

# Sodium

## essential in moderation

**Grains**  
they're essential!



**Les produits  
céréaliers,**  
essentiels pour la santé !

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## Overview of sodium and the diet

Sodium is an essential mineral required for regulation of extracellular fluid volume and plasma volume. Sodium is a cation and primarily found bound to the anion chloride<sup>1</sup>. Sodium chloride, also known as salt, is made up of 40% sodium and 60% chloride.

In the food supply, small amounts are found naturally in some foods but the primary source of sodium is processed foods. Sodium is added to foods during processing to enhance flavour, to control the growth of bacteria, to provide certain functionally characteristics (e.g. allows the dough of yeast bread to rise), and to act as a preservative (i.e., salted fish or sauerkraut)<sup>2</sup>. It is also a carrier for iodine. Iodized table salt is the major source of iodine in our diets.

### Sodium intakes

In Canada, the current daily consumption of sodium is between 2300 and 2806 mg in adult women and between 2882 and 4066 mg in adult men<sup>3</sup>. These levels are much higher than the recommendations as specified in the Dietary

Reference Intakes. For sodium, only Adequate Intake (AI) levels are established, as there is insufficient data to determine the Estimated Average Requirement. In addition, there are Tolerable Upper Limits (UL) for sodium. In many cases, intakes exceed the Upper Limit for all age and gender groups except for women over 70 years of age (Table 1)<sup>1</sup>.

### Sources of sodium in the North American diet

Dietary sodium comes from different sources. Recent estimates from the United States provide the following breakdown<sup>1</sup>:

#### 12% is naturally occurring

A few food items are naturally higher in sodium content. Some examples are:

- celery—100 mg sodium per 1 cup diced or 120 grams;
- milk—120 mg sodium per 1 cup or 240 mL;
- shellfish, such as scallops—72 mg per scallop.

#### 6% is added while cooking, 5% while eating

Many individuals add salt while cooking; in fact many recipes call for the addition of salt. Often people salt their food prior to consumption.

Table 1<sup>1,3</sup>

| Ages (years) | Gender  | Consumption (mg) | AI (mg) | UL (mg) |
|--------------|---------|------------------|---------|---------|
| 1-3          | Both    | 1918             | 1000    | 1500    |
| 4-8          | Both    | 2677             | 1200    | 1900    |
| 9-13         | Males   | 3513             | 1500    | 2200    |
|              | Females | 2959             | 1500    | 2200    |
| 14-18        | Males   | 4130             | 1500    | 2300    |
|              | Females | 2938             | 1500    | 2300    |
| 19-30        | Males   | 4066             | 1500    | 2300    |
|              | Females | 2793             | 1500    | 2300    |
| 31-50        | Males   | 3607             | 1500    | 2300    |
|              | Females | 2806             | 1500    | 2300    |
| 51-70        | Males   | 3334             | 1300    | 2300    |
|              | Females | 2573             | 1300    | 2300    |
| >70          | Males   | 2882             | 1200    | 2300    |
|              | Females | 2300             | 1200    | 2300    |

## 77% of sodium intake is from processed foods

The majority of sodium comes from the addition of sodium chloride or other sodium compounds such as monosodium glutamate or sodium benzoate to food during processing<sup>1</sup>.

The Canadian Community Health Survey indicates that 55% of sodium intake comes from the following ten groupings of foods or beverages—many of which are mixed foods making it difficult to identify how much sodium comes from each ingredient<sup>3</sup>:

Table 2<sup>3</sup>

| Food grouping                                      | % sodium intake |
|----------------------------------------------------|-----------------|
| Pizza, sandwiches, submarines, hamburgers, hotdogs | 19.1            |
| Soups                                              | 7.4             |
| Liquid milk and milk-based beverages               | 4.0             |
| Poultry and poultry dishes                         | 3.8             |
| Potatoes                                           | 3.4             |
| Cheese                                             | 3.2             |
| Cereals                                            | 3.0             |
| Beef                                               | 3.0             |
| Sauces                                             | 2.9             |

## Sodium, bread and baked goods

Salt used in bread making and baking has three major functions:

- fermentation,
- dough conditioning and
- flavour<sup>2,4</sup>.

### Fermentation

Salt aids the complex biochemical process of fermentation of yeast. The right fermentation requires control and consistency and salt helps by:

- controlling the normal rate of fermentation with yeast;
- controlling unwanted fermentation and acidity; and
- improving fermentation tolerance, which is the balance between gas production and gas retention to obtain a bread that has a high, fluffy appearance and texture.

### Dough conditioning

Salt strengthens gluten, the protein in wheat flour. When strengthened, the gluten is better able to hold water and gas and this helps prevent the formation of soft and sticky dough. The salt also helps condition the dough to achieve a uniform appearance and colour on the crust of bread.

### Flavour

Salt enhances the flavour of bread and other baked goods. Too little or too much salt can have a negative effect on product taste. Too little and the food is bland; too much and it tastes salty. In addition, reducing the

salt requires the addition of other compounds to achieve some of the functionality of the salt. For example, enzymes may be used to strengthen the gluten or control wild yeasts and bacteria.

### Proportion of salt in bread

The amount of salt usually added to make bread is about 1 to 2% of the amount of flour used.

## Sodium and health

### Hypertension and cardiovascular disease

There are many risk factors associated with cardiovascular disease including:

- age,
- gender,
- family history,
- ethnicity,
- tobacco smoking,
- physical inactivity
- being overweight,
- inadequate consumption of fruits and vegetables,
- high blood pressure, and
- diabetes<sup>5</sup>.

High blood pressure (systolic blood pressure of  $\geq 140$  mm Hg or diastolic blood pressure of  $\geq 90$  mm Hg) is a risk factor for cardiovascular disease, specifically stroke. All cardiovascular disease accounts for 36% of all deaths while approximately 7% of deaths in Canada are a result of strokes<sup>6</sup>. Since 1969 the mortality rates for all cardiovascular diseases have decreased by 56% and stroke deaths have decreased by 62%<sup>6</sup>. In addition, among the 20 countries with the lowest mortality rates worldwide, Canada ranks within the top four lowest mortality rates from cardiovascular disease and stroke. However, Canada's rates of high blood pressure have been increasing and are expected to continue to increase as the population ages<sup>5,7</sup>.

Lifestyle factors that increase blood pressure include excess weight, physical inactivity, heavy alcohol use, and excessive sodium intake. As a result, research has focussed on all these factors. However, more recently, with increased awareness and knowledge on sodium intake, there has been worldwide attention on whether a reduction in sodium consumption can reduce the rates of hypertension.

### Sodium and hypertension

Historically, animal model research has demonstrated the link between increased sodium intake and raised blood pressure<sup>8,9</sup>. More recently, a number of reviews of randomized human trials have concluded:

1. A reduction in salt intake for 4 weeks or more can have a significant decrease in blood pressure<sup>10</sup>. In hypertensive individuals the mean reduction of systolic blood pressure was 5.06 mm Hg and for diastolic the reduction was 2.70 mm Hg. In normotensive individuals, the reductions were 2.03 mm Hg and 0.99 mm Hg for systolic and diastolic blood pressure respectively.

2. A reduction in sodium intake can reduce blood pressure in those with elevated blood pressure much more than in those with normal blood pressure<sup>11</sup>. Reductions in systolic and diastolic blood pressure was 4.18 mm Hg and 1.98 mm Hg, respectively in individuals with elevated blood pressure and 1.27 mm Hg and 0.54 mm Hg respectively in those with normal blood pressure.
3. Intensive interventions to reduce sodium result in only small reductions in blood pressure (reduction of 1.1 mm Hg in systolic blood pressure and a reduction in 0.6 mm Hg in diastolic blood pressure in those given low sodium advice compared to controls) and overall effects on cardiovascular disease and deaths are unclear. These interventions are very difficult to maintain and are not suited to population based programs<sup>12,13</sup>.

Although there is relative agreement that reducing sodium intake can reduce blood pressure, the overall impact on heart disease, stroke and mortality is unknown<sup>7,13</sup>.

### **Sodium-Potassium Balance**

Most individuals consume diets that are high in sodium, yet the majority do not develop hypertension. The average prevalence of self-reported hypertension in Canada is 18.7%<sup>15</sup>. This prevalence rate is quite low in young adults (e.g., 2% in 20 year olds) and increases with age to over 35% in individuals older than 70 years<sup>7</sup>. Many factors influence blood pressure in the body including:

- genetics—several genes are involved in the regulation of sodium reabsorption by the kidneys and water balance;
- the level of potassium in the diet (higher consumption of fruits, vegetables and whole grains leads to higher intakes of potassium); and
- the ability of the kidney to excrete sodium and retain potassium<sup>16,17</sup>.

Ultimately, the sodium-potassium balance influences blood pressure levels. Altering this balance can be achieved by decreasing sodium intake or increasing potassium intake. Many of the intervention diets such as the DASH (Dietary Approaches to Stop Hypertension) diet have lower sodium content and higher potassium content. Increased intakes of potassium, as well as other minerals such as calcium and magnesium, have also been shown to decrease blood pressure irrespective of sodium levels<sup>14</sup>.

## **Reducing sodium in the diet**

Current dietary intake exceeds recommendations by two-fold. Although clinical (randomized) trials have shown that some reductions can occur by following a specific diet with reduced sodium, this approach is not successful on a population basis. As a result, organizations such as the Canadian Hypertension Education Program along with the World Health Organization, the Scientific Advisory Committee on Nutrition (UK), the American Medical Association, the American Public Health

Association and the American Heart Association advocate a population health approach. They have developed policies recommending a reduction in the overall intake of sodium to 2400 mg per day (or 100 mmol per day) to be achieved primarily through the reduction in the sodium content of processed foods<sup>7</sup>.

### **International Initiatives**

A number of countries have taken a variety of approaches to reduce the amount of sodium consumed through processed foods.

In the United Kingdom, the Foods Standards Agency has a program on salt reduction that incorporated a number of steps. They:

- identified the evidence for action showing a need for a population approach;
- developed a model for levels of salt reduction;
- worked/partnered with industry to determine if levels could be voluntarily met and
- developed a public education campaign.

After working with industry groups and securing commitment, the Food Standards Agency reassessed the target salt levels to address both product function as well as consumer acceptance. For example, the target sodium content for bread in this program is 430 mg per 100 g<sup>18</sup>.

#### **Did you know...**

Almost all major whole grain breads in Canada are at or below the UK target sodium level of 430 mg per 100 g of bread.

Finland took a different approach to reducing sodium than the UK. Finland's Ministry of Trade and Industry, together with the Ministry of Social Affairs and Health, developed mandatory salt-labelling regulations for all foods. One of the most effective components of the regulations is a "high salt content" warning on food when the salt content is above a specific percentage determined for each food category. Similarly, there is a "low salt" label which has not been popular with consumers as this is perceived to mean lack of taste. In addition, the media played a significant role in encouraging the reduction of salt in products by publishing the harmful effects of high sodium intake and promoting salt alternatives<sup>14</sup>.

Over three decades Finland reduced salt consumption from approximately 14 g/day in 1972 to just over 8 g/day (approximately 3200 mg sodium) in 2002. This has resulted in a decrease in blood pressure with the diastolic blood pressure dropping by more than 10 mm Hg<sup>14</sup>. Finland's reduced level (3200 mg per day sodium) is comparable to Canada's current level of intake.

### **Canadian Initiatives**

The Canadian food industry began to reduce sodium in food products such as soup, vegetable drinks, and bread a number of years ago. Some initiatives involved a gradual reduction of sodium so that consumers would not

## Conclusion

notice a dramatic difference in taste and would have the opportunity to slowly adapt to lower levels. The challenge has been to educate consumers about these reductions.

Canadian food regulations specify that the sodium reduction must be at least 25% before a nutrient content claim can be made. The marketplace now has lower salt products, some that meet label claims, while others don't. For example, a number of whole grain bread products have reduced the sodium levels by 25% allowing a nutrient content claim on the front of the packaging. The claim most often used is "25% less sodium".

Other products have been formulated with a lower level of sodium prior to entering the market and although they are not eligible for a claim, they may have the same level of sodium as products with sodium reduction claims. Therefore, it is important for consumers to check the Nutrition Facts Table to compare sodium values when making their food choices instead of relying only on the claim.

### **Potential opportunities for the food industry**

A key requirement of any effort to reduce salt is consumer acceptance of the product. Methods must maintain acceptable taste and required function so that consumers will continue to purchase many of these healthy foods. Sodium reduction will work for certain foods, but not for others. In some foods, the substituted ingredients may impart a changed taste and in other foods, the functional role of sodium may be lost on the final product.

There are options to help reduce sodium in processed foods such as:

- Reduction of sodium in small amounts that will continue to achieve functionality and not change taste dramatically. Research shows that a 10-25% reduction of sodium is acceptable to the consumer<sup>20,21</sup>;
- Use of potassium, magnesium, and/or calcium added to foods to counter some of the effects of sodium in raising blood pressure;
- Use of potassium and magnesium-enriched mineral salt (e.g. Pansalt<sup>®</sup>) or replacement of the sodium chloride with some potassium chloride. The result can be weaker in flavour and more bitter<sup>14</sup>;
- Use of enzymes to elicit the functional effects of salt in processes such as fermentation.

There is agreement in the literature that the Canadian population consumes levels of sodium that are much higher than needed. Compelling evidence exists that lowering sodium levels can decrease blood pressure in many individuals. However, there is lack of evidence that a decrease in dietary sodium will result in specific health outcomes for the population.

Currently, health professionals and the food industry are working to help decrease the rates of hypertension in the Canadian population by reducing sodium consumption through a combination of education and reduced sodium content of processed foods. The extent of the industry's ability and willingness to lower sodium levels will be determined by the levels needed to maintain functionality and by consumer acceptance.

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