DOI: 10.1111/jch.13482

WILEY

COMMENTARY

Potential use of salt substitutes to reduce blood pressure

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Around the world, we are eating far more salt than we need, on average 10 g of salt per day,[1] almost double the World Health Organization (WHO) recommended maximum intake of 5 g salt per day,[2] and it is putting our health at risk.[3]

This paper outlines the potential opportunities for the use of salt substitutes as a means to complement salt reduction strategies to further reduce salt intake and at the same time increase potassium intake, in line with the WHO strategy for prevention of noncommunicable disease (NCDs). Both sodium and chloride in salt lead to the expansion of the extracellular volume, which over a period of time causes a rise in blood pressure. This increase in blood pressure then causes strokes, heart failure, and heart attacks, as well as kidney disease.[4] Salt has also been linked to stomach cancer, osteoporosis, and obesity. These conditions have a significant impact on health and represent a considerable cost to any health system.[5] Each year, 17.5 million deaths are attributable to cardiovascular disease (CVD), which accounts for an estimated 31% of deaths globally. It is estimated that 1 out of every 10 CVD deaths are attributable to salt intake of more than 5 g per day.[3]

WHO recognizes the importance of reducing salt intake as a means to reduce the global burden of NCDs and set a global target of a 30% reduction in salt intake by 2025, toward the WHO salt target 5 g/d (2000 mg sodium/d).[6] Further to this, WHO also recognizes the importance of adequate potassium intake to mitigate the negative effects of sodium on blood pressure, and the further benefits of reducing the risk of CVD, and set a target recommendation for potassium intake of 3.5 g/d (3510 mg).[7] Most populations around the world consume more than the recommended maximum level of sodium[3] and less than the recommended amount of potassium.[7] Achieving the global targets for sodium reduction and ensuring adequate potassium intake require strong leadership by policy-makers, reformulation by food manufacturers, the support of health organizations to promote healthy eating and the use of less salt by consumers.[8]

National programs to reduce salt are underway in many countries.[9] Many successful initiatives include active engagement with the food industry to reduce the amount of sodium added to processed food,[10] as well as public awareness campaigns to alert consumers to the dangers of eating too much salt.[9] Progress is being made, albeit slowly, putting lives at risk. One major challenge that has been identified by both food manufacturers and public health experts is the need for more innovative strategies to lower sodium in the food supply, including processed foods, and salt added at the table and during cooking.

1 | SALT SUBSTITUTES: OPPORTUNITIES FOR USE

Salt substitutes are reduced sodium salt alternatives marketed as an opportunity to lower salt intake with a view to preventing and managing high blood pressure without impacting taste. The sodium is replaced with other minerals—commonly 65% sodium chloride, 25% potassium chloride, and 10% magnesium sulfate.[11] Potassium chloride is often used as the key ingredient in salt substitutes as it is closely related to sodium chloride in terms of its physical and functional properties.[12] It is "generally regarded as safe" (GRAS) by the US Food and Drug Administration with no limitations other than current good manufacturing practice (cGMP), which means that food manufacturers can use it at level necessary to achieve its intended technological effect in a food product.[13] The term salt substitute is regulated by CODEX, which states that the sodium content of salt substitutes will be no more than 120 mg sodium/100 g of the salt substitute mixture.[14] Therefore, most commercially available products are marketed under another name, for example, "reduced sodium salt" or "low salt." For the purposes of this paper, the term "salt substitute" will be used throughout.

Salt substitutes can be used to lower sodium intake from sodium chloride in both processed foods and in table/cooking salt. In regions where the primary source of salt in the diet is from processed foods, salt reduction programs tend to focus on reducing the amount of salt in these foods through reformulation, by gradually reducing the amount of sodium added during food processing.[15,16] In regions where most of the salt consumed is added during home cooking or at the table, effective strategies for reducing salt added during cooking or at the table need to be identified.[16,17]

For processed foods, where limits to reformulation without compromising taste or safety have been reached, salt substitutes have been identified as a potential solution to further reduce salt levels in foods.[17] Some industry stakeholders believe that the use of salt substitutes would further progress on reformulation of processed foods to contain less sodium. As such, there has been an increase in the number of salt substitutes coming on to the market, with commodity traders producing food-grade potassium chloride, stemming from mounting pressure from public health groups. However, for others, anecdotal evidence suggests some concerns regarding the cost, manufacturing, and labeling of products that use salt substitutes.

In regions where most of the salt consumed is added during home cooking or at the table, or also from high salt sauces including fish sauce and soy sauce, and other condiments, salt substitute versions of table salt, sauces or condiments could be made available as a way of both reducing sodium intake and increasing potassium consumption.[9] It is important to make consumers aware that salt substitutes are a more powerful tasting salt than table salt and to use less.[18] There is a risk that if salt substitutes are marketed as "healthier" individuals may consume more and mitigate the beneficial effects, on reducing sodium.

Salt substitutes have already been key to successful salt reduction strategies. For example, prior to 1970 the population of Finland was experiencing very high rates of hypertension. Since the 1970s, the Finnish government has employed a multifaceted approach to reduce population salt intake. The strategy includes working with the food industry to reduce the sodium content of foods by using a sodium reduced, potassium- and magnesium-enriched salt, as well as raising consumer awareness of the dangers of a high salt diet and mandatory sodium labeling. This has resulted in a 33% decrease in population level salt intake and >10 mm Hg decrease in average population systolic blood pressure (SBP) and diastolic blood pressure (DBP), and a 75%-80% decrease in both stroke and coronary artery disease mortality.[19]

There are some concerns regarding consumer acceptability of salt substitutes; however, evidence suggests that they are generally accepted in terms of consumer taste.[20,21] Taste testing of the use of salt substitutes is already widely used in food processing by food manufacturers. Consumer taste testing studies have shown that salt substitutes are accepted by consumers with no significant impact on acceptability of meat products with up to 50% replacement.[22] A sour taste, however, can be detected in over 50% replacement with KCl in cheese.[23] Triangle taste test has also shown that salt (used at the table and during cooking) can also be replaced by 25% with potassium-enriched salt substitute without consumers being able to taste the difference.[20]

In 2016, Unilever conducted a modeling study to review the dietary impact of adding potassium chloride to food as a sodium reduction technique in the general population using three reformulation scenarios.[24] It was concluded that the use of potassium-based salt substitutes would result in better compliance to the WHO guidelines on potassium intake[7] and would not exceed the European Food Safety Authority (EFSA) safety regulations.[25] However, the study acknowledged the need for better and clearer food labeling for the very small number of people who would be at adverse risk of a marked increase in potassium consumption. The study did not include modeling the use of salt substitutes from discretionary salt use and recognized the need for further modeling to determine the impact of optimal ratios for sodium and potassium intake.[24]

2 | SALT SUBSTITUTES: IMPACT ON HEALTH

The potential impact of replacing salt with salt substitutes on blood pressure has already been clearly documented.[26,27] The results from a systematic review and meta-analysis of the effect of salt substitutes on blood pressure showed that salt substitutes are effective at lowering blood pressure; this demonstrates a potential opportunity to use salt substitutes to reduce population blood pressure.[28]

The rural Chinese population are known to consume very high quantities of salt and suffer extremely high rates of hypertension and stroke. Since 2007, The China Salt Substitute Study Collaborative Group has been investigating the impact of a salt substitute-based sodium reduction strategy on stroke outcomes; secondary end points will include major cardiovascular events and total mortality. This is one of the largest scale cluster randomized trial in rural areas of China. Intervention participants will receive a free supply of reduced sodium salt substitute to replace their use of usual salt and education about the benefits of salt reduction. Individuals recruited from control villages will continue with their usual diet and receive some advice to reduce their salt intake at baseline only. If the study is successful, the results can be used to stimulate governments to encourage the use of reduced sodium salt, and save lives.[31]

3 | HEALTH IMPLICATIONS OF INCREASING POTASSIUM

In addition to the health benefits associated with a reduction in sodium, higher intakes of potassium are associated with decreased blood pressure independent of sodium intake.[27] Evidence also suggests that increased consumption of potassium can mitigate the

negative effects of high sodium consumption on blood pressure, and further, the effect of increased potassium intake is more effective the higher the salt intake. The sodium-potassium ratio of the diet is therefore a major determinant of blood pressure.

However, there are a small number of the population who may be at risk of adverse health effects of increasing potassium consumption, primarily those with severely impaired kidney function or those taking certain medications. As such, some public health agencies have been reluctant to endorse the use of (potassium-based) salt substitutes as a viable approach to reduce population level salt intake.

However, several government agencies have reviewed the risks and benefits of using salt substitutes with a view to updating advice on the use of salt substitutes.

In 2016, the Food Standards Agency, Ireland, reviewed its position to support the use of salt substitutes to complement salt reduction activities.[32] In 2017, the UK Department of Health released the results of a 2013 commissioned review by the Scientific Committee on Medical Aspects of Nutrition (SACN) and the Committee of Toxicology (COT), which used the Benefit-Risk Analysis for Foods (BRAFO) methodology to evaluate the available evidence on the effects of increasing the potassium content and decreasing the sodium content of food through the use of potassium-based sodium replacers. SACN/COT proposed a scenario whereby 15%-25% of sodium chloride in food was substituted with a potassium salt. The estimated benefits of increased potassium included a reduction in blood pressure in people with hypertension from 0.8 to 1.5 mm Hg for SBP, and 0.6 to 1.0 mm Hg for DBP, and a reduction in the incidence of stroke by 10 700. The estimated benefits of a reduction in sodium on blood pressure were a reduction of 1.2 mm Hg SBP and 0.6 mm Hg DBP in participants with hypertension, and 0.5 mm Hg SBP and 0.2 mm Hg DBP in participants without hypertension, and a reduction in the number of strokes by 3200. Increased potassium intake may adversely affect a subgroup of the UK population, of which the number of life-threatening cases of hyperkalemia presenting to hospital would increase by 2.2-fold, approximately 8500 additional cases per year. The analysis concluded that the health benefits of using potassium-based sodium replacers in food in the UK to the population outweigh the potential risks.[33]

Both expert committees now support the use of salt substitutes when further reducing sodium impacts foods safety, but not to maintain taste.

4 | POTENTIAL TO INCORPORATE IODINE

Further to WHO guidelines on sodium and potassium intake, WHO recommends that all food-grade salt is fortified with iodine to prevent and control iodine deficiency.[34]

Current recommendations include that the concentration of iodine may need to be adjusted by national authorities responsible for the implementation and monitoring of universal salt iodization, in light of their own data regarding dietary salt intake, recognizing that salt reduction and salt iodization are compatible strategies.[34] While there is no current guidance on fortification of potassium-based salts with iodine, there may be an opportunity for public health gains to optimize the use of salt substitutes as a further measure to reduce salt intake, increase potassium intake, and ensure adequate intake of iodine.

5 | CONCLUSIONS

High salt consumption and associated high blood pressure are a global burden. There is increasing support for the use of salt substitutes as a means to reduce population level salt intake, and thereby blood pressure, and CVD risk. This includes evidence for the potential health benefits, feasibility and consumer acceptability, and updated government advice in support of the use of salt substitutes as part of salt reduction strategies.

There are opportunities to reduce salt intake by replacing regular table salt (sodium chloride) with salt substitutes both at home and during food manufacturing.

As pressure to reduce the salt content of processed foods continues to grow, the food industry is looking for innovative ways to ensure the safety, quality, and palatability of foods with lower salt contents. Salt substitutes offer a potential solution for food manufacturers, supported by the growing consensus for the role for salt substitutes as part of coordinated national salt reduction programs

The use of salt substitutes as a public health intervention, to reduce sodium, increase potassium, and potentially ensure adequate iodine intake, and their long-term effect and cost-effectiveness, merits ongoing research as part of implementation of new policy recommendations.

6 | RECOMMENDATIONS

- Food manufacturers should gradually reduce the level of sodium in food to the lowest possible levels and explore the use of potassium-based sodium replacers to reduce sodium levels even further.
- Governments should continue to monitor sodium and potassium levels in processed foods
- Further consideration may need to be given to how best to label salt substitutes (namely potassium) in processed foods to ensure that people who may be adversely impacted are aware
- Governments to systematically monitor potassium intake at population level including for specific susceptible groups
- Governments to continue to systematically monitor sodium (salt) intake and iodine intake at population level to adjust salt iodization over time as necessary, depending on observed salt intake in specific targeted groups, to ensure they have sufficient but not excessive iodine intakes as salt intakes are reduced
- Governments should consider opportunities for promoting and subsidizing salt substitutes particularly in countries where salt added during cooking, or at the table is major source of salt in the diet.

CONFLICT OF INTEREST

Clare Farrand: No conflicts of Interest. Graham MacGregor: GAM is Chairman of Blood Pressure UK (BPUK), Chairman of Consensus Action on Salt & Health (CASH), World Action on Salt & Health (WASH) and Action on Sugar (AoS). BPUK, CASH, WASH, and AoS are nonprofit charitable organizations. GAM does not receive any financial support from any of these organizations. Norman RC Campbell: NRCC was a paid consultant to the Novartis Foundation (2016-2017) to support their program to improve hypertension control in low- to middle-income countries which includes travel support for site visits and a contract to develop a survey. NRCC has provided paid consultative advice on accurate blood pressure assessment to Midway Corporation (2017) and is an unpaid member of World Action on Salt and Health (WASH). Jacqui Webster: JW is Director of the World Health Organization (WHO) Collaborating Centre on Population Salt Reduction with a remit to support countries to implement and evaluate salt reduction programs in line with the WHO target for all countries to reduce population salt intake by 30% by 2025. JW receives funding from: World Health Organization; VicHealth (Grant number: 20122); National Health and Medical Research Council and National Heart Foundation Career Development Fellowship, (APP1082924); World Hypertension League; National Health and Medical Research Council (APP1052555 and APP1111457).

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