

# Stepping Back on Sodium

*Lowering sodium concentration can affect texture, taste and shelf life. TNO offers a stepwise approach that helps manufacturers to find tailor-made solutions.*

by Lisette de Jong

**T**he average daily sodium intake in Western countries is estimated to be about twice as high as recommended, at 10-12 grams; the World Health Organisation suggests less than 5 grams per day. Elevated sodium intake is an important risk factor for developing high blood pressure, which, in its turn, increases the risk of heart disease and stroke (WHO, 2007). The main reason for the high sodium intake is increased consumption of processed foods, such as snacks, bread, cheese, meat products and ready meals, soups and sauces.

### Health Impact

Reducing daily sodium intake would have a great positive impact on public health. Scientists from the Massachusetts Medical Society have estimated that, in the US, reducing dietary sodium by 3 grams per day would reduce the annual number of new cases of cardiovascular disease by up to 12,000. The number of stroke cases would decrease by up to 66,000, while the

number of people suffering from myocardial infarction would diminish almost 99,000. The number of deaths would go down with 44,000 to 92,000, and every segment of the population would benefit, they write in the *New England Journal of Medicine*. According to these scientists, even a modest sodium reduction of 1 gram, between 2010 and 2019, would be more cost effective than using medications to lower blood pressure in people with hypertension. Governmental organisations, therefore, do have a solid argument when

they prescribe that the industry decreases sodium concentrations in foods. The reality is that the British Food Standards Agency is aiming at a sodium reduction of 30% over the next ten years and the American Heart Association wants a 50% reduction. The Dutch Health Council, which advises the Dutch Government, recommends a 33% reduction in daily intake, from 9 to 6 grams. However, for manufacturers, reducing sodium content in foods is not so simple. "Cutting down sodium affects product texture and could



### Sodium Reduction in Bread and Bakery

A newly-patented technology, based on the principle of sensory contrast, enables up to 28% sodium reduction in bread without the use of sodium substitutes, or taste and aroma additives. The technology, developed within the public-private partnership TI Food and Nutrition, with TNO as one of the research partners, generates pulsed delivery of a salt solution, which enhances taste intensity. Bread accounts for about 25% of the sodium intake in an average diet, so the benefits of sodium reduction are obvious.

With conventional techniques, the bottleneck is that significantly lowering sodium levels strongly affects the tastiness and structure of bread, by influencing yeast activity and the physical properties of gluten. Sensory Contrast Technology eliminates this problem. This particular technology was tested in several experiments, including the assessment of the most favourable variation in salt contrast (see picture) and a volunteer study on saltiness perception involving 64 participants.



From the studies it was demonstrated that inhomogeneous distribution of salt largely enhances saltiness intensity and that the magnitude of enhancement increases with increasing contrasts. Moreover, the largest saltiness enhancement takes place at low sodium concentrations. Moreover, salt has been shown to migrate relatively slowly, facilitating the development of real-life products with sensory contrast.

The amount of sodium in bakery products could be reduced by 50% or more without loss of product quality or taste. This was demonstrated in a study conducted by TNO at the request of VBZ, a Dutch organisation representing manufacturers of bakery products and sweets. The sodium concentration in bakery products is strongly dependent on product type and additives used. For instance, if baking powder like sodium-bicarbonate or sodium pyrophosphate is used for structure, or sodium metabisulphite for dough improvement, the level of sodium rises. The TNO study focused on cake and biscuits. It is expected that similar results can be achieved with other types of bakery products.

reduce production efficiency by around 20 percent. Low-sodium meat products and bread, for instance, fall apart very easily, even during the production process", says Theo Verkleij, Meat Technologist at TNO Quality of Life. Moreover, cutting down sodium decreases shelf life and may increase the risk of food-related infections. "For instance in the UK, where sodium reduction in foods is already common, the incidence of *Listeria monocytogenes* is on the rise". Finally, there is the taste issue: many consumers perceive foods with reduced sodium levels as bland.

### Sodium Reduction Methods

A number of methods for reducing sodium content of foods are possible, including sodium replacement by substitutes, taste intensifiers, stepwise gradual sodium reduction over time, and enhancing taste perception using aroma, colour, sound and texture. Last year, a recently patented technology was added to this list, based on the principle of sensory contrast: pulsed delivery of salt solutions enhances taste intensity. It was developed within TI Food and Nutrition, a public-private partnership for precompetitive fundamental research. TNO is a partner in the project. "These methods offer a range of opportunities but do have their limitations", says Verkleij. "Using potassium as a sodium alternative only achieves a 15 to 20 percent sodium reduction. Using more potassium will create a bitter taste, whereas calcium as a sodium replacer, in phosphate-containing products like sausages, might cause sediments". The suitability of a technique largely depends on the type of product you are dealing with. "Pulsed delivery, for example, works very well in dry or semi-dry products like bread or bakery products, but is not so easy in products with high water contents, such as cooked meat", says Verkleij.

### Tailor-Made Solutions

To help food manufacturers find tailor-made solutions for their products, in 2007 TNO launched a unique stepwise, structured approach for product reformulation. "First we make sure that product texture is not affected by decreased sodium concentrations. In this stage we

determine the interaction between the proteins present in the food and a variety of salt ions that are candidates for replacing sodium", says Verkleij. In the second stage microbial product quality is dealt with. "In this step we use our model for shelf-life prediction.

Shelf life estimates are based on measurements of water activity, pH, and the presence of oxidants, antioxidants and antimicrobial compounds. We also take into account extrinsic factors, such as processing and storage temperatures, storage time, intensity of heat treatments and packaging quality", he notes. Finally, taste needs to be optimised, related to the above mentioned. This step usually takes place at the production plant of the manufacturer, together with flavour experts from TNO. "From these steps a method or combination of methods is selected that best fits a specific product under specific conditions. We also consider the public health implications of applying a particular method. For instance,

if in all processed foods sodium would be replaced with potassium, this could have a greater negative impact on public health than high sodium concentrations. High intakes of potassium could, in the long term, cause side effects with certain medicines, and health problems in kidney patients", Verkleij explains.

### Application Potential

In collaboration with Dutch manufacturers, TNO has successfully applied this approach in bread, bakery products and bacon (see boxes), and will be applied to other meat products in the near future. "Internationally, too, there is great interest in our reformulation programme. We are currently working with various international companies to help them produce healthier foods", says Verkleij. TNO's reformulation approach could be applied to fat and sugar reduction.

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### Cutting Down in Meat Products

Sodium reduction of up to 40% in bacon is feasible without affecting the taste, quality and shelf life. This was the outcome of a TNO study requested by the Dutch Product Boards for Livestock, Meat and Eggs. Based on experiments, TNO devised five brine recipes for bacon including a reference recipe. The percentages of sodium chloride (table salt), sodium nitrate and nitrate, potassium nitrate and nitrate, potassium chloride, potassium lactate and dextrose were varied in the brine. The most promising brines were used to produce bacons under normal industrial meat processing conditions. Sensory assessment by an expert panel revealed that it is technically feasible to reduce the sodium content of bacon by 40%



without adversely affecting product properties such as colour, aroma, structure and taste, compared to a reference bacon sample. Replacing 40% of the sodium (in the experiments) did not affect microbiological shelf life. Microbial quality, and therefore the level of food safety, also was maintained at original levels.

In February 2010, TNO began a collaboration project with Vaessen-Schoemaker (Deventer, the Netherlands), specialists in functional ingredient blends for meat, fish and vegetarian foods. The project's goal is to reduce sodium content in meat products by 50% without compromising taste or quality. Vaessen-Schoemaker wants to acquire in-depth knowledge for the development of products with less sodium, that taste as good, or even better, than the original. The project is part of the TNO/Ministry of Economic Affairs co-funding programme, focussed on the future knowledge demands of the food industry. In this programme, participating companies are able to develop a strategic technology position and boost their long-term competitiveness while TNO maintains its cutting-edge research position.