Sodium: too much or too little?

The salt content of processed food is another front in the fight for healthy food

Common salt is one of the most important ingredients in food and an essential nutrient for the human body. Nowadays diets are mostly processed food oriented are thus often a source of an increased consumption of salt with an unfavourable influence to the human health. There are basically three options to reduce the sodium intake connected with the consumption of salt.

By Henk Hoogenkamp

Not processed meat, but bread is the biggest contributor of salt in the American diet. Bread contributes to 7.4% of the average dietary sodium intake, followed by meat products (5.1%) and pizza (4.9%). Salt – and thus sodium – plays a vital role in food preservation, and is a great tool to manipulate or influence consumer taste preferences.

Salt is an important nutrient for the human body. Sodium, potassium and calcium salts are essential for all nerve cell activity, for muscle movement, and for osmotic balance of the body fluids. Over the last 8000 years, since the beginning of agriculture and farming, salt consumption has remained relatively stable. However, over the last some 50 years, use of salt has skyrocketed mainly caused by significantly increased consumption of processed foods and meats. On a molecular weight basis, sodium chloride is 39.34% sodium and 60.66% chloride. The Food and Drug Administration (FDA) standards allow regular table salt to contain up to 2% additives such as anti-caking agents and processing aids.

Convenience motivated consumers want fresh flavour while at the same time demanding all-natural ingredient labels. Time tested additives and ingredients such as salt, phosphate and nitrite are now often challenged and removed from the formula. Yet, the removal of these components might have unwanted side effects such as the increased risk of oxidative rancidity that leads to off-flavour development and unattractive discolorisation.

In most developed countries, salt intake has sharply risen to 150 mmol (= 3600 mg of sodium) per day or some 9 g. This is about double what the body needs to sustain optimal health. American men between the ages 30 and 39 are by far the highest consumers of sodium, ingesting an average of about 4500 mg per day. Processed food, including meat products are the primary source of salt overconsumption, hidden in pizza, salad dressings, deli-meat, formulated hamburgers and chicken foods.

To salt or not to salt

Salt content is another front in the healthy food fight. Of course, it's not the saltshaker but processed foods that are the source of most of the dietary salt consumed on a daily basis. An estimated 70% of total dietary sodium chloride (NaCl) intake comes from processed foods, such as canned soups, bread, snack foods, deli meats, cheese and condiments.

It seemed that for years marketing low-sodium foods was a thing of the past, but suddenly low-sodium and reduced-sodium foods have re-appeared in the limelight. Part of that change is due to the Center for Disease Control and Prevention (CDC) and the Institute of Medicine, which together with proactive food companies have weighed in on the urgent need for sodium reduction.

Part of the problem is that salt provides important benefits for processed food manufacturers and meat processors. Salt is a cheap ingredient and ideally suitable to extend shelf life. It also enhances flavour, improves texture and serves as an ideal masking agent for bitterness.

Salt or sodium chloride reduction will not be an easy task to accomplish. For starters, virtually every replacement option is markedly more costly. Furthermore, many people would say no when asked if salt reduction or elimination means switching to an alternative synthetic or chemical additive.

Frequent consumption of fast food rich in hidden salt and fat – burgers, lunchmeats, salad dressings, and pizza – can play havoc on people’s well-intended attempts to reduce salt intake. However, the CDC recommends that some two-thirds of adult consumers should limit sodium intake to no more than 1,500 mg a day – specifically, people over 40 years old, people with high blood pressure and African-Americans. (Baseline analyses of dietary intake consistently show that sodium consumption is positively associated with high caloric intake, male gender, fast food consumption and low socioeconomic status). Meanwhile, the average American per capita sodium intake is more than 3,400 mg a day. That is alarmingly high and needs to be ad-
dressed with real urgency. It is unrealistic, however, to expect the food industry to lower the sodium content in food products overnight. Aside from the fact that consumers are accustomed to a certain flavor profile, many technical hurdles to removing salt from food formulations are still unsolved. For healthy people a consumption of six grams of salt—the equivalent of 2,400 mg of sodium per person per day—is an attainable goal. Perhaps, salt intake can eventually be further reduced to 2,000 mg a day.

Promoting a lower salt intake suits very well with up-to-date lifestyle foods as long as these are formulated for segmented markets. Salt might have a somewhat negative perception, though if a product contains the wording “sea salt”, consumers have a very favourable opinion. Increasing numbers of consumers are using sea salt at home and many new products containing sea salt are steadily being introduced, according to the Innova database.

It is valid to ask if processed meat products fit the parameters of lifestyle foods, and the answer is a resounding, “yes”. Not only are meat products a universal favourite in nearly all cultures, but meat is also a centre-of-the-plate food that is versatile, wholesome and a source of high-quality protein and minerals, like iron and zinc, the former being essential for pubescent girls. One of new dietary guidelines is that people who are 51 and older reduce daily sodium intake to less than 1,500 mg – far less than the current average of American consumers. These lower recommendations also apply to those of any age who are African-American or have high blood pressure or (pre) diabetes. For the general public, a target sodium intake of 2,300 mg is recommended.

There is a strong correlation between salt intake and blood pressure. In nearly all cases, a low sodium diet shows an almost immediate decline in blood pressure. Salt is thought to be a contributor to high blood pressure, which has been linked to higher risk of heart attack, brain hemorrhages or stroke—the leading causes of preventable death.

There is a genetic disposition to develop hypertension. High salt intake, high calorie foods, lack of physical activity, and alcohol consumption all play an important and decisive role in the increase in hypertension.

The risk of hypertension increases with age. It is estimated that one out of two people over the age of sixty suffers from high blood pressure. If the blood pressure of a resting person is 140/90 mmHg – or higher on two different occasions this then can be classified as hypertension. The first number represents the systolic pressure, or the blood that is pumped into the body (140 mmHg), and a diastolic pressure, the blood that is pumped back into the heart (90 mmHg). If hypertension is not treated, it can have serious conditions.

### Renaissance deja-vu

The importance of minerals in the daily diet is enjoying a renaissance with a twist: This time there is more than just anecdotal evidence and strong scientific confirmation has given new impetus to the important role of potassium. It is also true that while in the last few decades people have increasingly overconsumed sodium, they have underconsumed potassium. The scientific data supported by EFSA and FDA support this mineral to maintain normal blood pressure as well as to maintain normal muscular and neurological functions in the body.

Contrary to sodium consumption, potassium intake via dietary intake needs boosting. Dietary potassium can lower blood pressure by blunting the adverse effects of sodium on blood pressure. Besides these important functions, potassium nutrients are also associated with reducing bone loss and adhering the risk of developing kidney stones. It can then be expected that the nutraceutical food industry will develop special fortification foods containing tripotassium citrate and potassium gluconate to boost diet absorption of this important natural mineral.

### Hidden in ingredients

The “hidden” places of salt in a diet are cereals, breads, fast food, and canned foods. In the U.S., pizza is the number one source of sodium for teenagers while it is estimated that 70 – 80% of sodium in a typical American diet comes from processed foods and not from the saltshaker.

Moreover, ingredients like soy protein isolate contain relatively high sodium levels. There is nothing wrong about that, but hidden sources should be also considered when reducing sodium levels in foods. Come to think about it; for accurate information on a food label this ingredient should be disclosed as “sodium soy protein isolate”, pretty much the same as the milk protein equivalent “sodium
caseinate” is disclosed. After all, why make a distinction between proteins that serve a similar purpose?

It is especially important to know that if teenagers reduce their often excessive intake of sodium – over 3,800 mg a day and well over the 2,300 mg/day maximum limit – the risk of cardiovascular disease in adulthood can be significantly reduced. Hence, teenagers could have measurable benefits by the time they reach 50, including reduction of heart attacks, coronary disease, stroke, and hypertension.

It is safe to predict that government and health agencies will mandate sodium reductions in processed food and meat products in the coming years. However, a mandate is easier said than done. For starters, salt and taste preferences are intimately associated and consumers might move away if taste is compromised. Then, salt is also essential for human health and development, particularly for regulating the body’s electrolyte balance, preventing dehydration and maintaining cellular functions. Still, people in the Western world consume much more salt than the recommended 2,300 mg sodium a day for the general population and 1,500 mg per day for those on salt-restricted diets. Switching nutrient-poor high calorie foods for nutrient-rich lower calorie foods will be essential to rebalance the American diet. Besides reducing portion sizes and (hidden) sodium content in foods, subtle changes need to be made such as increasing potassium to counterbalance some of sodium’s effect on blood pressure. Americans generally have inadequate potassium intake in relation to high sodium intake levels.

**Side-stepping phosphate**

It is also expected that phosphate additives used for meat and food manufacturing will regain new discussions. Of course, in Germany the use of phosphates in processed meat products is strictly regulated and even forbidden in most meat products. In most other countries, the use of phosphates is regulated to inclusion levels up to 0.5%. Elevated serum phosphate concentrations are possibly correlated with mortality in people with chronic renal failure which exposes organ calcification, while high levels of phos-
An example for a sodium controlled meat product is this honey ham. Its label states a 25% lower sodium content than USDA data for this product.


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**Sodium**

**and packaging.** Although research is still in the early stage, there is growing evidence that umami flavours can boost the perception of saltiness. Umami is one of the five basic tastes known to be detectable by humans along with salty, bitter, sweet and sour. Umami often is described as savoury and hearty flavour. By reducing sodium, the void can be filled by increasing certain herbs and spices. Beyond flavour, replacing salt entails challenges such as food preservation and texture.

The use of optimised salt such as flake salt is another possibility. Flake salt crystals generally have a larger surface area that might be beneficial especially when speeding up interaction processing time.

Finally, the use of potassium chloride and partially sea salt can be considered as a successful salt (sodium) replacement. The use of potassium chloride has been known and researched for a great many years. Both Professor Robert E. Rust and Dr. Dennis Olson pioneered the use of potassium chloride in emulsified meats at Iowa State University Meat Research Laboratories during the mid 1980’s. Both processors and suppliers agree that the use of potassium chloride is by far the best way to mimic sodium chloride reduction, which allows some 50% substitution. It should be taken into consideration, however, that potassium chloride can negatively influence taste by creating bitter notes and “metallic” tastes. This usually requires the necessity of masking with flavour enhancers such as hydrolysed proteins, yeast extracts, sugars and spices.

Nevertheless, the current increase in diet-related diseases requires a repositioning of fat and sodium content in sausage and processed meats, which already contain elevated levels of saturated fat and sodium. Unfortunately, both fat and sodium are closely intertwined with important sensory properties and functional benefits. Salt and sausage are intimately linked, and the extraction and solubilisation of myofibrillar proteins is achieved by sodium chloride. Reducing sodium levels may negatively impact emulsion stability and texture, as well as sensory quality. When lean sausage meat is emulsified, extreme care should be given to avoid an overdose on sodium chloride which could cause water to be drained from the meat muscle fibres, instead of solubilising the protein.

Replacing common salt with alternative ingredients, such as potassium chloride, monosodium glutamate (MSG) or hydrolysed vegetable protein (soy sauce) is not only much more expensive but also has inherent drawbacks. Ingredient suppliers are developing multi-layered formulations and exploring the use of pseudo-sodium alternatives to help food formulators enhance salt perception.

As a general rule, most sausage formulations specify for every 100 kg of raw meat emulsion 2 kg of salt and 1 kg of sugar. In Europe these levels are somewhat lower and are typically 1.6 kg of salt and 0.5 kg of sugar. The exception of this is Scandinavia where typically higher amount of carbohydrates (skim milk powder) is used in frankfurter-type sausage.

These levels, however, provide a good starting point when re-formulation projects require lower sodium levels. In this respect, it should also be noted that functional ingredients like soy protein usually have hidden levels of sodium. These undeclared levels should be factored in and become part of the total salt analysis.

**Sodium solutions**

A solution is not so simple to find. Salt is the best friend of meat processors and consumers alike. For meat processors, salt offers yield, product stability, and antimicrobial and spoilage reduction, shelf-life extension, while consumers prefer the flavour sensations of salt. Salt also blocks the growth of botulism-causing bacteria and prevent premature spoilage.

There are a number of methods to reduce and or replace sodium. It is important, however, to implement a strategy to gradually reduce sodium levels in food and meat products to allow consumers to adjust their palates over time. There are basically three options to reduce sodium levels:

- **Straight salt reduction**
- **Use of optimised salts**
- **Replace with salt substitute**

**Straight salt reduction** can be achieved to a certain point and by using other ingredient hurdles like lactate and diacetates, as well as by considering new process systems such as high-pressure processing time. For starters, it is necessary to distinguish between natural (organic) phosphate and chemically-derived phosphates. Natural or organic phosphates are found mainly in protein-rich foods such as meat, fish, eggs and dairy. These natural occurring phosphates are slowly broken down in the gastrointestinal tract and subsequently slowly resorbed from the intestines. In a typical diet, about 50% of these organic phosphate esters are resorbed this way.

In contradiction to organic phosphate, industrially processed food contain much higher levels of added (poly)phosphate in order to obtain certain product modulations and or cost advantages. For example, chemically-derived phosphates are used as preservatives, yield manipulating agents, acidity buffers, emulsifying support as well to intensify flavour and reduce warmed-over-flavour in cooked meat products. Phosphates are also frequently used as “melting salt” in soft or processed cheese spreads, not to mention its use in soda’s and dry-blended powdered beverages.

Regulatory speaking, on a worldwide basis, and specifically for processed meat applications, phosphate is the most universal and frequently used additive in nearly all categories: emulsified, coarse, enhanced and whole muscle meat products. All these combined industrial uses have doubled the average daily intake since 1990s: from just under 500 mg/day to 1,000 mg/day. Perhaps time has come for the collective food and meat industry, to label the presence of added phosphate not only qualitative but also quantitative.

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