



Review Article

Sodium intake and its reduction by food reformulation in the European Union – A review

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ABSTRACT

Background: The purpose of this article is to review the current situation with regard to sodium intake in the European Union, provide an update on the efforts being made to reduce the sodium content of food products in various industries via food reformulation and identify the factors motivating food reformulation.

Methods: A review was conducted of published literature as well as government and nongovernment organization websites and publications.

Results: Food reformulation efforts have been made in the bread, meat, dairy and convenience foods industries. The World Health Organization (WHO) recommendation of <5 g/day of dietary salt intake (<2 g/day sodium) provides an internationally accepted baseline for reformulation efforts. Most Europeans continue to consume salt above the recommended limit. About half of the EU member states have legislated change in the form of taxation, mandatory nutrition labeling and regulated nutrition/health claims.

Conclusions: These actions have encouraged sodium reductions in existing food products, but food safety, consumer acceptance, cost and complications arising from the use of sodium alternatives remain limitations to food reformulation.

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1. Food reformulation to reduce sodium intake

Salt is the commonly used name for sodium chloride, which consists of 40% sodium and 60% chloride by weight. Salt provides about 90% of the sodium in the human diet [1]. Sodium is essential for the maintenance of cellular membrane potential and the absorption of nutrients in the small intestine. Furthermore, its presence determines the volume of extracellular fluid, thereby maintaining blood volume and blood pressure. However, excessive consumption of sodium has been associated with negative health effects, the most alarming being elevated blood pressure (BP) [2,3]. The prevalence of hypertension (blood pressure $\geq 140/90$ mm Hg) exceeds 40% in most European countries [4,5] and is particularly high in eastern European countries such as the Czech Republic, Slovenia, and Hungary (Fig. 1) [6–8] many of which exhibit an extremely high sodium intake [9]. Hypertension is a major risk factor for cardiovascular disease (CVD), the leading cause of death worldwide (Fig. 2) [3,10]. It accounts for 62% of strokes and 49% of coronary heart disease (CHD) [11]. Prospective cohort studies and outcome trials have shown a positive correlation between salt intake and CVD [3, 12]. It was estimated that if the average person would decrease salt intake by about 5 g per day to the intake recommended by the World Health Organization (WHO) a reduction of 23% of strokes and 17% of CVD would result preventing an estimated four million deaths annually worldwide [3]. A meta-analysis by He, Li and MacGregor showed that reduction of salt intake resulted in decreased blood pressure in both hypertensive and normotensive patients. The authors concluded that although a reduction to 5 g salt per day has a positive effect on blood pressure, a further reduction to 3 g salt per day would have a much greater effect [13].

In 2004, the WHO Global Strategy on Diet, Physical Activity and Health was adopted by the World Health Assembly providing an action plan for the control and prevention of non-communicable diseases. In addition to elimination of *trans*-fatty acids (TFA) in foods, a primary goal was the reduction of salt. Due to the success of the Consensus Action on Salt and Health, established in 1996 in the UK, the World Action on Salt and Health (WASH) group was founded in 2005 to achieve salt reductions worldwide by working with governments and the food industry to implement national salt reduction initiatives. Aims of the WASH group include working with food companies to reduce the amount of salt in processed foods and improving consumers' awareness of the impact of added salt [11]. Furthermore, the EU launched the framework for National Salt Initiatives in 2008, aiming for a 16% salt reduction within four years across all food categories to achieve the WHO recommendations of an intake of less than 5 g/day of salt (<2 g/day sodium) for adults [14,15]. Activities to reduce populations' salt intake have included data collection, establishing benchmarks and food

categories, increasing public awareness as well as monitoring and evaluation. Promoting food reformulation within the food industry is one of the major challenges of the framework [14].

Food reformulation describes the action of changing the composition of processed foods to obtain a healthier product [16,17]. These changes seek to limit the addition of ingredients such as salt, *trans*-fatty acids (TFA), saturated fatty acids (SFA) and sugar believed to be associated with negative health effects including obesity, diabetes, CHD and stroke when consumed in excess [18–20]. These diseases are the major cause of death worldwide accounting for more than 60% of all deaths [21]. Food reformulation, therefore, is intended to promote health and prevent disease by limiting certain nutrients in the diet. Thus, food reformulation is distinguished from food enrichment and food fortification [16].

1.1. Salt intake in Europe

The salt consumption among adults in most European countries ranges from 7 to 13 g per day according to the European Commission data. Germany, Cyprus, Bulgaria and Latvia reported the lowest salt intake (6.3–7.3 g/day), whereas the Czech Republic, Slovenia, Hungary and Portugal reported the highest salt intake (12.3–13.6 g/day) (Table 1) [14]. Powles et al. reported notably different salt intake levels with the lowest intake values observed in Denmark, The Netherlands and Belgium (8.3–8.8 g/day) and the highest in Hungary, Slovenia, Slovakia, Portugal and Italy (10.7–11.2 g/day) (Table 1) [22]. Thus, both surveys demonstrated that eastern and southern European countries exhibit the highest salt consumption rates. It must be noted that the comparability of the data is limited as three different data collection methods were used to determine salt intake: 24-hour dietary recall, dietary records and 24-hour urine samples. In the study performed by the European Commission in 2013, countries reporting the highest salt intake used the 24-hour urinary sodium excretion assessment method, either alone (Slovenia, Portugal) or in combination with the 24-hour dietary recall (Czech Republic, Hungary), whereas countries reporting the lowest salt intake only used dietary studies for evaluation [14]. Kersting et al. showed that urinary sodium excretion was 1.4–1.7 times higher than the sodium intake estimated by dietary records (3-day food diary) in a previous study. This implies that sodium intake assessed by dietary reports may be underreported by an average of 29%–41% [23]. However, in Hungary, a 24-hour recall resulted in much higher estimated salt intake values (17.2 g/day and 12.0 g/day in men and women, respectively) than the 24-hour urinary sodium estimation (11.2 g/day and 9.2 g/day of salt in men and women, respectively) [14]. Data from different studies are also confounded by the inclusion or exclusion of salt added during cooking or

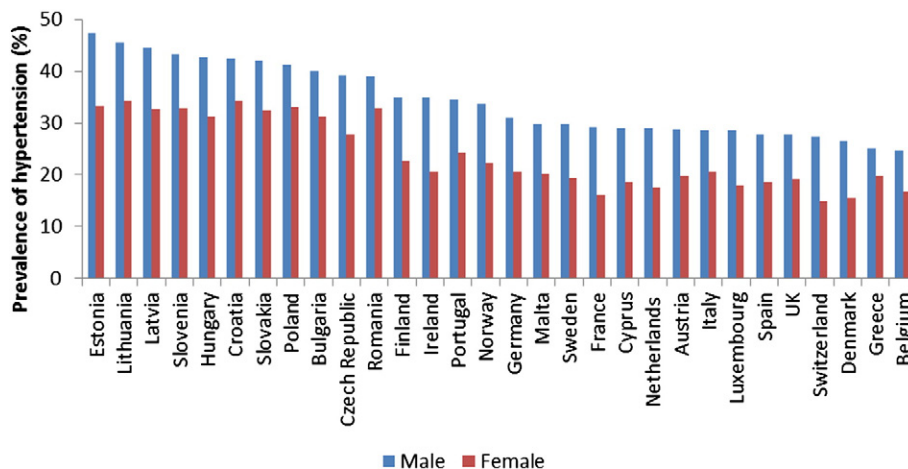


Fig. 1. Prevalence of hypertension ($\geq 140/90$ mm Hg) among adults aged ≥ 25 years in the European Union, Norway, and Switzerland [132].

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