Technical Brief

Food Reformulation for Salt

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What is salt?

Salt (sodium chloride, NaCl) is a target for product reformulation as it is the major source of sodium (Na^+) in most people's diets (approximately 90%). Whilst sodium is an essential component of human body fluids, prolonged high dietary intake affects human health and that is the real issue. Therefore, reformulation for salt means reducing the amount of sodium, and in this context, it is important to also look beyond traditional salt and work on the remaining 10% that comes from a wide variety of sodium forms [1] of which a subset is presented in Table 1.

Table 1- Some common sodium examples and their application

Component	Function	Application
Monosodium Glutamate (MSG)	Flavour enhancer	Asian food, soups and meat
Sodium citrate	Flavouring, preservative	Soda beverages, melting cheese
Sodium cyclamate	Artificial sweetener	Baked goods, confectionary, desserts, soft drinks, preserves, salad dressings
Sodium bicarbonate (baking soda)	Raising agent	Baked goods (e.g. crackers, cakes, waffles), carbonated drinks
Sodium nitrate	Preservative, colour fixative	Cured meat (e.g. bacon, sausage, ham), poultry
Sodium polyphosphate	Protein solubilisation, texture, moisture retention	Processed meat and plant-based analogues

Where does sodium in the diet come from?

Major dietary sources are not necessarily the products with the highest salt levels per 100g, but those where the combination of salt level in the product, and its relative proportion in the diet, results in the highest contributions (see Table 2).

Table 2- The main contributors to dietary sodium intake in the UK and USA

UK	USA
Discretionary salt (added by individuals to food) 18%; sodium naturally present in food 21%; salt in processed food 61% [10]	About 65% comes from food bought at retail stores; 25% from restaurants [3]; 10% from other sources
Products (or those containing), in decreasing order [10]: cereals, meat, milk, vegetables, fish, savoury snacks, eggs, fat spreads, non-alcoholic beverages. Minor contributors (<1%): alcoholic beverages; sugar, preserves, confectionery; fruits; nuts and seeds	More than 40% of sodium comes from [3]: bread and rolls; cold cuts and cured meats (e.g. deli ham or turkey); pizza; fresh and processed poultry; soups; sandwiches and burgers; cheese; pasta dishes; meat-mixed dishes (e.g. meat loaf with tomato sauce), snacks (e.g. potato chips, pretzels, popcorn)

N.B. as different brands of the same foods may have different sodium levels, the recommendation is for consumers to check the label. Across the implemented reformulation policies in the 194 World Health Organisation (WHO) Member States, **bread and bread products** are the most targeted food category for sodium reduction; followed by **processed meat, poultry, game or fish; ready-made and convenience foods and composite dishes; savoury snacks** [6].

Why is sodium a concern for health?

Prolonged high dietary intake of sodium affects the ability of the kidneys to respond efficiently, hence excretion is impaired. Short term, a high sodium intake is associated with reversible symptoms such as thirstiness, swelling of hands and feet, and bloating. Whilst longer term, high sodium intake leads to an increase in blood pressure and subsequently increased risk of cardio-vascular disease, one of the non-communicable diseases (NCD) resulting from diet rather than infection. Both short- and long-term health consequences of high sodium intake represent an avoidable cost to society in terms of medical and infrastructure. Consequently, many National Health Agencies across the world have launched awareness campaigns and issued maximum targets for daily sodium intake, for example 6g salt /2400 mg sodium per day in the UK [4] and 2300mg sodium/day in the USA [5].

In many cases, voluntary (or even mandatory, such as South Africa) maximum sodium thresholds are set for different food categories, to be met at specific times, allowing the food industry to reformulate products, but also to allow the consumers to gradually adapt their taste palates. In the UK, the Food Standards Agency (FSA) and Public Health England (PHE) have been pioneers in this area with track records of over 20 years, pushing for sodium reduction across the food supply chain. The benefit of a set of common thresholds is that these act as a level playing field across the category.

At a global level, WHO has identified sodium reduction in the diet as a key strategy to reduce the burden of NCD:

- The largest number of diet-related deaths, estimated at 1.89 million each year, is associated with excessive intake of sodium [6]
- The global average sodium intake is estimated to be 4310mg/day (10.78g of salt per day) [6]
- The minimum sodium intake level required for physiological needs is not well established but is estimated to be <500 mg/day [12]
- WHO recommended maximum daily intake is 2000mg of sodium (equivalent to <5 g of salt) per day in adults [6].

Details of its functional role in food

Salt plays multiple functions in manufactured products and it is often difficult to separate them [7] as seen in Table 3.

Table 3- Salt functionality

Sensory attribute
Direct effect on **taste** i.e. salty
Flavour enhancing effect on other ingredients in foods
Improves **texture** in bread, breakfast cereals, pickled vegetables, some expanded products

Process/product benefit
Preservation, primarily through reducing water activity (Aw)
Impacts the **water-holding capacity** of some meat products
Maturation of cheese

Technical strategies to reduce salt in food products

Reformulating a product for salt is often a lot more complex than simply 'taking-out salt from the recipe'. Given the external pressure and the food industry's commitment to reduce salt by a given time, product reformulation often faces the challenges of: (i) maintaining consumer acceptance and product superiority and (ii) meeting the economic viability of implementing the change in the supply chain.

The first step is to understand the role(s) salt plays in the food system and to define if any of these represents a real limit to salt reduction. For example, taste is known to be adaptable over time, therefore a gradual reduction in multiple smaller steps may work. However, microbial preservation has absolute limits, whilst texture may be the result of an interaction between process conditions and sodium content in the recipe. In the latter, it is essential to build a fundamental understanding of how texture is controlled during the process and what the processing levers are that compensate for lower sodium levels. To ensure that completely new product recipes meet the external benchmarks by design, the sodium thresholds should be included in the innovation brief, and by doing so, one avoids the complexity and the additional costs associated with product reformulation. Apart from the technical challenges to achieve sodium reduction, there can also be tensions with respect to communication. Depending on the salt reduction strategy applied, positioning as 'clean label' may not be possible because of the nature of the salt replacer. Another issue is that labelling a food product as 'reduced salt' may be perceived by consumers as the 'reduced taste' version of the product they used to buy. Therefore, a 'stealth' (hidden) sodium reduction approach is often the most preferred path followed by most food manufacturers. The actual salt reformulation strategies to follow will depend on the nature of the product and usually, one or more strategies will be applied:

1. **Stepwise reduction of salt** added to the recipe: depending on the food product category, it is possible to take out 15-25% salt without further re-engineering the flavour profile of the recipe, provided the subsequent steps are spread over time (2-3 years).
2. Most likely, the reduction in sodium will require some **rebalancing of the flavour** profile using:

a) **Herbs and spices**

b) **Flavours**

c) **Salt replacers** - have been suggested but none allow for a direct replacement:

- Potassium chloride (KCl) is widely accepted but is self-limiting in the level of addition, because of a metallic after-taste at higher levels. Whilst there was initial caution around the safety of potassium salts for children with undiagnosed kidney disease, and therefore food companies adopting a 'no-potassium approach', the UK joint Scientific Advisory Committee on Nutrition - Committee on Toxicity (SACN-COT) [13] working group concluded that overall, at the population level, the potential benefits of potassium-based sodium replacers to help reduce sodium outweigh the potential risks.

- Sea or marine salts (different origins) usually have limited impact. A wide variety of natural occurring sea salts are available, each having a typical composition with various minerals, however there is still the need to check for lower amount of sodium, as still the main component.

d) **Taste enhancers**: despite some of them containing sodium (e.g. MSG, yeast extract, peptides from hydrolysed proteins), these umami flavour components enforce the taste performance of the salt present allowing for a significant net reduction.

3. Only in dry food product applications, can one consider **engineering the salt crystal physical properties** to deliver the same performance at a lower percentage. However, reducing the granular size of the salt crystals alone may improve the initial efficiency (speed) of the taste delivery but can result in reduced longevity of the delivery, thereby delivering inadequate performance.

Notes:

1. *To convert salt to sodium, **1g salt = 0.4g sodium**; to convert sodium to salt, **1g sodium = 2.5g salt**.*
2. *This summary is primarily focusing on neutralising the impacts of reformulation on taste performance, but it is key to ensure that by lowering salt, the product is still safe from a preservation perspective, and performs adequately in terms of texture and other properties.*
3. *An often misunderstood concept is that of hidden salt. 'Hidden' refers to an amount of salt that is locked-in the food matrix (e.g. precooked meals and pasta) and is not completely released during chewing in the mouth. This amount of salt is excluded from generating the 'salty' taste experience, yet it is adding to the amount of sodium that may lead to a rise in blood pressure over time.*
4. *Some more specifics on various possible strategies recommended by the food product types that were most contributing to the salt intake in peoples diet, were tabled in a review paper by L. Kloss et al. [8].*

Learnings – where are we now?

Taking the UK example of a long-standing effort to reduce sodium, there is solid evidence from Kantar data that the UK Food and Drink Federation (FDF) member products, sampled in 2022, provide **24% less salt** to the average shopping basket as compared to 8 years ago [9]. However, national surveys of urinary sodium levels (using the most reliable method of 24-hour urine collections), on a representative sample of the population carried out by the UK government, suggests that there has been **no statistically significant change in the actual population salt intake since 2008/2009** [4]. In other words, despite more than two decades of significant salt reformulation by the UK food industry, the net impact on sodium intake and associated health improvement was not statistically significant. This conclusion should help to put the focus on complementary action programmes targeting the remaining origins of salt in the diet, hardly addressed until present, such as: out-of-home eating occasions; food catering processors; scratch-cooking at home as most recipe books mention 'add salt to taste'.

The future – where do we go from here?

The ambition of improving populations' short- and longer-time health outcomes by means of a reduction of sodium in the diet, requires a significant contribution by food manufacturers as packaged foods contribute over 60% to the dietary salt intake. However, the UK sodium surveys over time, show that despite serious food industry efforts, there is little or no impact on the actual dietary sodium intake by the population, which indicates the need for complementary efforts. More and more health authorities, including WHO, PHE and the USA Food and Drug Administration (FDA) have recognised this gap and defined additional workstreams to meet the original goal [6], [4], [5]:

1. Continue lowering sodium content in manufactured food products but also in out-of-home eating occasions, catering services and in-home cooking.
2. Implementing front-of-pack labelling to help consumers select branded food products with lower sodium contents.
3. Conducting mass media campaigns to alter consumer behaviour around sodium.
4. Implementing public food procurement and service policies to reduce sodium content in food served or sold.

References

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