

## Sodium Content in Vegetable Soups Prepared Outside the Home: Identifying the Problem

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### ABSTRACT

Cardiovascular diseases are a major cause of mortality and disability in developed countries, accounting for 39% of deaths. One of the most important factors associated with their onset is a high sodium intake, which increases the risk of high blood pressure. Excessive salt intake is associated with the consumption of processed foods and eating outside home, which nowadays can vary from one to all day meals. The consumption of vegetable soup is a healthy cultural practice, negatively associated with obesity, but their high sodium levels raised some concern recently.

The aim of this work was to quantify the sodium content in vegetable soups served at public institutions' canteens. Soups, with and without salt added, were collected from kindergartens, elementary schools and nursing homes, and their sodium content was determined by flame photometry.

In soups without added salt, sodium contents ranged from 0.13 to 216.63 mg/100g, in nursing homes, and 0.93 to 284.02 mg/100g, in kindergartens. Sodium content in soups with added salt ranged from 124.71 to 429.04 mg/100g, in nursing homes, from 36.58 to 409.53 mg /100g, in elementary schools, and from 63.23 to 438 mg/100g, in kindergartens. Considering a standard serving of 300g, sodium intake reported from soup alone can represent 31 to 54% of the adequate daily intake, becoming a major contributor to the high sodium intakes reported in developed countries. As most of the sodium comes from added salt during cooking processes, intervention strategies should be directed to raise awareness among food handlers and chefs about limiting salt content in different foods, as well as educational strategies directed for the consumer, in order to maintain acceptability of soups with reduced sodium content.

*Keywords:* Sodium; Soup; Nursing Homes; Elementary Schools; Kindergartens.

### 1. INTRODUCTION

Modern life leads consumers to eat out and away from home and this is a trend that does not appear to be declining. The number of meals eaten away from home may vary from one to all day meals, and this practice has been associated with an increased risk of higher energy intake and obesity [Orfanos, 2007]. One important food item consumed in Portugal, even when eating out, is “vegetable soup” which is strongly recommended given its high nutritional value and negative association with obesity [Moreira, 2006]. However, soup has been identified in some studies as a food with high levels of sodium [Conceição, 2011; Mano, 1983].

The average salt intake in most countries is about 9 to 12 g/d [Brown, 2009], and in Europe the average intake range from 5.4 to 18 g/d [Webster, 2011]. The average daily intake reported for sodium is between 3500 and 4700 mg/d, well beyond the Food and Nutrition Board [2004] and the 2010 U.S. Dietary Guidelines [USDA, 2010] recommendations, set at 1500 mg/d (“adequate intake”) for elderly and children.

Several studies have linked a high intake of salt with pathological conditions, such as high blood pressure, left ventricular hypertrophy, and increased risk of cardiovascular and renal diseases. There is also some evidence that excessive salt intake is associated with an increased risk of osteoporosis and stomach cancer [He, 2009].

In Portugal, over the past twenty years, cardiovascular diseases accounted for 39% of deaths and malignant tumours for 20% of deaths, being the incidence and mortality of gastric cancer the highest in the European Union [Ferlay, 2006]. By this set of evidence, excessive salt intake is one of the main concerns for health professionals [INE, 2002] and, from a public health perspective, reducing salt intake is one of the most upcoming strategies to put into practice. About 80% of salt intake can come from added salt in processed foods [Ferlay, 2006] and soup is no exception. However, given the high nutritional density of vegetable soup, it would be desirable to encourage its consumption at main meals, both at home and when eating out, without concerns of increasing sodium intake at the same time.

This study aims to quantify the sodium content in vegetable soups served in several different Portuguese institutions, namely kindergartens, elementary schools and nursing homes.

### 2. MATERIALS AND METHOD

#### 2.1 Study Design

This study encompasses data on sodium content in vegetable soup collected in 3 different institutions at lunch. At first, two samples of soup were collected in two geriatric institutions of the city of Barcelos for seven consecutive days, both before and after the addition of salt. Secondly, samples of soup were collected in eight kindergartens of the city of Vila

Nova de Gaia for five consecutive days, also before and after adding salt. Lastly, samples were collected in ten elementary schools in the city of Porto and Bragança for three consecutive weeks, but only after the addition of salt. The total number of samples was 588, being 28 samples of nursing homes (14 before and 14 after salt addition), 110 of kindergartens (55 before and 55 after salt addition) and 450 of elementary schools.

## 2.2 Sample preparation

The sample preparation procedure was adapted to soups from one validated method proposed to quantify sodium content in bread [Vieira, 2011]. All soup samples were stored in plastic containers at 4 °C until analysis. After homogenization of each soup, 2g were sampled and 2ml of nitric acid were added. The mixture was shaken during 90 minutes to allow the food matrix's complete hydrolysis. Then, 20 ml of water were added and the mixture was again homogenized using an electric homogenizer (Ultra Turrax model). Volume was completed up to 40 ml and shaken for 30 min, followed by centrifugation (4,000 rpm, 15 min). Finally, 1.00 ml of aqueous supernatant was diluted up to 40 ml of deionized water before reading in the flame photometer.

## 2.3 Chemicals and samples

All reagents used were of analytical grade purity. Standard solution of sodium (1,000 mg/L) was supplied by JenWay, England. Calibration curves were constructed using 0.5, 1, 2.5, 5.0 and 7.5 µg/ml standards. The solutions were stored in a refrigerator. To avoid contamination of the samples, all PTFE materials were emerged in a freshly prepared solution composed of 15% (v/v) proanalysis HNO<sub>3</sub> (Merck) during 24 h, then rinsed thoroughly with doubly deionized water, and dried in a stove.

## 2.4 Instrumentation

A flame photometer (Model PFP7, JenWay, England) with filters for lithium, sodium, and potassium was used. Butane gas and air were supplied as the source of flame. The flow rate of fuel was adjusted to get a maximum sensitivity. Other apparatus used were a Seradest LFM 20 Water Purification System, a Heidolph REAX 2000 vortex, a Kern ALS 120–4 balance (Ziegelei), an Ultra Turrax homogenizer T25 (Sotel), a Heraeus stove D-6450 model and a Centrifuge Labofuge 6000 ®, from Heraeus.

## 2.5 Method validation

For the evaluation of the instrumental precision, intensity emitted was determined in the same soup sample 20 times under the established instrumental conditions. Linearity was observed in the working ranges (in microgram per milliliter) from 0.5 to 7.5. Repeatability of the extraction procedure was evaluated by the coefficient variation using six aliquots of solutions that were submitted to extraction by direct dissolution of soup sodium in water. Recovery studies were carried out to determine the accuracy of the method. The samples were analyzed after the methods validation.

## 2.6 Statistical analysis

Statistical analyses were carried out with SPSS (version 17, Chicago, USA). Data are presented as the mean ± standard deviation, and percentiles 5, 25, 50, 75 and 95; mode, maximum and minimum are also presented.

## 3. RESULTS AND DISCUSSION

The method's limit of detection was 0.2µg/ml and the limit of quantification was 0.2µg/ml. These values show that the method is precise and sensitive, enabling the quantification of low levels of sodium. The instrumental precision was 1.46%. Recovery studies were carried out to determine the accuracy of the method and it was found that recoveries ranged between 93.8% and 97.5%.

The higher mean values of sodium in soups with added salt were found in nursing homes (269.06mg/100g) and kindergartens (213.16mg/100g). These results (Table 1) may be due to a lack of awareness of the cooks to limit sodium intake, the absence of specific control for added salt in food preparation, or to rely on salt to satisfy consumer preferences (particularly in geriatric institutions). Moderate content in elementary schools may be due to a greater control by the institutions, but further analysis should be carried to test this assumption.

As expected, the sodium content of soups with added salt was significantly higher than before adding salt, strongly suggesting that the main contributor for sodium content is the addition in the cooking process. Actually, we found that the large majority of the soup sodium content (more than 90%) comes from the salt added during cooking.

The Portuguese traditional food habits include the consumption of soup, rich in vegetables, twice a day (lunch and dinner). In the cohort EPI Porto study, the frequency of daily consumption of vegetable soup was 58.8% in women, and 54.9% in men [Lopes, 2006]. As populations are becoming more sedentary and with higher access to energy-dense foods, there is a strong need to maintain or increase the intake of vegetable soup, which may protect against obesity and other chronic diseases [Flood, 2007; Maureen, 2011]. At the same time, it is very important to determine the level of sodium added to soups in order to maintain its positive nutritional characteristics.

Table 1 – Results of sodium content in soups (mg Na/100g of soup)

	Sodium in soup before adding salt			Sodium in soup after adding salt		
	Nursing Homes	Elementary Schools	Kindergartens	Nursing Homes	Elementary Schools	Kindergartens
<b>Mo</b>	0.13	-	4.93	124.71	372.14	63.23
<b>Mean ± sd</b>	25.33 ± 48.78	-	18.07 ± 37.18	269.06 ± 75.64	153 ± 105.59	213.16 ± 85.11
<b>Min</b>	0.13	-	0.93	124.71	36.58	63.23
<b>Max</b>	216.63	-	284.02	429.04	409.53	438.79
<b>P5</b>	0.42	-	0.94	151.45	52.06	77.98
<b>P25</b>	2.96	-	4.68	208.41	67.96	139.21
<b>P50</b>	5.24	-	8.90	277.66	98.06	225.42
<b>P75</b>	20.14	-	14.87	324.36	238.32	269.38
<b>P95</b>	142.73	-	62.56	423.98	366.26	362.63

Considering the possibility of having a standard serving of 300 g of soup served per meal, sodium intake per soup may be up to 459-850mg, representing 31 to 54% of the daily adequate sodium intake [He, 2009] for the elderly and children. We should also be aware that the salt consumed in the soup is only a part of the total sodium intake throughout the day, and that the recommended dietary intake values can be easily overcome.

There is a well-established link between high intake of salt and physiological and pathological changes such as increased blood pressure [Nagata, 2004], left ventricular hypertrophy [Du Cailar, 1992], increased cardiovascular disease (heart attacks, strokes and heart failure) and renal diseases [Verhave,2004; Arnlov, 2005]. There is also some evidence that salt intake is associated with an increased risk of osteoporosis [Cappuccio, 2000] and stomach cancer [Jooseens, 1996]. In a meta-analysis of randomized salt reduction trials, 17 trials estimated that a reduction of 6 g / d in salt intake could reduce strokes by 24% and cardiovascular disease by 18% [He, 2002].

Many workplaces, schools or social institutions provide daily meals for their employees, by self-production of meals or catering business, and thus have the potential to induce healthy food consumption choices [Wanjek, 2005]. The payback for investing in workplace health programs can be measured in several ways, including decreased direct health costs, increased performance measures and lower rate of absenteeism. A 400 mg of sodium reduction by adults with uncontrolled hypertension could represent an annual reduction of 1.3 million absent days, 6.3 million full-time equivalent days with presenteeism and 1.8 million days lost because disability [Dall, 2009].

It would be desirable that consumers exposed to the consumption of meals outside the home could make informed choices and take effective action about their own salt intake, and benefit from meals that reduce their health risks. Geaney and colleagues [2010] have shown that structured catering initiatives in public sector have potential to reduce dietary intakes of salt. These initiatives may be through increased consumer information and / or by providing healthy meals at the public institutions.

Studies show that 25% to 30% of medical costs per year are spent on employees, that exhibit health risk factors for chronic diseases, such as hypertension [Zuidhof, 1998], and the reduction of one risk factor decreases presenteeism by more than 9% and absenteeism by 2% [Glasgow, 1997]. To solve this problem, national food policy aiming at reducing salt intake should establish dietary guidelines and sodium intake goals in a defined timeline. A solution that ensures the maintenance of the basic elements of the healthy meal requirements: with an emphasis on reducing added sodium to foods, namely to vegetable soups, together with measures to raise the awareness among chefs and food handlers on this topic, is needed.

The strengths of this work lie in the equal methodology laboratory in all three institutions, the accuracy of sample collection, the large number of samples and differentiate the added salt from that intrinsic of soup ingredients. The small number of the institutions surveyed and the convenience sample used act as the main weaknesses of this study.

#### 4. CONCLUSIONS

Average sodium levels in soups may be considered high, particularly in nursing homes and in kindergartens. Sodium content per soup has reached 31 to 54% of the daily adequate intake for the elderly and children. The values were very heterogeneous, probably because the sodium added to soups varied according to intrapersonal and interpersonal food preparation practices.

In terms of public health it would be important to standardize and monitor the sodium content of foods served outside the home, and provide nutrition education to food handlers about reducing salt consumption and global health. For companies in the European market, the development of health promoting workplace will be an essential requisite to incorporate a healthy, qualified and motivated workforce.

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