

The Naming of Prague Salt

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8 May 2016

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## **1. INTRODUCTION**

At our pork processing plant in Cape Town, Woody's Consumer Brands, we use Prague Powder to cure the meat. I wondered where the name comes from and a fascinating journey started.

Prague Salt and its later version of Prague Powder are meat cures that contain sodium nitrite, a revolutionary development which transformed the cured meat industry. The name Prague Salt is closely tied with the direct addition of nitrite in curing brines. The one story is the story of the other.

From the outset, a word of caution. This is the background to the enigmatic name, Prague Salt. The historical context in Germany, Prague and in the USA are considered between the middle of the 1800 to the 1920's, related to sodium nitrite. It does not deal with the safety of nitrite in foods. An extraordinary amount of data on nitrites became available since 1925 which form the basis of every government on earth and the World Health Organisation's decisions to allowing its use in the curing of meat. A full overview of these considerations will be presented in a future article.

With that cautionary, let us begin.

In order to understand what Prague Salt is and why it is so important for meat curing we begin with an overview of the curing process.

## **2. MEAT CURING: 1600 - 1910**

Meat curing is a complex process where brine ingredients react with each other and with the meat which is made up of "water, proteins, lipids, carbohydrates and inorganic, non-protein compounds containing nitrogen and trace amounts of vitamins. (Pegg, B. R. and Shahidi, F.; 2000: 23) Each reaction is governed by many and complex factors and mechanisms, some of which are still not clearly understood by modern science.

Curing is a fascinating process. A modern understanding of the benefits of curing is that it fixes a pinkish-reddish cured meat colour. It endows the meat with unique longevity, even if left outside a refrigerator, many times longer than that of fresh

meat. It is powerful enough to prevent the deadly toxin formation by clostridium botulinum. It prevents rancidity in fat. It lastly gives meat a unique cured taste.

Discovering the curing process and the mechanics behind it was a slow process that took hundreds of years. The object was the preservation of meat for future consumption. Bacon and other cured products, properly prepared, have, however, always been a delicacy as it remains to this day. Today, taste and a visual appeal probably dominates, but ask any outdoor's person and they will tell you that preservation for future consumption is still a huge factor in the immense popularity of cured meats.

Before the 1600's meat preservation was done with salt only. Vegetable dyes were used to bolster colour. ([The history of curing](#)) A few people added a little bit of saltpeter (*potassium nitrate*) to the salt for "cured colour development." This practice gained momentum from the year 1700. By 1750, the trend turned into the norm, being practiced almost universally. During the 1800's sugar was added to the mix. This, with the exception of phosphates which have been added since the mid-1900's, is very much the same process as we follow today. ([Ladislav NACHMÜLLNER vs The Griffith Laboratories](#))

On 7 May 1868, Dr. Arthur Gamgee from the University of Edinburgh, brother of the famous veterinarian, Professor John Gamgee (who contributed to the attempt to find ways to preserve whole carcasses during a voyage between Australia and Britain), published a groundbreaking article entitled, "*On the action of nitrites on the blood.*" He observed the colour change brought about by nitrite. He wrote, "The addition of ... nitrites to blood ... causes the red colour to return..." (Gamgee, A; 1867 - 1868; Vol. 16, 339-342) Over the next 30 years, it would be discovered that it is indeed nitrites responsible for curing and not the nitrates added as saltpeter.

It fell upon a German researcher, Dr. Ed Polenske (1849-1911), working for the Imperial Health Office in Germany, to make the first discovery that would lead to a full understanding of the curing action. He prepared a brine to cure meat and used only salt and saltpeter (nitrates). When he tested it a week later, it tested positive for nitrites. (Polenske. E. 1891)

The question is where did the nitrites come from if he did not add it to the brine to begin with. He correctly speculated that this was due to nitrate being converted by microbial action into nitrite. He published in 1891. (Polenske. E. 1891)

Karl Bernhard Lehmann and Karl Kißkalt discovered in 1899 that nitrite is responsible for the reddish color of dry cured meat. It was John Scott Haldane who showed in a 1901 article that the cured meat colour is due to a nitrosylheme complex. ([Concerning the direct addition of nitrite to curing brine](#)) (Hoagland, Ralph. 1914) <sup>[1]</sup> The *heme* part of the meat protein is where the colour is generated through the presence of an Fe ion and *nitrosyl* refers to a non-organic compounds containing the NO group. In the protein, nitric oxide is bound to the Fe ion through the nitrogen atom. Therefore the term, nitrosylheme complex.

The change of nitrate into nitrite through bacterial action takes weeks. If a salt, like sodium nitrite, is used instead of saltpeter, curing is accomplished in days or even hours (if a heating step is applied to the meat before it is smoked).

The only aspect in curing that is time-consuming is however not the bacterial reduction of nitrates to nitrites. The change from nitrite into a form that reacts with the meat protein and produce the nitric oxide coupling with the Fe ion is also not instantaneous. The rate of reaction is slow.<sup>[2]</sup> It is not like mixing sugar into coffee. An analogy is if you put sugar in your coffee and have to wait twelve hours and reheat it in the microwave before you can taste sweetness.

When the brine enters the meat, the anion  $\text{NO}_2^-$  is formed and a very small amount of nitrite (less than 1% of the total nitrite) forms the neutral nitrous acid ( $\text{HNO}_2$ ). It is nitrous acid that is responsible for the formation of nitrosating compounds which is the ultimate reaction of joining nitric oxide to an organic compound, in this case, the myoglobin protein (resulting in a nitroso derivative). (Sebranek, J. and Fox, J. B. Jn.. 1985)

The first step in the reaction sequence of creating such a link between myoglobin and nitric oxide is the formation of nitrous acid ( $\text{HNO}_2$ ). From nitrous acid, the neutral radical, nitric oxide is formed directly as well as a variety of nitrosating species or molecules that create such a nitrite-oxygen pair of atoms to link to an organic structure like a protein. <sup>[3]</sup> <sup>[4]</sup> (Sebranek, J. and Fox, J. B. Jn.. 1985)

This reaction takes time and its rate is dependent on the pH of the meat it is injected into, the temperature of the meat and the brine and the concentration of nitrite. Curing then happens when the nitric oxide reacts with iron which is part of the meat proteins, myoglobin. [1]

The concentration of nitrous acid is very low in meats. This means that the potential for nitrite to change into nitric oxide to react with the meat protein is very low. In general, nitrite is readily reduced by endogenous reductants in the meat to form nitric oxide. (Toldr, F.; 2010: 180) [5] The reduction of nitrous acid can be sped up by adding a "reducing agent" to the brine mix. (Pegg, B. R. and Shahidi, F.; 2000: 39) (the presence of table salt also speeds up the conversion of nitric oxide, but this matter is for another article)

One such reducing agent, introduced to brine cures in the 1800's, is sugar. [6] Sugar was added originally to reduce the salty taste of the meat. Curers noticed that if sugar is added with saltpeter to the brine mix, the meat cures slightly faster and with better colour development. ([The history of curing](#)) In the 1920's, ascorbate or its isomer, erythorbate became the magical reducing agent [7] , but this too is the subject for another article.

If saltpeter is used as principal curing ingredient, adding sugar favours the proliferation of bacteria that reduces nitrate to nitrite. It, therefore, speeds up the curing process.

Better colour development is due to the action of reducing sugars (such as brown sugar) to create a reducing environment in the meat which encourages the reduction of nitrous acid to nitric oxide (Kim-Shapiro, D. B. et al. 2006). [6] ([The history of curing](#))

This was then the understanding of meat curing by the beginning of the 1900's. Scientists knew that adding nitrite directly to the meat would dramatically speed up the curing process, but working out how to do it and navigating through the complex maze of public perception and legal restraints would be another matter altogether.

### 3. QUESTIONS ABOUT THE ORIGIN OF PRAGUE SALT

Changing from saltpeter to the direct addition of nitrite in curing brines has not been easy to accomplish. In 1925, a curing brine was imported into the USA by the Chicago-based firm, the Griffith Laboratories. It was a crude mechanical mix of sodium chloride (table salt) and sodium nitrite. They called it Prague Salt. It arguably became the most successful curing brine of the early 1900's.

The name fascinated me. Especially after an internet search where I learned that nobody really had a clue where the name came from. The Griffith Laboratories documents state that the product was imported from Germany ([Ladislav NACHMÜLLNER vs The Griffith Laboratories](#)), but I was unable to find a curing brine from the 1920's that was produced and sold in Germany called Prague Salt. I found no reference to Prague Salt at all before 1925, in Germany or any other country for that matter.

If it was not called Prague Salt in Germany, why would Griffith call it that? I wondered if the fact that "Prague" is used in the name had any definite link to Prague, even if it was produced in Germany. Is there a link and if so, *what* and possibly, *who* is that link? Is there any significance to the "Salt" in *Prague Salt*? Similar curing brines of the time was not called "salt." Is this just coincidence or is there more to this?

I started to unravel the history of the direct addition of nitrite to curing brines. Tantalizing possibilities of what was behind the name, *Prague Salt*, developed. The answers are conjecture, but as you will see, they naturally flow from concrete facts. *The conclusions are presented here, in part, to allow others to contribute and bring evidence to the table that will prove the contrary or confirm my hypothesis.* As new information comes to light, this article will be amended. What I discovered makes for one of the greatest stories of our age.

### 4. EARLY EXPERIMENTS WITH SODIUM NITRITE

The Danes took the development where nitrites are directly applied to curing, in one very particular direction. They invented the "mother brine" cure. The English imported this Danish invention as early as the 1910's and called it tank curing. Tank curing later became the famous Wiltshire curing process. ([The Mother Brine](#) and [C & T Harris and their Wiltshire bacon cure](#))

In this process, a nitrite and salt brine is prepared and injected into meat. The brine that inevitably runs out of the meat (exudate) contains nitrate that has been turned into nitrites by bacterial action. When the meat is finally removed for smoking, the leftover brine is collected. It now contains nitrites.

The next batch of meat is injected with fresh salt and nitrates and placed in a tank with the old brine which contains nitrites. The old brine that is re-used is called the mother brine. This method is particularly effective in terms of final product quality due to the action of enzymes, but again, the subject is for another article.

There was another easier option in the early 1900's. Nitrites were already being used in a large, industrial process since the end of the 1800's in the form of sodium nitrite. This made it generally available.

Sodium nitrite was used in the production of azo dyes. It was available in every country and city where there was a large dye industry. This was part of the new and booming new industry of coal-tar dyes. The late 1800's and early 1900's was the birth of the age of chemistry and chemical synthesis, a development that directly resulted from the dye industry. ([Concerning Chemical Synthesis and Food Additives](#))

A direct consequence of this development (chemical synthesis) was the creation of new preservatives and colourants which flooded the market and offered to improve food safety through chemical means. In reality, it became a way to disguise inferior products. There was an uproar from consumers around the world and governments reacted by introducing food legislation. ([Concerning Chemical Synthesis and Food Additives](#))

Unscrupulous producers cheated the public but many food scientists and producers had noble intentions. Populations in Europe and the UK were booming and the race was on to find a way to feed them from produce from the new world. Chemical preservation was one of the options of making it possible to supply the old world with meat from the new. This was before refrigeration solved the problem definitively, early in the 1900's. ([Ice Cold Revolution](#)) The general public's perception about sodium nitrite was, however, that it was part of the chemicals dye industry and that it had no place in food preparations.

There were nevertheless early scientific flirtations with the use of sodium nitrite in meat. A laboratory in Germany, founded by C. R. Fresenius, records in 1848 experiment with sodium nitrite to preserve meat. ([Ladislav NACHMÜLLNER vs The Griffith Laboratories](#))

An article appeared in the Sydney Morning Herald on 1 March 1870 where it lists the methods of preserving canned meat in use at that time. Included in the list of "antiseptic agents" are "sulfurous and nitrous acids, sulphites and nitrite. (It also lists sodium and "other substances having a special affinity for oxygen.") It was explained that "these agents are not applied to meat itself, but are used simply to absorb oxygen unavoidably left within the tins and pores of the meat." As far as the preservation of fresh meat is concerned, the world saw it as a race between the use of chemicals or cold. (Sydney Morning Herald, 1 March 1870, p4)

The major obstacle standing in the way of a chemical solution was perception. Those of the general public and the governments of the world alike.

## **5. EARLY PUBLIC PERCEPTION ABOUT NITRITE**

Between the mid 1800's and early 1900's, industry and informed members of the public knew nitrite as an ingredient in medication <sup>[8]</sup> (Vaughn E, et al.;2010; Jul–Aug; 18(4): 190–197) and sodium nitrite as an intermediary in the chemicals dye industry. ([Concerning Chemical Synthesis and Food Additives](#)) Most people, however, knew nitrite as a toxic chemical that kills livestock and people if the drinking water has even small traces of it. Such was the concern that nitrite levels in drinking water were reported in local newspapers every week to alert the public to possible contamination. It is, therefore, no wonder that the public and authorities were very sceptical about its use in food.

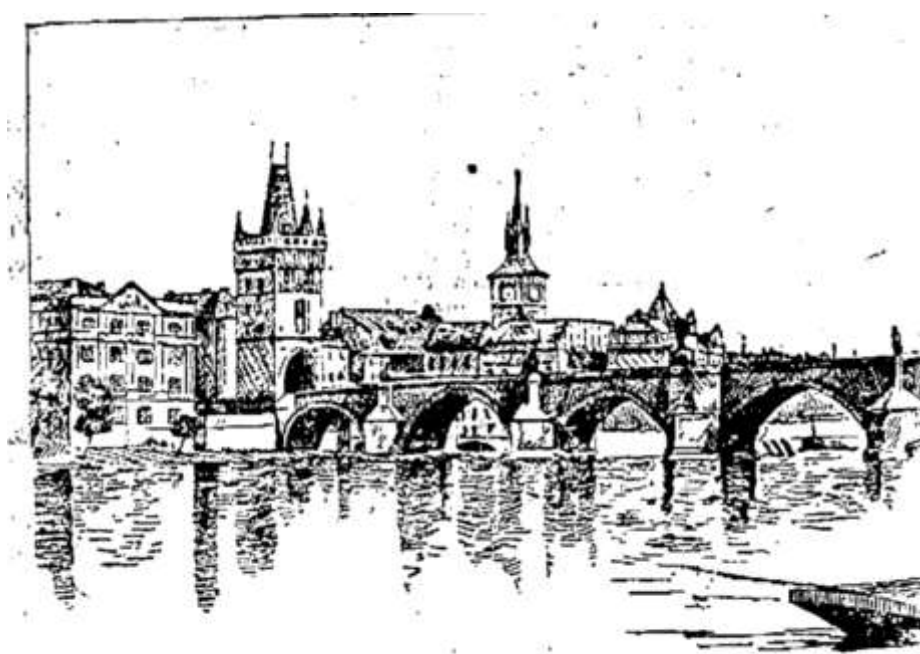
At the beginning of the 1900's, science developed a detailed understanding of the chemistry of curing which clearly showed the priority of nitrites in curing. In contrast to this, the general public and their elected officials were against the direct use of nitrites in food. As is many times the case, the scientific understanding was not general knowledge yet.



We now delve deeper into the story and zoom in on developments in three parts of the world, Prague, Germany and in the USA, Chicago. Events, dates, and places will start to overlap and two processes will become very important, the electric arc method of extracting nitrogen from the atmosphere and the Haber process.

As we do so, it is important to understand one more point in chemistry namely the close proximity of nitric oxide ( $NO$ ), nitrous acid ( $HNO_2$ ), nitric acid ( $HNO_3$ ), nitrite ( $NO_2^-$ ), nitrate ( $NO_3^-$ ) and ammonia ( $NH_3$ ). All have a nitrogen atom as part of either the molecule or the ion. The Haber process yields ammonia ( $NH_3$ ) and the electric arc process, either nitrous acid ( $HNO_2$ ) or nitric acid ( $HNO_3$ ). From any of these, nitrite ( $NO_2^-$ ) can be formed. (Webb, H. W.; 1923)

## 6. PRAGUE 1800 - 1920 - Food innovation, industrial leadership and the availability of nitrite



THE OLD BRIDGE GATE AND BRIDGE AT PRAGUE.

Prague, Logansport Pharos Tribune, 19 Oct. 1895

Germany's neighbor and ally in World War One, the Austro-Hungarian Empire with the key cities of Prague, Vienna and Budapest, in the late 1800's and early 1900's led the world in many respects in matters pertaining to science and technology. In Bohemia and regions surrounding Prague the industries were leading Europe in

innovation. (Turmock, D.;1989: 40) It was reported that in many respects, industry in this region surpassed Germany.

A huge textile industry developed in Vienna. In Prague, cotton printing became the dominant industry with the accompanied dyes industry. Bohemia, in general, had well-developed textile manufacturing. (Hiemstra-Kuperus, E. 2010) This means that by the early 1900's, sodium nitrite was available in and around the city of Prague.

Prague and surrounding areas were not just a consumer of chemicals. The scientific and industrial environment was sophisticated and advanced and they produced many of the chemicals for their industry themselves, primarily in support of the textile printing industry. The point is that when we deal with the people in Prague, we are talking about people who understood chemistry (my personal experience is that this is still the case to this day).

D. Hirsch, for example, established his factory in Prague to "provide acid for calico printing in 1835." F. X. Brosche supplied printing inks, paint, and pharmaceuticals. The first major chemicals producer in the area was Johann David (J. D.) Starck had a sulfuric acid plant near Zwittau (now Svitavy in the Czech Republic), 183km to the east of Prague, in 1810.

Between 1810 and 1850, J. D. Starck expanded into a multi-plant operation manufacturing a variety of products including phosphates at Kaznau (now Kosnejov, in the Czech Republic), 109km South West of Prague. He was big enough to own his own source of coal from the Falknov (Sokolov) basin. (Turmock, D.;1989: 39) It all supports a picture of sodium nitrite being readily available in Prague as part of the chemicals associated with the dyeing and textile printing industry. <sup>[9]</sup> More than that, the Bohemian people proved to be innovative and capable in matters pertaining to chemistry.

At the end of the 1800 and beginning of the 1900's, Prague was a fertile breeding ground for industrial and food innovations. A case in point is the phenomenal success of Pilsner named after the city of Pilsen (Plzen). The innovation was the application of steam power to the production of chilled lager. It was an important improvement on the old processes and helped the town of *Pilsen* to become one of the great European *beer* producers. (Turmock, D.;1989: 40)

Another Bohemian innovation was the invention of the sugar beet refining process through diffusion to produce refined sugar. "The diffusion process was discovered in Seelowitz (Zidlochovice) in Moravia by J. Robert, the son of the founder of the first sugar beet factory in the Czech lands." Within a few years, 25 other factories converted to this process and sugar refining machines were being exported to Germany and France. The Prague-based engineering firm of C. Danek (founded in 1854) was particularly successful. (Turmock, D.;1989: 40)

The kingdom boasted the most sophisticated food industry with a very strong scientific backing from the local academia in Prague. Under their leadership, the first food code in industrialized Europe was created, the Codex Alimentarius Austriacus, which is the basis for international food legislation to this day. ([The Life and Times of Ladislav NACHMÜLLNER – The Codex Alimentarius Austriacus](#)) It also became the first country in the world to specifically allow the use of sodium nitrite in food, before Germany and the US.

Not just was Prague and the Bohemian people leading the world in food innovation and food science and chemistry, but the existence of large food industries created an environment where other food industries would benefit, for example, the meat industry. (Turmock, D.;1989: 39, 40)

## 7. THE MASTER BUTCHER FROM PRAGUE

The ether around Prague and the Bohemian people was right for a company or an individual to step forward and take up the challenge to work out the details of how to use sodium nitrite directly in meat curing.



Into this advanced and scientifically and industrially mature environment, Ladislav Nachmullner was born on 2 April 1896. ([Eva's Beloved Dad](#))

In 1912, the Bohemian boy, Ladic (Ladislav) NACHMÜLLNER was 16 years old. His dad tragically burned to death four years earlier, in 1908, when his clothes caught fire in his home. His mother had just passed away from tuberculosis and as the oldest child, the responsibility fell on him to care for his siblings.

Ladic got an opportunity to learn the art of meat curing to provide for his siblings in a land where chemistry was well understood, salts were of a high quality, sodium nitrite was widely available and there was an appetite for and a culture of innovation in food production. He was taught the art of curing by a well known butcher, Josef Pazderky from Praha, almost 600km from Prague. He was an unusually gifted young man who

learned fast and an illustrious career followed.<sup>[10]</sup> At the young age of 19 he invented Praganda, which would become the most successful curing brine of its day, containing sodium nitrite. This was the year 1915 when he also started writing his book on Praganda.

How his invention happened is not known, but possibly very early in his employment he was introduced to the use of sodium nitrite for meat curing. Ladic himself gives important clues.

He says that he discovered the power of sodium nitrite through “modern-day professional and scientific investigation.” He probably actively sought an application of the work of Haldane. Ladic quotes the exact discovery that Haldane was credited for in 1901 that nitrite interacts with the meat's "hemoglobin, which is changing to red nitro-oxy-haemoglobin." This must have made a profound impression on him which explains why he never forgot it. If it was not him personally, it must have been his mentors in Prague who decided to start experimenting with sodium nitrite to develop a meat curing brine.

The "modern day professional investigations" that he spoke of would have been the input of master butchers who was not primarily interested in a quicker process, but in a better end product. Saltpeter is potassium nitrate. The butchers did not like it due to the slightly bitter taste of potassium. Butchers who used Ladic's brine would later put signs in their shop windows that their meat is free of saltpeter.

Another point that Ladic specifically addressed in his nitrite-based brine is the use of as little nitrite as possible. This shows an advanced understanding of the chemistry of curing and an ability to apply this to his trade.

His fame as curer spread and he received employment offers from more countries. He moved to Austria and then, Switzerland for the duration of the war.

He received offers for management positions from all over Germany, France, England, Holland, Switzerland, Romania, Yugoslavia, Poland and as far afield as America and China.



He says that he invented Praganda in 1915 (when he was 19 years old) and at a time when the use of nitrites in food was not legal in Germany.

We know that it was not legal in Germany before August 1914 when Walther Rathenau who created the War Raw Materials Department (Kriegsrohstoffabteilung or KRA) restricted the use of saltpeter to military purposes only and the use of nitrites in food were allowed. Germany again banned its use some time during the war. The concession on sodium nitrite's use in food was reversed after an accident in Leipzig where sodium nitrite was mistaken for table salt and 34 people died. ([Concerning Nitrate and Nitrite's antimicrobial efficacy – chronology of scientific inquiry](#)) This must then have happened some time in 1915.

The impression one gets from reading his life story through the writings of his daughter Eva, is that he probably learned the basics of nitrite curing early on and this "paid his way" on many travels through Europe. Along the way, he must have continued to refine

and perfect his formulations and solve the many challenges of using such a potentially dangerous chemical. (For a detailed analysis of the technical challenges facing him and how he dealt with it, see [Ladislav NACHMÜLLNER vs The Griffith Laboratories.](#))

His move to Switzerland for the remainder of World War One is of interest. In Switzerland, the Polish chemist, Prof. Mościcki of the University of Freiburg, invented a process to use atmospheric nitrogen to produce both nitric and nitrous acid (US patent US1097870) in 1901 through the use of an electric arc in a closed container. (cesa-project.eu)

In 1910, a factory opened in Switzerland, Chippis, in Wallis canton, where the world's first nitrous acid was produced using Prof. Mościcki's electric arc process. (cesa-project.eu) This means that a factory producing nitrite was in operation in the same country where Ladislav lived, during the war.

It is equally important that Prof. Mościcki opened another factory in Poland during the War, the Azot nitrogen factory near Jaworzno. (cesa-project.eu) Jaworzno is less than 460km from Prague.

From the evidence of his life, handed down to us by his daughter, Eva, he returned to Prague from Switzerland in 1929 and set up his first outlet where he sold Pragnada and ham moulds which he invented.

It makes Prague the center of the development to add sodium nitrite directly to meat, other than canned meat.

(All information and pictures about Ladislav Nachmüllner and Pragnada, from Ladislav Nachmüllner vulgo Pragnada. Nachmüllnerová, Eva, Editor, 2000, Translated by Monica Volcko)

## 8. THE SALTS FROM PRAGUE

The history of Ladislav Nachmuller not only points to the first commercial curing brine containing nitrites, but also to the use of pure salt from the regions surrounding Prague. Using the correct salt was very important to Ladislav. The area around Prague, like the neighbor to the north, Poland, were famous for the production of high-quality salt. Ladislav procured salt from various mines, including from the salt producer, Solivary Prešov. He gives the requirement for good salt as pure, clean, and "regular salt." This mine delivered on this requirements.

Mining at Solivary Prešov started as far back as the 13th century. The salt was produced from "brines" (water saturated with a salt solution) where the water was evaporated. First in pans and then in boiling rooms. The final result was good quality NaCl (table salt) which has been popular among butchers in the area on account of its purity. (From private communication with the museum curator, Prof. Marek Duchoň)

Historical records inform us that the salt production exceeded local consumption, which points to the fact that the salt from Solivary Prešov was widely traded. The technology used in producing the salt was sophisticated. (<http://www.stm-ke.sk/>)

An interesting fact, relevant to our current discussion, is that the mine produced its own sodium nitrite since 1945. It falls outside our time of interest and the production has since the been discontinued, but the fact that producing sodium nitrite was fairly "widespread" and the technology, common in the area is fascinating. (From private communication with the museum curator, Prof. Marek Duchoň)





Sodium nitrite, produced at Solivary in 2007.

This is a key fact in piecing together why it was "natural" to call the sodium nitrite/sodium chloride mix that Griffith imported into the USA, *Salt from Prague*. The region was indeed famous for its salts.

## 9. GERMANY 1910 - 1920 - the race to access atmospheric nitrogen



Austerity for the middle class in Germany during the Great War.

By the end of the war, the largest stockpiles of nitrite in the history of humanity up to that point were in Germany. It was created by the most productive chemicals industry in the world.

By the end of the 1800's it became apparent that the world's growing populations will not be fed unless atmospheric nitrogen can be harvested. Solving the problem of how to do this became one of the biggest priorities of science.

After an intense search and various processes tested on an industrial scale, including the electric arc method, the German chemist, Fritz Harber finally solved the problem with the help of Robert Le Rossignol who developed and build the required high-pressure device to create ammonia. It would be the most productive system ever developed to fix atmospheric nitrogen.

The process was first demonstrated in 1909. The German Dyes manufacturer, BASF acquired the technology and under the leadership of Carl Bosch, the first Haber-process factory went into operation in Oppau, Germany in 1913. ([Concerning the direct addition of nitrite to curing brine](#)),

As a direct consequence of this development, Germany was no longer reliant on saltpeter from Chili (sodium nitrate) as fertilizer to feed its massive agriculture industry. Another consequence of the Haber-process is that it made World War One possible on an industrial scale. Nitrogen is key in ammunition production. Germany and its allies could escalate the war to a never before seen level.

There are good examples of Germans toying with the use of nitrite in food, even before the war. The German scientist, Glage (1909) wrote a pamphlet where he outlines the practical methods for obtaining the best results from the use of saltpeter in the curing of meats and in the manufacture of sausages. (Hoagland, Ralph, 1914: 212, 213)

Glage gives for the partial reduction of the saltpeter to nitrites by heating the dry salt in a kettle before it is used. It is stated that this partially reduced saltpeter is much more efficient in the production of color in the manufacture of sausage than is the untreated saltpeter. (Hoagland, Ralph, 1914: 212, 213)

This means that by the 1910's, German scientists tried to solve the problem by still using saltpeter as starting point to the reaction but getting to a reduced state faster. The line of thinking of using nitrate as the starting point was finally perfected by the Danes who allowed the reduction to take place at the normal pace.

It was however not before BASF's new Haber process came into operation that sodium nitrite became generally and cheaply available. Solving the problem by using sodium nitrite was now a serious possibility. The Great War provided the environment to "motivate" an entire industry to change from saltpeter to sodium nitrite when saltpeter was suddenly not available for curing, survival was linked to speed of curing and public perceptions were put aside.

By 1909, the world production of inorganic nitrogen by the electric arc method and some miscellaneous processes were standing at a combined 3000 metric tons. The Haber process was not invented yet. One year after Ladic started working as a meat curer, by 1913, the arc and miscellaneous processes yielded 18 000 metric ton and the Haber process, 7000 metric tons.

By 1917, the arc and miscellaneous processes delivered 30 000 metric ton and the Haber process, 100 000 metric tons. This was 5 years after Ladic learned the art of curing and

possibly started using sodium nitrite in meat curing. Over this five years, he has seen a dramatic increase in the availability of nitrite and therefore a reduction in nitrite prices.

In 1920, the Haber process delivered a staggering 308 000 metric ton of nitrogen, compared to the 33 600 metric tons of the arc and miscellaneous processes. (Scott, E. Kilburn. 1923; : 859–76)

World War One broke out on 28 July 1914 and lasted until 11 November 1918. When the war ended, Germany had huge stockpiles of sodium nitrite (along with many other war-chemicals). They had to pay a massive war debt and raise the German economy from the dead. These were desperate times and Germany threw its full energy and industriousness behind this effort. The effort focused on the lucrative market of the USA.

## **10. THE USA - 1910's - Nitrite on trial**

The drama of the sale of German nitrites played itself off in the USA and particularly in Chicago. This directly led to the creation of Prague Salt.

We begin our US story by looking at public and government views on nitrite. During the 1910's, the USA wrestled with the question whether nitrites in food constitute adulteration and its consideration created its own epic drama.

Vastly opposing views were held in relation to preservatives and colourants generally. Prof. Julius Hortvet, a chemist at the Minnesota Dairy and Food Commission said in an address delivered on 16 July 1907, at the Eleventh Annual Convention of the Association of State and National Food and Dairy Departments, in Jamestown, "Some state laws go so far as to inflict fine and imprisonment for making an article appear better than it really is."

He presented the opposing view when he said that he believes that "if we must have legislation in regards to this, it would be wiser to reserve it and punish the man who did not make his food product as attractive as possible." (American Food Journal; 1907)

In his speech, he made the following prophetic comment about saltpeter which in years to come would become one of the dominant arguments for the use of nitrite in foods. He said that "we know..that certain substances, as salt and saltpeter, have caused death from the effects of large doses." He then draws a brilliant comparison between these products and alcohol when he said that " alcohol is classed as a poison." His point was that what is good for alcohol, which is a poison if consumed in high concentrations and large volumes, should be good for saltpeter (i.e. limit the amount of nitrate and nitrite in foods instead of banning it altogether, as is the case with alcohol). "In short," he said, "the whole question sometimes is relative." (American Food Journal; 1907)

He was "not contending that certain articles commonly used in...food may or may not under certain circumstances act as a poison." He was "simply defending... against two possible evils: first, the addition to...food of any substances that will tend to augment the possibilities of harm arising from our daily diet."

His second point sounds like one directed to the use of nitrite and its medicinal use when he said that "he is *secondly defending against*," the addition to ... foods of substances having therapeutic or even toxic properties by persons unqualified to prescribe such substances." (American Food Journal; 1907) He is possibly tripped up by a lack of scientific understanding about nitrites at the time, but his cautionary note is commended.

In the 1910's, the US Department of Agriculture had the right to promulgate "standards of purity for food products and to determine what are regarded as adulteration therein." (American Food Journal; 1907 vol 2 no 2, 15 Feb 1907, p43 ) Whether these standards would become law was an open question at this stage. If there was a dispute about a substance, it was heard by a special organ of the US Department of Agriculture, the Referee Board of Consulting Scientific Experts, created in 1908.

The battleground about the use of nitrites itself was not the meat industry. It seems that the meat industry considered and possibly used it in secret. The battle played out in its use as a bleaching agent in flour. The controversy came to a head in a landmark court case in 1910.

The Millers were infuriated because the attorney general opted for a jury trial instead of . referring the matter to the Referee Board of Consulting Scientific Experts. (Chicago

Daily Tribune ; 7 July 1910; Page 15) I can only suspect that he was himself against the use of nitrites in food and probably did not want scientists to decide.

A court case was brought by the US Federal Government against the Mill and Elevator Company of Lexington, Nebraska. The charge was that they adulterated and misbranded flour and sold it to a grocer in Castle, Missouri.

The government seized as evidence 625 sacks of flour from the grocer. The court case lasted five weeks. The case was brought by the government under the pure food and drug act of 1906. (Chicago Daily Tribune ; 7 July 1910; Page 15) This is an act "for preventing the manufacture, sale, or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines, and liquors, and for regulating traffic therein, and for other purposes." ([www.fda.gov](http://www.fda.gov))

The government contended that "poisonous nitrites are produced in the flour by bleaching." They did not share the view of Prof. Julius Hortvet that we looked at earlier who said that these matters are relative to the amount of the substance used since alcohol is also a poison if used in the right quantity. The Federal Government said that "any amount of poison introduced into food is an adulteration." (Chicago Daily Tribune; 7 July 1910; Page 15)

The issue was that as much as 80% of the flour produced in the USA during that time was bleached with a nitrogen peroxide process. Flour naturally has a creamy tint. The cheaper the grade, the more creamy it is. In ages past, flour was bleached simply by age. The chemical bleaching process with nitrogen peroxide instantly changes the yellowest flour whiter than the highest grade. The process results in residue traces of nitrous and nitric acid being left in the flour which produce nitrites and nitrates. (Chicago Daily Tribune ; 7 July 1910; Page 15)

The defense argued that "nitrates (and nitrites) were present in such small quantities that no man could eat enough bread at one time to be poisoned by them." (Chicago Daily Tribune; 7 Jul 1910; Page 15) The government contended that "if this view were upheld by the courts all foodstuffs manufactured could introduce quantities of poison into their products, infinitely small in each case, but devastating in their cumulative effect." (Chicago Daily Tribune, 7 Jul 1910, Thu, Page 15) (The arguments will be analysed and

an overview will be given of how the international food industry answered it in the years following 1910 in a separate article)

This was a case of huge importance to the industry as can be seen from the list of people called upon by the defense. Pierce Butler of St Paul acted as special attorney for the defense. (Chicago Daily Tribune; 7 Jul 1910; Page 15) Whether he still had the position in 1910 when the case was heard must be verified, but he was a lawyer of such stature that in 1908, Butler was elected President of the Minnesota State Bar Association. From 1923 to 1939 he served as Associate Justice of the Supreme Court of the United States. (saintpaulhistorical.com)

Apart from Butler, "a large staff of distinguished lawyers fought for the company who's flour was seized, and for the millers of Nebraska, the millers of Kansas, and the company who makes the bleaching machines. Among the experts who testified were all the toxicologists who testified in a previous landmark case (the Swope case), professors of chemistry and medicine from twenty universities, doctors, bakers, millers, and housewives." (Chicago Daily Tribune; 7 Jul 1910; Thu, Page 15)

After seven hours of deliberation, the jury returned a verdict in favour of the government upholding the charge that the bleached flour was both adulterated and misbranded. (Chicago Daily Tribune; 7 Jul 1910; Thu, Page 15)

It is fair to conclude that by 1910, nothing was more sensitive in food production than the presence of nitrites and the use of sodium nitrite in food was highly controversial.

## **11.SODIUM NITRITE TESTED IN MEAT CURING IN CHICAGO**

In the early 1900's, in Chicago, the powerful meat packing companies set up by Phil Armour, Gustav Swift and Edward Morris were all looking for ways *to reduce steers to beef and hogs to pork in the quickest, most economical and the most serviceable manner.*" (The Indiana Gazette. 28 March 1924).

The earliest reference to a test of meat curing with sodium nitrite in the USA places a secret experiment conducted where sodium nitrite was used to cure meat in 1905. <sup>[11]</sup> This was probably done in Chicago. When the "Pure Food and Drug Act and

Meat Inspection Act" of 1906 was promulgated, it made the use of sodium nitrite in food illegal. It was not specifically forbidden, but the act was applied, for example in the 1910 court case we just looked at, in such a way that it was seen as making its use in food illegal.

During the 1910's a very interesting article appeared in Chicago that places a company with the technology to produce sodium nitrite in the same city. It appeared in the American Food Journal of 15 February 1907 entitled "Cheap Nitrogen."

It said that a Chicago-based company was producing nitric acid by the electric arc method invented by Prof. Mościcki of the University of Freiburg, Switzerland, that we looked at before. The method, in reality, was able to produce both nitric and nitrous acid (US patent US1097870) and dates back to 1901. (cesa-project.eu) The article states that the process made its production "cheap enough to be commercially applicable." (American Food Journal. Vol 2. No 2. 15 Feb 1907, p29) The entrepreneur behind this company was William M. Thomas, who set an experimental plant up in Marshfield Avenue, Chicago. His main goal was probably to produce fertilizer. (Chicago Sunday Tribune, Nov 10, 1907)

We have already referred to the electric arc method several times. Mościcki, the inventor of the process was the former assistant to Józef Wierusz-Kowalski (1896), professor of physics, and rector (provost) at Albert-Ludwigs University in Freiburg, Switzerland.

Prof Mościcki was an interesting person. After a very successful academic career and a career as an inventor, he became the 3rd president of the second Polish Republic. He was in office from 4 June 1926 to 30 September 1939. Another interesting fact relates directly to his invention is that in Bern, Switzerland, his patent application was handled by none other than Albert Einstein.

"In 1905 Einstein *Prof Mościcki's* special arc furnace *which employed* a rotating electric arc and *was used* for the production of nitric (and nitrous) acid..." "The field generated by an electromagnet was used to rotate the arc. The 26-year-old physicist (Einstein) and the still young (38) but already renowned inventor and scholar (Prof Mościcki's) met and discussed the patented idea. Einstein was curious to know why an electric arc changed its orientation in a magnetic field." Prof Mościcki's became a successful businessman in Switzerland. (Zofia Gołąb-Meyer Marian. 2006) <sup>[12]</sup>



When we looked at the career of Ladic Nachtmullner, we have seen that the first production of nitrous acid in Switzerland was in 1910, during World War One based on the invention of Prof Mościcki. This happened "immediately after *his* procedure was patented." "A factory was opened in Chippis in Wallis canton, *Switzerland*." "In the subsequent years, this procedure was substantially perfected and nitrous acid could be supplied not only to Switzerland but also to neighbouring countries." (cesa-project.eu)

What is interesting in relation to Chicago is that the American Food Journal article says that the Chicago company was already in production by 1907 manufacturing nitric acid "in a small way" from free nitrogen, using the technology invented by Mościcki's. (American Food Journal. Vol 2. No 2. 15 Feb 1907, p29)

In the USA the fixation of atmospheric nitrogen was a priority and they knew they lagged behind Germany. The first US plant for the fixation of atmospheric nitrogen was built in 1917 by the American Nitrogen Products Company at Le Grande, Washington. It could produce about one ton of nitrogen per day. In 1927 it was destroyed by a fire and was never rebuilt. (Ernst, FA, 1928: 14)

An article in the Cincinnati Enquirer of 27 September 1923 reports that as a result of cheap German imports of sodium nitrite following the war, the American Nitrogen Products Company was forced to close its doors four years before the factory burned down. We will consider America's response to these cheap imports momentarily. (The Cincinnati Enquirer (Cincinnati, Ohio), 27 September 1923. Page 14.)

We can conclude then with great certainty that there was at least one company in Chicago by 1907 that could produce sodium nitrite. Was this venture funded by the meat packing companies? It is a question for further discovery. A much larger project got under way in 1917, but by 1923, the USA was not in a position to supply material quantities of sodium nitrite.

## **12. AFTERMATH OF THE GREAT WAR**

At the end of World War One, England had its own stockpiles of nitrite to dispose of.

Sodium nitrite in the UK appeared for sale in an advertisement in the Times of London on 1 May 1919, 6 months after the armistice. (The Times, London)

The stockpile of the English was dwarfed by what was available from Germany. The German Government did not wait long before they started selling their war stockpile. An article appeared in The Watchman and Southron on 19 Feb 1921 and shows that German goods, especially chemicals have been making its way to the USA in such quantities that it was seen as a threat to the local industry.

## **13. RESTRICTIONS ON GERMAN SODIUM NITRITE IN THE USA**

Our three worlds of Germany, Prague, and the USA now merge.

The Detroit Free Press (Detroit, Michigan) reported on 14 Jan 1921 that "large stocks of imported sodium nitrite are offered at extremely low prices by agents of German manufacturers."

Some of the tactics used by Germany to get goods into the USA, including goods subjected to presidential restrictions, were to import goods through the "concealment of the origin of shipment." German chemicals, subject to such restrictions have been making their way into the USA "appearing as having been shipped from Switzerland, Italy and elsewhere. "Also, there has been extensive smuggling." The article states that the German plans to sell their products in the USA and economic domination have been made as early as May 1919. (The Watchman and Southron, 19 Feb 1921, page 3)

Great emphasis is placed on sodium nitrite. The author of an article that appeared in The Watchman and Southron, 19 Feb 1921, misread its importance when it was reported that "sodium nitrite would seem to be of minor importance." "Since the first of the year (Jan 1921), the Germans have glutted the American sodium nitrite market, threatening to destroy the hitherto prosperous American industry, and no relief has yet been

obtained through the war trade board." (The Watchman and Southron, 19 Feb 1921, page 3)

In April 1921, the call made in February for greater control over the import of sodium nitrite was answered when the war trade board in the USA placed an embargo on the importation of Sodium Nitrite. In the future, it could only be imported under license.

An article that appeared in the Detroit Free Press, 22 April 1921, reported that the goal of the embargo was to "check the heavy imports from Germany and Norway which have swamped the market in the country and reduced prices to a level below the cost of manufacture in the United States. (Detroit Free Press, 22 Apr 1921, Page 18)

On 7 May 1924, The Indianapolis News, reports that the tariff for importing sodium nitrite was increased by a massive 50% from 3 cent a pound to 4.5 cent per pound. This was the maximum duty permitted under the Fordney-MacCumber tariff act. The additional duty was levied in response to a petition filed by the American Nitrogen Products Company of Seattle, Washington. (Detroit Free Press, 22 Apr 1921, Page 18)

In June it is reported that the measures were effective and that sodium nitrite prices were increasing. (Detroit Free Press, Detroit, Michigan, 11 June 1921, p4)

#### 14. GERMAN SODIUM NITRITE APPEARS AS CURING AGENT IN THE USA - ingredients for deceit



Union Stock Yard, Chicago, USA, C 1920

Then arrived 1925 and everything seems to change as sodium nitrite became available through the Griffith Laboratories in a curing mix for the meat industry. They described Prague Salt and how they came upon the concept in official company documents as follows, "*The mid-twenties were significant to Griffith as it had been studying closely a German technique of quick-curing meats. Short on manpower and time, German meat processors began curing meats using Nitrite with salt instead of slow-acting saltpeter, potassium nitrate. This popular curing compound was known as "Prague Salt."* (Griffith Laboratories Worldwide, Inc.)

In Canada, Prague Salt was classified as food adulteration. A progress report from the Canadian department of agriculture in 1925 lists the fact that "one sample of " *Prague* " salt" was tested and it was found to contain "5.87 % of potassium *nitrite*." It calls it an adulteration. (Progress Report for the Years Canada. Dept. of Agriculture. Division of Chemistry, 1912)

In 1925 in the USA however, the fortunes of nitrite seem to change overnight. If the courts continue to find against the use of an ingredient in food that is seen as a food adulteration, the easiest way to solve the problem is to change the law.

In Oct 1925 the American Bureau of Animal Industries legalised the use of sodium nitrite as a curing agent for meat.

In December of the same year (1925) the *Institute of American Meat Packers, created by the large packing plants in Chicago, published the document. The use of sodium Nitrite in Curing Meats.*

A key player suddenly emerge onto the scene in the Griffith Laboratories, based in Chicago and very closely associated with the powerful meat packing industry. In that same year (1925) Hall was appointed as chief chemist by the Griffith Laboratories and Griffith started to import a mechanically mixed salt from Germany consisting of sodium nitrate, sodium nitrite and sodium chloride, which they called "**Prague Salt.**"

Probably the biggest of the powerful meat packers was the company created by Phil Armour. More than any other company in that time, Armour's reach was global. It was said that Phil had an eye on developments in every part of the globe. (The Saint Paul Daily Globe, 10 May 1896, p2) He passed away in 1901 (The Weekly Gazette, 9 Jan 1901), but the business empire and network that he created must have endured long enough to have been aware of developments in Prague in the 1910's and early 20's.

Could one of the offers of employment that Ladislav received before 1926 have been from Armour or one of the other meat packers in Chicago?

Griffith Laboratories is formed in the year following the armistice in 1919. This is the same year when the United Kingdom starts selling its sodium nitrite stockpile. Two years later, even cheaper German and Norwegian sodium nitrite start arriving in the USA. In response to this, import duties are levied against German sodium nitrite.

By April 1921, the import duties have been bolstered by a blanket embargo on importing sodium nitrite, except where a special permit is granted. In 1924, the tariffs on sodium nitrite is increased by 50% to the maximum allowed level permitted under the law. By this time, the use of sodium nitrite in curing brines were in all likelihood the norm in Chicago and the 50% increase would have impacted on the bottom line of these companies.

Is it possible that by calling it the curing mix from Germany, Prague Salt, did Griffith sidestep the import tariff and the required permit for importing sodium nitrite completely? My thesis is that it is entirely possible. Even probable. It may have misrepresented the content in Prague Powder (mislabeling) as well as misrepresenting the country of origin.

When Phil Armour passed away, his personal fortune was estimated at \$50 000 000. This is almost \$1,500,000,000 in 2016. So powerful were the packing companies that US anti-trust legislation was created to break these companies up. The point is that big money was at stake and big influence on parts of the American government.

## **15. CONCLUSION**

Is it possible that Prague Salt is no more than clever name given to a curing brine? Taking the full weight of the historical context of events in Prague, Germany and the USA into account in the 1910's and 1920's; particularly the severe measures to keep German sodium nitrite out of the USA, with the last blow being dealt, in 1924; understanding the extreme pressure on the packing houses to deliver huge volumes of bacon faster, I seriously doubt it.

The issue is not so much that nitrite was a controversial chemical. This only helped to drive its use underground. The main issue was that German sodium nitrite was not welcome in the USA and the US plants were nowhere near the level of the German plants in efficiency and low cost product output.

It seems that the name, Prague Salt, was crafted to misrepresent the country of origin and possibly its real composition. Importing salt was no problem. There is a possibility, of course, based on the popularity of salt from Bohemia, and the fact that we know it was widely exported, including to Germany, that the original mix done in Germany, could even have been done with actual salt from Prague with German sodium nitrites added.

Whether this was so or not, the name had enough of a basis in reality in Ladislav Nachtmullner, Praganda and the famous salts from Prague to get it past the customs officers at the American harbours and into the meat packing plants of Chicago and later, around the world.

The fact that it was tested in Canada and found to contain nitrite shows that this was not something that was declared at borders, at least in one of the event of the import into Canada and even though this does not prove that it was done in the US also, it at least build the case for the theory that it was imported into the US without a disclosure of its nitrite content at the borders.

Prof. Julius Hortvet, in his address in Pittsburgh, had these prophetic concluding remark about the future of science in the food industry. He said that "...it is imperative that the use of colouring matter should be kept under intelligent control. Regulations of the food industries will in future depend more than ever before on the results of scientific investigations, and the laboratory will become the dominant factor in the shaping of food standards and food laws." (American Food Journal; 1907)

The legal status of nitrites as food additive was clarified in 1925 through proper legislation, based on Prof. Hortvet's principal of "intelligent control" when science decided the matter and it was taken out of the hands of "the court of popular opinion." However, the involvement of the packing plants and Griffith in everything that happened in 1925 raises suspicion of collusion with the US government.

The real hero in the story is the master butcher from Prague who through practical application and the exact scientific inquiry that Prof Hortvet spoke about, developed the first commercially successful curing mix, Praganda. Unknowingly, he became the central figure in the saga about the naming of Prague Powder and the worldwide phenomena of the direct addition of nitrites to curing brines.

Finally, there is the Griffith Laboratories. It seems as if how Prague Salt came into the USA was possibly not above board. They did however became central around the world in making the direct addition of sodium nitrite through Prague Salt and later, Prague Powder a worldwide phenomenon.

Understanding this grand story, helps us to understand ourselves and the technology we use and to apply our trade with greater skill through knowledge. Much gratitude must be shown to these legendary companies and individuals.

## 16. Notes:

### 1. The colour changes in meat.

The meat colour generally "changes" (either red, purple or brown), based on how many electrons are spinning around the iron atom which is part of myoglobin. Nitric oxide stabilizes or fixes the myoglobin colour through a reversible chemical bond. It does not colour the meat. (Pegg, B. R. and Shahidi, F.; 2000: 23 - 45) This is an important point to remember because, in the consideration of the use of nitrite in meat, nitrite can not be viewed as a meat colourant.

### 2. Rate of reaction.

The reaction of nitrite in meat is slow, in part due to the very small quantity used in the curing brine. The rate of reaction, as always, depends on the concentration of the reactants, the pH and temperature.

### 3. Nitrosating species from nitrous acid.

"The first step in the reaction sequence beginning with nitrous acid is the generation of either a nitrosating species or the neutral radical nitric oxide (NO)." (Sebranek, J. and Fox, J. B. Jr., 1985)

The following list gives the relative reactivities of various nitrosating species, species 1 being the strongest and species 5 being the weakest.

#### **Species 1:**



Source: "From smoke which has many other phenolic compounds"

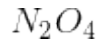
#### **Species 2:**

*NOCl*



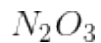
Source: From curing salt

**Species 3:**



Source: Found in the air.

**Species 4:**



Source: Nitrous acid anhydride

**Species 5:**

Nitrose derivatives of citrate, acetate, sulphate, phosphate.

Sources: Cure ingredients, weakly reactive under certain conditions.

I excluded those found under very acidic conditions. (Comparison by Sebranek, J. and Fox, J. B. Jn.. 1985)

4. The term "nitrite"

"The term nitrite is used generically to denote both the anion,  $NO_2^-$ , and the neutral nitrous acid  $HNO_2$ , but it is the latter which forms nitrosating compounds." (Comparison by Sebranek, J. and Fox, J. B. Jn.. 1985)

5. Reducing agents in the meat system.

One such mechanism for the conversion of "nitrite to nitric oxide in meat is by oxidation of myoglobin to metmyoglobin (brown coloured meat;  $Fe^{3+}$ ). This oxidation-reduction coupling produces both nitric oxide and metmyoglobin. It has been suggested by Kim et al. (2006) that metmyoglobin can be converted back to deoxymyoglobin through metmyoglobin reducing activity (MRA), a reaction facilitated by lactate. It is the enzyme activity of LDH that helps convert lactate to pyruvate and produce more NADH.

Hendgen-Cotta et al. (2008) suggested that deoxymyoglobin can convert nitrite to nitric oxide and the generation of more deoxymyoglobin is likely to result in more nitric oxide (NO) from nitrite and less residual nitrite." (McClure, B. N.; 2009: 28)

#### 6. Sugar as reducing agent.

"Sugars itself does not reduce dinitrogen trioxide in the way that ascorbate or erythorbate does, but it contributes to "maintaining acid and reducing conditions favorable" for the formation of nitric oxide." (Kraybill, H. R.. 2009)"Under certain conditions reducing sugars are more effective than nonreducing sugars, but this difference is not due to the reducing sugar itself. The exact mechanism of the action of the sugars is not known. It may be dependent upon their utilization by microorganisms or the enzymatic systems of the meat tissues." (Kraybill, H. R.. 2009)

#### 7. Ascorbate or erythorbate supplements sugar.

An excellent reducing agent was discovered in the 1920's when ascorbate was isolated. As early as 1927, two German chemists, J. Tillmans and P. Hirsch (1927) observed that there is a correlation between the reducing capacity of animal tissue and their vitamin C content. ([Concerning the Discovery of Ascorbate](#)) . It reacts so aggressively (effectively) with nitrite, that a less effective, but more manageable cousin (an isomer of ascorbate), erythorbate turned out to be the most practical to use in curing brines along with nitrite and salt.

Ascorbate (vitamin C) reacts so aggressively (effectively) with nitrite, that a less effective, but more manageable cousin (an isomer of ascorbate), erythorbate turned out to be the most practical to use in curing brines along with nitrite and salt.

The old curing brines of the 1800's consisting of saltpeter (nitrate), sugar (create reducing conditions) (6) and salt are, therefore, equivalent to the current curing brines of nitrite (being added directly), erythorbate (reducing agent) and salt. The same general functionality at vastly reduced curing time.

Today, nitrate is still being added to many curing brines as a reservoir for future nitrite as bacteria continues to change nitrate into nitrite. This bolsters the residual nitrite levels in cured meat which is important since it was found that nitrite has a unique anti-

microbial function in cured meat, in addition to its function of fixing the cured colour and contributing to the cured taste. It is unique in the sense that it is the most effective chemical control against a highly lethal pathogen, clostridium botulinum. ([Concerning Nitrate and Nitrite's antimicrobial efficacy – chronology of scientific inquiry](#))

Table salt remains the most important curing agent, but salt alone will not give the cured colour or taste and will not, on its own, be effective against clostridium botulinum. Sugar is still being used in many brines today, mostly to enrich the taste profile and to create browning during frying, especially in bacon. Its contribution to reducing conditions is now secondary and since the addition of ascorbate or erythorbate. Saltpeter has been replaced by sodium nitrite.

#### 8. Nitrite as medicine.

"The organic nitrite, amyl of nitrite, was initially used as a therapeutic agent in the treatment of angina pectoris in 1867, but was replaced over a decade later by the organic nitrate, nitroglycerin (NTG), due to the ease of administration and longer duration of action."

#### 9. Azo dye and textile colouring in 1895.

##### "Dyeing with Diazotised Dyestuffs

All the diazotised dyestuffs belong to the substantive group, and therefore, all that has been said with regard to these dyestuffs and their manner of application applies to the former also. In the majority of instances, however, the dyeings obtained direct are not sufficiently fast to be usable in that condition. Nevertheless, they can be converted into fast dyeings – provided the dyestuff contains free amino groups – by diazotising, followed by developing or coupling. The chemical reactions and method of procedure are just the same as in the case of cotton.

In practice, the diazotising is effected in the following manner : –

The dyed and rinsed silk is entered at once into the cold diazotising bath and is worked about constantly for fifteen to thirty minutes. For each 100 parts of silk, the bath contains 3 parts of sodium nitrite dissolved in 1500-2000 parts of cold water, 8-10

parts of crude hydrochloric acid (20° Be.) being added. The operation must be conducted in wooden vats, metal vessels or fittings (lead excepted) being unsuitable. At one time, ice was used for cooling during the process, but this has been given up in favour of water at ordinary temperature, and in some cases, e. g. diazo indigo blue, the bath may be allowed to rise to 20-30° C. As a rule, the diazotisation will be complete in fifteen minutes, though some dyestuffs take longer and have to be left in the nitrite bath for half an hour. The goods are centrifuged or squeezed, contact with metal being avoided. A lead-lined hydro-extractor may be used, or else the goods must be wrapped in packing-cloth.

The intermediate diazo compound formed on the fibre is very unstable and sensitive to light, especially direct sunlight. The operation must, therefore be carried on in a shady room, and care be taken to prevent any part of the diazotised goods from getting dry, or streaks and spots will be formed in the coupling stage. The diazotised material is rinsed and then immediately entered in the developing bath. The nitrite baths will keep for a considerable time, and can be freshened up for use by the addition of one-third the original amounts of nitrite and acid. During the whole process the bath should smell strongly of nitrous acid. In the case of light shades the bath may be weaker in nitrite and acid." (Ganswindt, A; 1895: 98, 99)

#### 10. The Professional Career of Ladic

After his apprenticeship he worked in several factories in Praha (Kracik, Beranek, Ugge-Sitanc and Miskovsky) as an assistant. His first work as a specialist in his field was with A. Chmel, Fr. Hlousek in Praha, Fr. Strnad in Lazne Luhacovice, and later in Germany, at the factories of Josef Sereida, Fr. Seidl, Zemka and Leopold Fisher in Berlin.

He worked as a "cellar man" at Josef Cifka, Vaclav Miskovsky in Praha, Kat. Rabus & Son in Zagreb, Jugoslavia,

Later he worked as a Foreman (Workman Leader) for the companies, Fr. Maly, Vacl. Havrda, A. Kadlec in Praha and Alexander Brero, Hard a/Bodensee Vorarlbersko and, in the end, he worked as a "Quick Production Specialist" for the export of hams for Carl Jorn A.-., Hamburg, Germany, Herrmann Spier, Elberfeld, Westfalso, Karl Frank, Urach b/Stuttgart, Wurttemberg, A. Brero & Co, St. Margrethen, Switzerland.

#### 11. The secret 1905 curing test with sodium nitrite.

Upon inquiry, the author of the article who mentioned it explained that the article was not intended for wide circulation and it lacks verification of the source. I, therefore, do not cite the reference, but I want to mention it. Circumstantial evidence makes such a test in 1905 very likely plus, the date was probably not conceived out of thin air.

I mention it for several reasons. Firstly, circumstantial evidence makes such a test in 1905 very likely plus, the date was probably not conceived out of thin air. Secondly, the fact that the reference can not be verified fits the image of the meat curing industry at that time as a secretive fraternity, especially in light of the enormous amounts of money at stake on the one hand and on the other, both the public and governments negative perceptions about chemical preservatives generally and nitrite in particular at this time. Verifiable references from this time are almost completely missing from historical records and conclusions are left, in large part, to inference. Thirdly, I mention the 1905 US test because the person who wrote the article is a well-known and highly respected figure in the modern, international meat curing industry. If anything, I trust his instincts that there is enough to the date for him to have mentioned it in an article.

#### 12. Prof. Mościcki

"As a young student of chemistry in St. Petersburg, Russia, Mościcki was an active socialist. Later, back in Poland, he participated in a failed attempt on the life of the tsarist governor of Warsaw. In 1892, he was threatened with arrest and escaped to London where he met Józef Piłsudski, who was to become one of the most important people in Polish history. In 1920, Marshal Piłsudski led the forces that defeated the Soviet army at the Battle of Warsaw. This and subsequent battlefield successes led to Poland's victory in the Polish/Soviet war and saved weakened by WWI Europe from the threat of Soviet conquest. After Piłsudski engineered a coup d'état in Poland, Ignacy Mościcki was asked to become the president. He gave up his academic positions and served as president of the Republic from 1926 until the outbreak of the WWII in 1939. Among his other titles, Mościcki is known as the father of the chemical industry in Poland. A town in southern Poland (Mościce) is named after him. And one of his many patent applications was studied by a young technical expert, Albert Einstein, in Bern, Switzerland." (Zofia Gołąb-Meyer Marian. 2006)

## 17. References

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Images



Image 1: Old Prague: Old Prague Logansport Pharos Tribune Sat Oct 19, 1895

Image 2: Ladislav Nachmüllner from Ladislav Nachmüllner vulgo Praganda Nachmüllnerová, Eva. OSSIS, 2000.

Image 3: Ladislav Nachmüllner from Ladislav Nachmüllner vulgo Praganda Nachmüllnerová, Eva. OSSIS, 2000.

Image 4: Sodium nitrite, photos by Prof Duchon.

Image 5: Germany. <http://theintersectionist.com/wp-content/uploads/2012/05/austerity-for-middle-class-meat-market.jpg>

Image 6 and 7: Notice of sale by UK government: The Times, 1 May 1919, Thu, Page 18

Image 8: Union Stock Yard, Chicago. The Modern Packing House. 1905, 1921. Nickerson & Collins.