiency or fluoridated to avoid tooth decay. As well as household salt's use in cooking and at the table, salt is added in the manufacture of many processed foods. Because of its widespread usage in food preparation and at the table worldwide, defining what scientifically constitutes the named origin of particular forms of edible salt, especially gourmet salts, is not an exact science. With many gourmet varieties caught up in marketing hype, there are many conflicting descriptions and statements of uniqueness tied to offering such salts at a price premium (Table 1).

**Common or Table Salt**

Table salt is a refined salt containing 97 to 99 percent sodium chloride, along with anti-caking agents such as sodium alumino-silicate or magnesium carbonate to make it free-flowing. Some table salt sold for consumption, and usually labelled as some form of fortified salt, contains additives to address a variety of health concerns, especially in the developing world. The identities and amounts of additives vary widely from country to country. Iodine is an essential micronutrient for humans, and a deficiency of the element can cause lowered production of thyroxine (hypothyroidism) and enlargement of the thyroid gland (endemic goitre) in adults or cretinism in children. Iodised salt has been used to correct the deficiency since 1924 and consists of table salt mixed with a minute amount of potassium iodide, sodium iodide or sodium iodate. A small amount of dextrose may also be added to stabilise the iodine. Iodine deficiency affects about two billion people around the world and is the leading preventable cause of mental retardation. Iodised table salt has significantly reduced disorders of iodine deficiency in countries where it is used. The amount of iodine and the specific iodine compound added to salt varies from country to country. In the United States, the Food and Drug Administration (FDA) recommends 150 micrograms of iodine per day for both men and women. US iodised salt con-

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1 The Alberger process is mechanical evaporation that precipitates salt using an open evaporating pan and steam energy. This results in a three-dimensional hopper flake salt, which has low bulk density, high solubility, and good adhesion.
Sodium ferrocyanide, also known as yellow prussiate of soda, is sometimes added to salt as an anti-caking agent. The additive is considered safe for human consumption. Such anti-caking agents have been added since at least 1911 when magnesium carbonate was first added to salt to make it flow more freely. The safety of sodium ferrocyanide as a food additive was found to be provisionally acceptable by the Committee on Toxicity in 1988. Other anti-caking agents sometimes used include tricalcium phosphate, calcium or magnesium carbonates, fatty acid salts (acid salts), magnesium oxide, silicon dioxide, calcium silicate, sodium aluminosilicate and calcium aluminosilicate. Both the European Union and the United States Food and Drug Administration permit the use of aluminium compounds in the latter two compounds.

In "doubly fortified salt", both iodide and iron salts are added. The latter alleviates iron deficiency anaemia, which interferes with the mental development of an estimated 40% of infants in the developing world. A typical iron source is ferrous fumarate. Another additive, especially important for pregnant women, is folic acid (vitamin B9), which gives the table salt a slightly yellow colour. Folic acid helps prevent neural tube defects and anaemia, which affect young mothers, especially in developing countries.

A lack of fluorine in the diet is the cause of a significantly increased incidence of dental caries. Fluoride salts can be added to table salt to reduce tooth decay, especially in countries that have not benefited from fluoridated toothpaste and fluoridated water. The practice is more common in some European countries where water fluoridation is not carried out. In France, 35% of the table salt sold contains added sodium fluoride.

Levels of fluoride added to a water supply or toothpaste is maintained at safe beneficial levels by government legislation. However in some tribal regions in the African Rift Valley, the use of salt from natron (halite plus trona) crusts collected in "naturally precipitated" salt deposits means the local population is using a salt with "naturally elevated" levels of fluorine. The longterm use of such fluoride-rich trona as a food tenderiser has led to widespread fluorosis (mottled teeth and skeletal fluorosis) in the local population (Vuhahula et al. 2009).

Table 1. Terms and types of the major types of edible salt.

| Table Salt or Common Salt | Is a refined salt containing about 97 to 99 percent sodium chloride. Generally, anti-caking agents such as sodium aluminosilicate or magnesium carbonate are added to make it free-flowing. Iodized salt, containing potassium iodide, is widely available.
| Sea-Salt and Rock-Salt | Are general terms to describe salt produced by evaporation of seawater (sea salt) or mined from ancient evaporite rocks (rock salt) original deposited as sea salt and then buried under later rock layers. Either can be a source for table salt. Because sea salt tend to be less refined than white table salt, sea salt is often coloured and can contain other minerals such as calcium, iron, magnesium, potassium, manganese and zinc.
| Flaked Salt | Is a general term describing salt varieties characterized by dry, platy ("lamellose") crystals. Most flaked salt is dominated by thin flat "hopper" crystals and dendrites, with the sea-salt-derived types being precipitated as rafts or hoppers at an air-brine interface. "In the mouth" an inherent large surface area and low mass makes for a crunchy texture and relatively fast dissolution rate. (for example, raft or flaky salt styles include salt types marketed as Murray River Salt flakes, Fleur de Sel and Sel Gris).
| Smoked Sea Salt | Generally derived from seawall, with the salt gaining additional flavor from being smoked over various woods (encompasses various black and bamboo salts).
| Kosher Salt | A type of flaked salt that in the popular perception contrasts with regular table salt due to its larger crystal size, as well as its lack of iodine and most other additives. Some Kosher brands may contain an anti-caking agents, IN the USA Kosher Salt is mostly manufactured from processed rocksalt brines.
| Fleur de Sel | Translated as "flower of the salt," this variety of flaked salt (salt rafts) is raked by hand from the air-brine interface in salt ponds near certain French villages (de Guerande) and is effectively marketed to gourmands as a exclusive salt product.
| Sel Gris (Grey salt) | Raft or hopper salt contaminated with clay from the bottom the manufacturing pans in the Guerande region, giving a characteristic grey color. Basically floured salt hoppers collected from the clay pan floor.
| Namibian Salt Pearls | Halite ooids (spheres) formed in the zone of wave oscillation along the water's edge, driven by the Namibian Berg Wind blowing over shallow saltpan strandzones.
| Hawaiian Red Salt (alaea) | Essentially a sea-salt mixed with red volcanic clay.
| Asian Black Salt (Kala Namak) | A kiln-fired salt in South Asia derived from various rock salt sources combined with various additives, its distinctive flavour that comes from its elevated sulfur content. Hawaiian black salt.
| Hawaiian Black Lava Salt | Generally, a sea salt blended with activated charcoal and used as a finishing salt (as for other black salts) with their characteristic sulphur-influenced flavour.
| Bamboo Salt (Jugyeom) | Korean smoked salt prepared by packing marine embayment pond salt in a thick bamboo stem, and baking it nine times at high temperatures using pine firewood.
| River Murray Salt Flakes | Salt from evaporation of continental surface brines the Australian Murray River basin. Peach-coloured flake salt. The salt contains calcium and magnesium and has a relatively mild taste.
| Maras Salt | Solar concentration of continental brines in artificial mountain side salt pans in Peru are at an altitude of 3,000 metres. Brine is supplied by the Conjuquio spring, which is then routed to roughly 5,000 evaporation ponds staggered down the valley in terraces.
| Himalayan (Pink) Salt | This pink rock salt is mined in the Khewra region of Pakistan, near the Himalaya Mountains and, depending on processing, ranges in texture from fine to extra coarse. The pink color comes from the multiple mineral impurities, especially iron, and other trace elements.
| Persian Blue Salt | Crushed rock-salt extracted from a salt mine in the halokinetic Infracambrian Hormuz formation in the northern province of Semnan in Iran. The intriguing blue colour indicates localised radiation damage in the NaCl lattice structure, caused by elevated levels of radionuclides potassium minerals, such as sylvite and carnallite. |
Sea Salt and Rock Salt

Sea salt is typically crystallised by the natural solar evaporation of modern seawater in a series of purpose-built salt ponds. Rock-salt is mined from ancient buried rock beds, first deposited by solar concentration in ancient highly restricted marine embayments and then buried by other rock layers (Table 1).

Raw sea salt for human consumption is made up of individual crystals of various sizes recently precipitated from concentrated seawater.

Rock salt has been buried underground, so crystals tend composed of a fused and cemented impervious crystal mesh. Hence, edible salt from rock salt is manufactured by crushing of the original mined rock salt. Today rock salt is often converted to brine and then reprocessed (e.g. vacuum evaporated) to produce various premium-priced salt products with designed ranges of crystal sizes, textures and moisture contents.

Unrefined sea salt contains small amounts of magnesium and calcium halides and sulfates, traces of algal products, salt-resistant bacteria and sediment particles. The calcium and magnesium salts confer a faintly bitter overtone, and they make unrefined sea salt hygroscopic and so clumps as it gradually absorbs moisture from the air if stored uncovered. Algal products can contribute a mildly "fishy" or "sea-air" odour, the latter from organobromine compounds, while biological pigments can colour the raw salt. Both rock salt and sea salt are available in a variety of coarseness levels and crystal shapes that give a range of "feel in the mouth" textures.

Today, as long as it meets the FDA's purity requirements, salt in the USA that is labelled "sea salt" might not have come from modern sea brines. All mined salt (rock-salt) was originally sea salt since it precipitated from the solar concentration of a marine evaporating shallow sea (e.g. Himalayan Pink Salt).

Flaked Salt

Flaked salt is a general, non-brand-specific term used to describe edible salt varieties made up of dry, plate-like crystals that are termed "lamellrose salt" in the gourmet world. This salt texture characterises salt rafts made up of flat hopper crystals that grow at the air brine interface (Figures 3, 4, 5a). It is one of the three main textures that typify salt crystallising in any shallow body of brine. The inverted pyramid structure is a result of supersaturation and differing growth rates between the faces and edges of the crystal (Figure 4). Such pyramid or hopper shapes dominate salt harvested from air-brine interfaces and marketed under names such as River Murray Salt Flakes and Fleur de Sal de Guerande (Figures 4, 5a, b). When rafts become too large to maintain a position at the air-brine interface, they flounder and sink to the pan floor, creating what is known as a cumulate texture (Figure 3). When this form of floundered-raft clay-contaminated salt is collected from the pan floor, it is marketed as sel gris or grey salt (Figure 5c).

Ironically, in an industrial sea-salt operation, where salt is harvested to supply a pure and consistent high-grade feedstock to the world's chemical industries, this type of clay-contaminated harvest is known as "black spot." It is to be avoided as it lowers product purity. Black spot indicates a situation where the harvester blades have cut too deep into the salt layer and have picked up material from the original clay pan floor. The use of laser-levelling in industrial salt harvests is designed to avoid this problem. In the gourmet world, collecting a little clay with the product makes sel gris (grey salt) and is marketed at a premium (Table 2).

Pyramidal salt hoppers can also be produced by a variety of mechanical
Figure 5. Features of some of the edible salts. A) Salt pans at Le Guerande with halite rafts floating on brine surface and being harvested using a hand-held rake. B) Fleur de Sel (hopper crystals raked from the brine surface). C) Sel Gris (floundered rafts collected from pan bottom where the crystals are mixed with clay to give its characteristic grey colour). D) Namibian Salt pearls (halite ooids collected from the swash zone about the pan edge). E) Bamboo Salt (nine-times pinewood-fired salt. F) Hawaiian Red Salt (seasalt mixed with red volcanic clay). G) Hawaiian Black Lava Salt (charcoal-fired seasalt). H) Himalaya Pink Salt (crushed rocksalt. I) Persian Blue Salt (crushed radiation-damaged rocksalt).
or artificial methods from rocksalt-derived brining followed by slow boiling brine over metal salt pans or evaporating brine in greenhouse solar evaporators (Figure 4). One of the most common artificial processes for pyramidal salt manufacture is the Alberger process.

Flaked salt crystal properties can depend on the artificial technologies used, as well as atmospheric conditions, brine depth and salinity maintenance in natural settings, and so yield varying crystal structures and textures in a particular context (Warren, 2016; Chapter 1). Flake salt crystals marketed as varieties of gourmet salt can be made up of irregular salt shavings, pyramidal shapes, hoppers, dendrites and potato chip-like laminated crystals. Mechanically-manufactured flake salts from processed rock salt brine tend to have lower trace mineral contents than natural flake salts, which some gourmets argue gives a stronger salty taste. The large surface area and the low mass of flaked salt gives a crunchy texture in the mouth and a relatively fast dissolution rate.

Kosher Salt

Kosher salt is coarse-grained salt that is generally not iodised, although some brands of Kosher Salt may contain an anti-caking agent. Rather than fine cubic crystals of common table salt, kosher salt is much coarser and has crystals with flattened plate-like shapes compared to crushed fine cubes of common table salt (Figure 6). The coarser salt crystals in Kosher Salt are generally made by the Alberger process to give crystal textures that are more amenable to design. The flattened form is made when otherwise newly minted cubic crystals are forced into a flatter shape under pressure, usually by passing between rollers. There is a 20-40% price premium for kosher salt compared to ordinary table salt.

Figure 6. Comparison of ordinary table salt and kosher salt

The term Kosher Salt gained common usage in North America last century and refers to the salt’s use in the Jewish religious practice of dry brining meats—known as koshering. Some salt companies labeled boxes of coarse salt as kosher salt, rather than koshering salt, and the shortened form of the name passed into common use. Contrary to popular belief, the term Kosher Salt does not refer to the salt having to be manufactured under any Jewish religious guidelines. However, some salt brands further identify their kosher-certified salt as being approved by a religious body. It is a common misconception that kosher salt must be blessed by a rabbi, but this is not so, its name simple relates to the process of dry-brining meat.

Gourmet salt styles

As well as the range of flaked and kosher salt derived from natural sea salt or from mechanically-processed rocksalt brines there are many additional forms of modified and flavoured salt, as well as a few widely marketed and hyped gourmet rocksalt and seasalt products (Table 1; Figure 5).

Bamboo Salt (Jugyeom)

Smoked and flavoured salts are heated and smoked using a variety of woods or bamboo (Figure 5e). For example, Jugyeom (Korean), also known as bamboo salt, is a form of smoked salt prepared by packing sea salt in a thick hollow bamboo stem, then baking it nine times on high temperature over a pinewood
fire or kiln (Figure 7a, b) During baking, the salt absorbs the bamboo constituents giving a distinctive sweetness, called Gamrojung flavour. Baking and contamination with organic residues darkens the salt and the ninth baking cycle uses the highest temperature, over 1,000°C. Heating encourages the absorption of a variety of organic products means the final bamboo salt contains blue, yellow, red, white and black hues. Well-baked bamboo salt, with a temperature above 1,500°C, is called "Purple bamboo salt" because of its unique purple colour, which indicates the best quality (Figure 7c). While the quality of bamboo salt cannot be solely determined by colour, its crystal structure and hardness is definitive. The baking method that transforms sea salt into Jugyeom create is also considered by some to create a health food that can slow the growth of some oral cancers.

Kala Namak (Asian Black Salt)

Kala namak or Asian Black Salt is another form of smoked salt, sourced initially from rock salt from mines in India, Nepal, Pakistan and Bangladesh and from salt harvested from the North Indian salt lakes in the Sambhar Salt Lake area and the Didwana and the Mustang Districts of Nepal. More recently it has been marketed as Himalayan Black Salt. Traditionally, salt was transformed from its relatively colourless raw natural form into dark-coloured commercially-sold Kala namak using firing to turns some of the naturally-occurring sodium sulphates in the raw salt into pungent hydrogen sulfide (aka rotten-egg gas) and sodium sulfide.

Raw salt is fired in a kiln or furnace for 24 hours, while sealed in a ceramic jar with charcoal, along with small quantities of harad seeds, amla, bahera, babul bark, and natron. The fired salt melts, chemical reactions with the additives occur, and the salt is then cooled, stored, and aged before sale. Kala namak is still prepared in this manner in northern India with production concentrated in Hisar district, Haryana. Marketed salt crystals appear black and are usually ground to a fine powder that is pink.

Today much of the manufactures kala namak is synthetically produced. This is done through combining ordinary sodium chloride mixed with smaller quantities of sodium sulphate, sodium bisulphate and ferric sulphate, and then chemically reducing the mixture in the presence of charcoal in a furnace. Reportedly, it is also possible to create similar black salt products through reductive heat treatment of sodium chloride, 5–10% of sodium carbonate, sodium sulphate, and some sugar.

Commercially-available kala namak consists primarily of sodium chloride and trace impurities of sodium sulphate, sodium bisulphate, sodium bisulphite, sodium sulphide, iron sulphide and hydrogen sulphide. Sodium chloride provides the salty taste, iron sulfide provides its dark violet hue, and all the sulfur compounds give kala namak its slight savoury taste as well as a highly distinctive smell, with small amounts of hydrogen sulfide from the breakdown of newly-formed metastable greigite (Fe₃S₄) being the most prominent contributor to the smell. The acidic bisulphates/bisulphites also contribute a mildly sour taste.

Asian black salt quality (and the types of impurities) varies widely according to the skills and motivation of the manufacturer. Depending on the salt source and its additives, some longterm high-level users of some types of Asian Black Salt have been implicated as sufferers of various forms of fluorosis (due to high levels of fluorine).

Hawaiian Gourmet Salts (sea salt & mineral or organic additives)

Hawaiian Red Salt (Alaea salt) made by mixing sea salt with alaea clay, a red Hawaiian volcanic clay that is rich in iron, and historically honoured by the pre-European Island culture for its beauty, health benefits, and spiritual properties. Traditional salt pans used in the manufacture of Alaea Salt are small seawater sumps constructed in the volcanic clay of coastal Hawaii, as at Hanapepe on the island of Kauai. Traditional owners hold these pans, and according to local custom the salt produced there cannot be sold. It can only be gifted or traded by the 20 select families that have harvested the salt plots for over five generations at Salt Pond.

At Hanapepe, seawater from the coastal marine groundwater prism is collected from wells penetrating fractured volcanic aquifers and then held in holding pools, where the seawater becomes concentrated through evaporation. Next, the brine is transferred to shallow harvesting ponds (Figure 8). The amount of time it takes until the salt is ready to be harvested from a shallow pond depends on seasonal factors like precipitation and evaporation rate. Under ideal conditions, it can be as little as two months. Salt is not harvested during the rainy winter months.

Figure 8. Hanapepe salt ponds on the island of Kauai, Hawaii.
During harvest from other commercial ponds, the top, white sea salt is raked, rinsed, and dried. This sea salt flake form is used as a table salt. Some of the white sea salt is also mixed with red ‘alaea’ clay, which is collected from the nearby mountains of Waimea. The resulting red colour in the salt comes from iron oxides in the clay (Figure 5g). Native Hawaiians believe that “alaea gives the salt spiritual power,” it is used in traditional ceremonies, for ritual blessings and purifying, and for healing purposes.

Hawaiian Black Lava Salt has a similar sulphur-influenced taste as Kala Namak (but somewhat milder) as it is sea salt blended with activated charcoal from coconut shells and fired, with the final product generally used as a finishing salt (Figure 5f).

**Himalayan Pink Salt (crushed rock salt)**

This premium-priced culinary salt comes from one of the larger specific-purpose rocksalt mining operations in the world, the Khewra Salt Mine in the Punjab Region of Pakistan. The mine lies in the Salt Range at the foot of the Himalaya. It targets the pink halokinetically-thrusted 550 million-year-old Salt Range Formation (regionally equivalent to the Hormuz Salt Formation). This geological formation consists of extensively flow-deformed crystalline pink halite (Figure 5h), intercalated with potash salts, overlain by gypsiferous marl and interlayered with beds of gypsum and dolomite with infrequent seams of oil shale (Figure 9; Richards et al., 2015). These strata and the overlying Cambrian to Eocene sedimentary rocks have been thrust southward over younger sedimentary rocks and eroded to create the Salt Range.

Although Himalayan pink salt is sometimes marketed as "Jurassic Sea Salt", this salt precipitated in much older subsiding rift basins along the edge of Gondwanaland some 600 and 540 million years ago. The Jurassic period is much younger (199 - 145 million years ago). The characteristic pink colour comes from various mineral impurities, especially iron, and other trace elements.

The Khewra salt mine has nineteen levels or storeys, and more than 400 km of passages. Salt is extracted using the room and pillar method, where about half the material is left in place to support the upper levels. Extraction of Himalayan salt from the Khewra salt mine is expected to last 350 years at the present rate of extraction of around 385,000 tons per annum.

Himalayan salt is marketed as a gourmet salt to be used to flavour food, and its distinctive pink hue has led to a misconception amongst some health food fantasists that it is healthier than ordinary table salt. It is not iodine or iron-enriched, unlike some...
forms of fortified table salt, so there are no health advantages. The US Food and Drug Administration has already warned a manufacturer about marketing the pink salt as a dietary supplement by using unproven claims of health benefits. Due mainly to marketing and packaging costs, pink Himalayan salt is up to 30 times more expensive than ordinary table salt or sea salt (Table 2).

As well as the crushed pink rock salt as being marketed as a gourmet salt, blocks of Himalayan salt are sold for use as serving dishes, baking stones and griddles. The same pink salt is also used in the manufacture of salt lamps, wherein light bulbs are placed within hollowed blocks of Himalayan salt to radiate a pinkish hue. Once again, contrary to some marketing claims, there is no evidence that such salt lamps provide any health benefits. Himalayan salt is also used in spas as decoration, but again there is no scientific evidence that using Himalayan Salt in such a way provides any health benefit.

**Persian Blue Salt (crushed rock salt)**

Persian Blue Salt is a gourmet salt manufactured by grinding blue and white rock-salt extracted from a salt mine in near-surface halokinetic Miocene salt structures in the northern province of Semnan in Iran (Figures 5i, 10). As noted in some gourmet sales materials "... The Persian blue salt has a more intense flavour than other salts. It has a strong initial saltiness and then produces an interesting tingling on the palate with a pleasant, slightly acidic aftertaste – attributable to the high potassium content".

The "intriguing" blue colour in some of the salt crystals (Figure 7) in this crushed rock salt product and the "tingling" in the mouth sensation both indicate the elevated potassium levels. After all, sylvite is a bittern salt, and carnallite (when present micro-inclusions in a salt) gives a highly astringent taste. The extreme astringency of the mineral carnallite and the bitter, salty taste of sylvite are taught to Earth Science students as defining characteristics in Mineralogy 101 classes. The blue colour indicates localised radiation damage in the NaCl lattice structure and is not all that unusual in salt deposits anywhere with high levels of potassium salts nearby. Blue halite is found in many potash fertiliser mines where sylvite or langbeinite ore layers are hosted in halite beds, as in mines in New Mexico, Germany, Poland and Russia. The blue colour is not an interesting "optical illusion," although this is given by some suppliers as the reason for its colour in some of the gourmet literature.

Rather, the blue colour in this type of gourmet halite is indicative of radiation damage, albeit from the presence of radiogenic potassium (40K) at very low levels in the subsurface. Blue radiation-coloured halite is especially common in zones of potassic rock salt subject to intense structural deformation (Zelek et al., 2014). Submitting halokinetic salt to controlled radiation exposure and lattice damage creates blue halite in a nuclear reactor. This is a standard scientific laboratory method to document the deformation evolution in geological samples of flowing (halokinetic) rock salt (e.g. Schléder et al., 2007).

**Is Gourmet Salt Worth the extra cost?**

Some naturally-produced gourmet salt flake varieties (from sea-salt) tend to be less processed than ordinary table salt. The presence of impurities and minute traces of various minerals in a speciality salt can result in slight differences in appearance and flavour. Still, the fact remains that all gourmet salt is essentially sodium chloride.

In the developed world you can pay from two to fifty times as much for gourmet rock or sea salt as you do for regular table salt. Paying a price premium in Australia can get you a salt that's "made by the action of sun and wind on pristine Australian seawater", "harvested from the crystal clear seas on the east coast of Tasmania", "produced from ancient saline waters sourced from underground aquifers found in Australia's Murray Darling basin region", or "handcrafted in small batches". From the same "healthy and organic gourmet suppliers of salt, you can buy pink salt that's "found naturally deep inside the pristine Himalayan Mountains."
Perhaps the most expensive choice of gourmet salt is a flaked salt known as "Fleur de Sel de Guerande", which according to some very effective marketing is also known as the "Celtic Queen of Salts", and the hype continues "...This salt is no imposter as Her Majesty originates from Guerande (just as authentic Champagne is from Champagne, true Fleur de Sel must come from Guerande). This exceptional salt is hand-harvested according to Celtic tradition and is characterised by highly irregular, relatively fine crystals. The smaller crystals dissolve quickly, while the larger crystals take longer. This salt unravels across your palate in a wave. Many chefs see this salt as the best of all sea salts, because of its elegant appearance, delicate flavour and moist texture."

All gourmet salts are sodium chloride with an overlay of marketing hype and packaging that allows the supplier to charge up to 50 times more than standard or common table salt (Table 2). The distinguishing features of the various gourmet choices compared to common household table salt are mostly based on colour, additives and "feel on the tongue" (crystal size, shape and moisture content).

In general, non-flavoured or smoked gourmet salt varieties tend to be flaked, and many are marketed as "less processed or refined" than ordinary table salt. The presence of impurities and minute traces of various minerals in speciality salt varieties can result in slight differences in appearance and flavour. Still, the fact remains that all gourmet salt is essentially just sodium chloride with a variety of crystal textures, or in the case of flavoured salts, sodium chloride plus organic or clay or sulphur-based additives introduced to the salt as impurities then dispersed and altered via the introduction of a heat source.

**Health Benefits of Gourmet Salt?**

We probably shouldn't believe the health benefit hype of the speciality salt marketers. Australian and most other western consumers eat twice as much salt as we should, mostly in the diet from processed foods. Some gourmet salt suppliers claim their products contain minerals essential to our health, but are they really better for us?

If you google "Himalayan salt benefits" you'll find claims that its high mineral content helps improve hydration, balance your body's pH levels, encourage better sleep, support weight loss and hormone balance and more. And the labels of Himalayan salt products allude to multiple benefits too. Chef's Choice Himalayan Pink Salt Rock, for example, boasts of its "high mineral level" and "beneficial minerals." Master of Spices Himalayan Pink Rock Salt speaks of its "rich mineral elements ... providing the body with all 84 natural elements it needs". And Equagold Pure High Altitude Himalayan Coarse Pink Salt claims to be "rich in minerals.". But according to most health experts, these types of claims should be ... well, taken with a grain of salt.

Jacqui Webster, director of the World Health Organization Collaborating Centre on Population Salt Reduction, The George Institute, told Choice Australia in January 2018 that the beneficial minerals present in Himalayan pink salt are only in very small amounts.

"Any health benefits from the trace amounts present would be offset by the detriment caused by the associated sodium content. Australians in general already eat too much salt, with much of it coming from the packaged food we're eating, so we're better off not adding salt to our food at all," she says.

Some speciality salt suppliers, however, claim to offer a nutritional edge.

In the same Choice article, Heart Foundation dietitian Sian Armstrong says, "From the Heart Foundation's perspective, salt
is salt. All different types of salt – whether it's gourmet or table, flakes or rocks – contain sodium, which is the part that's damaging to health.

"Gourmet" salt may, or in some cases does, contain essential minerals, but they're in tiny amounts. To even get close to the recommended daily intake for those minerals you'd need to eat enormous amounts of salt, which isn't good for you or even realistic. All of those essential minerals can be found in foods like fresh fruit and vegetables, and it's far better to eat those instead," she adds.

Summary

So, in terms of what you are paying a premium for when purchasing gourmet salt, is generally some form of flaked salt, with its attractiveness mostly related to its interesting "in the mouth" coarse crunchy texture. You do not get the same "feel in the mouth" with the small crystals that typify ordinary table salt. You can also pay a premium price for culinary additives of various types when you buy a flavoured or smoked salt variety. Or you can buy a "natural sea-blue salt" where the blue color is certainly a product of nature, but indicates low-level radiation damage to the lattice at the atomic scale.

A decision on whether a gourmet salt variety is worth up to a 500% price premium, I guess is up to you and your levels of disposable income.

References


