Salt – sodium reduction in food – possibilities and concepts

Salt chloride or cooking salt (NaCl) is an all-purpose foodstuff and its usage for seasoning and preservation of food can be traced back to the earliest of the ancient civilizations. In those times preservation played a particularly important role. Salt preserves food by inhibiting the growth of bacteria through osmotic deprivation of water. In addition, salt has essentially important sensory functions. Excessive consumption, however, may lead to high blood pressure.

Physiological function
Depending on age and gender, about 40 to 80 percent of the human body consists of water. Sodium ions are essential for the osmo-regulation of the human body. Aside from HCO₃⁻, Na⁺ and Cl⁻ are the most common ions within the extracellular liquid and significantly determine its volume and the osmotic balance.

The water and ion balance of the body is maintained by the kidneys’ removing water and ions from the blood and returning them selectively. Thus the function of the kidneys has a direct influence on the regulation of blood pressure. The impact of Na⁺ on the blood pressure is described in detail in literature and is undisputed among experts1-4, 7-9.

Sensory function
The exact flavour-imparting mechanism of salt is still disputed in literature. It is clear, however, that NaCl has the commonly known purely salty taste while other cations (K⁺, Mg⁺) disturb the sensory impression for example by bitter qualities.

The salty taste can both intensify and impede the taste of other components since the individual flavours of food interact intensively.
Salt for example intensifies umami which is a hearty taste and confines sweet. This makes it an important ingredient in both spicy and sweet foods. A bitter taste is confined by salty which may turn the reduction of salt in foods into a sensible undertaking.

Technological functions
In meat and sausage, salt controls the water content and influences also the consistency via the protein structure. It increases the bonding capacity of meat which, for example, is important in the production of sausages or hamburgers and other products with ground meat.

In the production of hard and soft cheese, salt influences the maturing and the microbial growth. By its influence on the protein structure salt also has an important impact on the consistency of cheese.

In fermented vegetable products such as for example sauerkraut or pickled gherkins, salt also influences the fermentation process. Aside of that, however, it also keeps the “crisp” consistency of the vegetables by rapidly extracting large quantities of water from the plant matter.
Many breakfast cereals contain salt as a flavour enhancer even if it does not obtrude with regard to taste.

In bread and baked goods, salt is also an universal ingredient which – aside from giving the taste – has an influence on the growth of the yeast and the gluten properties of the dough and the consistency of the final product.

In many thermally preserved products, salt supports the microbiotic stability over many years. Proverbial in this context has become the term spam: It originally was very strongly salted meat in cans.

<table>
<thead>
<tr>
<th>Results of in-house baking tests with Dr. Paul Lohmann Salt Substitute</th>
<th>Standard (NaCl)</th>
<th>Premix Salt substitute (50% Na red.)</th>
<th>50% NaCl / 50% salt subst. (25% Na red.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baking yield/ Spec.vol. (ml/100g)</td>
<td>302</td>
<td>353</td>
<td>350</td>
</tr>
<tr>
<td>Crust</td>
<td>Typically light/brown; medium hard</td>
<td>Darker / harder than standard</td>
<td>Typically light/brown; medium hard</td>
</tr>
<tr>
<td>Taste / aroma</td>
<td>Typical</td>
<td>A little less salty; acceptable</td>
<td>Almost typical</td>
</tr>
<tr>
<td>Crumb /elasticity</td>
<td>Very good</td>
<td>Very good</td>
<td>Very good</td>
</tr>
<tr>
<td>Pore structure</td>
<td>Consistently fine to medium pores</td>
<td>Almost consistent pores</td>
<td>Consistently fine to medium pores</td>
</tr>
<tr>
<td>Mouthfeel</td>
<td>Typically soft; good taste</td>
<td>Typically soft; good taste</td>
<td>Typically soft; good taste</td>
</tr>
</tbody>
</table>
Functional beverages contain a defined quantity of salt to control the osmotic properties and, with sports and isotonic drinks, to remineralize the body.

Sodium reduction – restriction of salt consumption
With both adults1-3 and children and adolescents4 the connection between salt consumption and blood pressure has been investigated and identified. Both national5,6 and international7 health authorities consider the presently consumed daily quantity of salt in many countries of the world too high and recommend to reduce the quantity of salt to six grams per day8,9,10. This corresponds to a quantity of 2,400 mg sodium per day.

The reduction of salt in food may among other things be achieved via a gradual decrease of the salt quantity (“reduction by stealth”). Although individual producers could save up to 33% of the originally used salt this way, there is, however, a risk that the trait of a food is lost and it thus becomes unattractive to consumers. A pure reduction of salt, however, does not only hold the risk of loss of taste but may furthermore reduce the shelf life of food.

Sodium reduction – substitution of salt with other substances
Another possible approach is to substitute cooking salt with other ingredients such as spices or other strongly aromatic ingredients. Substances like amino acids, glycine or glutamate can intensify a salty or umami taste and thus compensate sensory losses to a limited extent. Another way of substituting cooking salt is the use of other mineral salts. In particular potassium chloride is being used here which substitutes up to 50% of the sodium. However, potassium chloride has a distinctly bitter taste. Since the sensory sensitiveness towards bitter may be very strong for genetic reasons, the usage of KCl in sodium reduction is clearly restricted. The same applies to calcium chloride or various salts of magnesium. In addition, the latter also have a laxative effect which forbids intensive use.

Furthermore, at present possibilities are investigated to achieve a higher saltiness via special emulsion techniques of saline solutions or by manipulating physical parameters. However, development is still in a beginning state and the applications are likely to be limited here, too.

Taste decides
In his wide range of products, Dr. Paul Lohmann has an interesting choice of salty-tasting mineral salts that can be combined for various applications. The Premix Salt Substitute is a completely mineral mixture of various salts. The mixture contains 20% of sodium which represents a reduction of the sodium content of 50% compared with usual cooking salt (40% Na+). The decisive factor for the consumer’s acceptance of a salt substitute is its taste profile. The Premix Salt Substitute tastes familiarly salty with regard to both flavour and intensity. A careful selection of ingredients prevents an acerb taste. The individual components are generally approved as food and food additives and unproblematic as far as declaration is concerned. Dr. Paul Lohmann’s salt substitute does not contain glutamate or any other flavor enhancers like amino acids. Thus allergic reactions are extraordinarily unlikely.

Already successfully in use
In particular in the production of sodium-reduced pastries, the Lohmann salt substitute is already successfully applied in practice. Further possible application areas are sausage and meat products, fish products, salty snacks and breadsticks, cheese and dairy products as well as the usage in ready-made meals, in gastronomy, in condiments or for direct consumption out of the salt shaker at table.

Dr. Paul Lohmann is in a position to develop customer-specific solutions for special applications such as completely sodium-free salt mixtures or special mixtures with magnesium. The following potassium and magnesium salts are approved for use in food within the EU10,11:

- Potassium Citrate
- Potassium Bicarbonate
- Potassium Phosphate
- Potassium Chloride
- Magnesium Sulfate
- Magnesium Chloride

This makes a declaration of these substances unproblematic. With regard to the declaration of individual components contained in mixtures, Dr. Paul Lohmann offers adequate and competent advice.

References