Food Chemistry 238 (2018) 117–124

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Is sodium and potassium content of commonly consumed processed packaged foods a cause of concern?

Meenu Singh, Suneeta Chandorkar *

Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara 390 002, Gujarat, India

ARTICLE INFO

Article history:
Received 10 September 2016
Received in revised form 20 November 2016
Accepted 21 November 2016
Available online 25 November 2016

Keywords:
Food composition
Sodium
Potassium
K:Na ratio
Processed packaged foods

ABSTRACT

Processed foods are the major contributors towards sodium intake thereby pre-disposing individuals towards risk of Diet Related Non-communicable Diseases (DR-NCDs). There is paucity of data on sodium and potassium content of processed packaged foods in India. The sodium and potassium content of the most commonly consumed processed packaged foods (n = 154) was analyzed by AOAC 969.23 method using Flame Photometer. Highest analyzed mean sodium content was found in soups (4823 ± 1674 mg/100 g, range = 3220 to 8000 mg/100 g) while the potassium content was highest in chips with a mean of 778 ± 260 mg/100 g and ranged between 360 and 1220 mg/100 g. A higher potassium to sodium ratio is desirable for good health, however only 20% of the analyzed products were found to have the same. Therefore, there is a need to monitor the sodium and potassium content of the processed packaged foods and to reformulate the products to bring about favorable potassium to sodium ratio.

1. Introduction

Sodium (Na) and Potassium (K) are essential nutrients for healthy functioning of human body. Excess consumption of Na and inadequate K is one of the major factors contributing to hypertension and related diseases. Therefore, K:Na ratio is associated with etiology of cardiovascular disease and mortality. World Health Organization (WHO) has recommended an optimum safe sodium intake of <2000 mg/day or 5 g/day salt and potassium at least 3510 mg/day intake by adults (⩾16 years) (WHO, 2012a, 2012b). The optimal sodium to potassium ratio has not been derived by WHO but an increased potassium intake and decreased sodium intake is strongly recommended (WHO, 2012a, 2012b).

Processed foods and restaurant foods often contain higher sodium contents for either palatability or food safety reasons and thus the trend is likely to contribute to high sodium consumption (He & MacGregor, 2009). According to a study conducted in Europe, processed foods are assumed to be the main source of sodium in the diet (about 70–75% of the total intake) of the population, with about 10–15% from naturally occurring sodium in unprocessed foods and about 10–15% of sodium from discretionary sources such as sodium added during cooking and at the table. The content of sodium as sodium chloride in processed foods may be much higher in bread- 20 mmol/100 g, cheese- 30 mmol/100 g, salted butter- 40 mmol/100 g and lean raw bacon-80 mmol/100 g (EFSA, 2005). A study in UK revealed that 80% of the total salt consumption among the population was through processed foods and foods served at canteens and restaurants. Only 15% and 5% contribution was from "during cooking or at the table" and "naturally present in the food", respectively (He & MacGregor, 2009). Similar results were observed in a cross-sectional study among 655 Chinese post-menopausal women with pre-hypertension. The major contributors of non-discretionary salt were soup (21.6%), rice and noodles (13.5%), baked cereals (12.3%), salted/preserved foods (10.8%), Chinese dim-sum (10.2%) and sea foods (10.1%). Discretionary salt use in cooking made a modest contribution to overall intake (Liu et al., 2014). A cross sectional study in Greece among 4580 children aged 10–12 years showed that 20% of the children had more than 2200 mg/day recommended sodium intake, excluding salt added at table and during cooking. The study revealed that 34% of sodium intake was from 'hidden' sources namely, bread, processed cereals and white cheese (Magriplis et al., 2011). An increase in the consumption of highly salted processed foods resulted in increase in salt intake. The average salt intake in most countries around the world is approximately 9–12 g/day, with many Asian countries having mean intakes more than 12 g/day. Salt intake is commonly more than 6 g/day in children older than 5 years and increases with age (Brown, Tzoulaki, Candeias, & Elliot, 2009). Salt intake among children in developed countries has increased due to the

* Corresponding author.
E-mail address: suneetachandorkar@gmail.com (S. Chandorkar).

http://dx.doi.org/10.1016/j.foodchem.2016.11.108
0308-8146/

increasing consumption of processed foods accounting for approximately 80% of total salt intake. The processed, restaurant, fast foods and snacks are generally very high in salt, fat and sugar. It is possible that children from the age of 3–4 years onward consume as much salt as adults (He & MacGregor, 2009).

The efforts to reduce salt content in processed foods by various countries namely, China, Japan, UK, Finland, Portugal and US reflected that processed foods are the major contributors of salt in diet of the populations. These countries brought about regulations to reduce sodium content in processed foods, labeling of processed and prepared foods, public education and collaboration with the food industry (He & MacGregor, 2009). Though, salt content in processed foods has been reduced through systematic measures in many European countries, they are still considered to be the main contributors to dietary sodium intake (EFSA, 2005).

Therefore, processed foods contain large amount of Na and are usually deficit in K. However, data on Na and K intake by Indians as well as the Na and K content of processed packaged Indian foods is scanty. Thus, the aim of the study was to determine the Na and K content of commonly consumed processed foods by the free living population of Vadodara, Gujarat, India.

2. Materials and methods

The present investigation was carried out in Vadodara, Gujarat, India. The study was executed in three phases.

Phase I-**Consumer survey** involved random selection of consumers from free living population from five zones (East, West, North, South and Central) of Vadodara (n = 807) for arriving at the most commonly consumed processed packaged foods. Pretested Semi-structured Questionnaire was used to collect the information on frequency of processed food consumption by the consumers.

Phase II- **Market Survey** dealt with the purposive selection of commonly consumed (consumed at least once a week) processed packaged foods (n = 154) to examine Na and K content on NFP using standardized proforma.

Phase III-**Sodium and Potassium Analysis** implicated examination of Na and K content of commonly consumed processed packaged foods (n = 154) by AOAC 969.23 method using Flame Photometer (Model: Elico CL 361). Sodium Standard (Sigma Aldrich-Fluka Analytical; 1000 mg/l ± 4 mg/l, product Code 11116500) and Potassium Standard (Sigma Aldrich-Fluka Analytical; 1000 mg/l ± 4 mg/l, product Code 101280125) were used for standardization and calibration.

2.1. Standardization

The standard solutions of sodium (1000 mg/l) and potassium (1000 mg/l) were procured from Sigma Aldrich-Fluka Analytical to prepare the working standard solutions. The procured standard solutions were diluted with de-ionized water to obtain a series of working standard solutions of sodium (1 ppm, 2 ppm, 3 ppm and 4 ppm) and potassium (2 ppm, 4 ppm, 6 ppm and 8 ppm).

2.2. Estimation of sodium and potassium involved three steps,

2.2.1. Moisture determination (AOAC 925.09)

About 5 g of the ground sample was weighed in a pre-washed, dried borosilicate crucible. The crucibles with sample were dried in an oven to 105 degrees Celsius and cooled in a desiccator. The process of drying, cooling and weighing was repeated till a constant weight was achieved. The final weight was recorded as "dried sample weight."

2.2.2. Ash determination (AOAC 900.02A)

The dried sample obtained from moisture determination was weighed accurately and heated first over a low flame till the entire sample was completely charred, followed by heating in a muffle furnace for about 10–12 h at about 600 °C. The sample was then cooled in a dessicator and weighed. To ensure complete ashing, the crucible was again heated in the muffle furnace for half an hour, cooled and weighed. This was repeated until two similar consecutive weights were obtained and the ash was almost white or greyish white in color. The final weight was recorded as "ash weight."

2.2.3. Sample preparation and determination

- The ash was moistened with 1 ml of de-ionized water and 5 ml of concentrated hydrochloric acid was added to it. The mixture was then evaporated to dryness on a boiling water bath.
- Another 5 ml of concentrated hydrochloric acid was added and the solution was evaporated to dryness as before. After this, 4 ml of hydrochloric acid and 1 ml of de-ionized water was added and the solution was warmed over boiling water bath for 5 min.
- This solution was then filtered into a 100 ml volumetric flask using Whatman No. 44 filter paper and the volume was made up to 100 ml using de-ionized water.
- The prepared sample solutions were aspirated in Flame Photometer (Model: Elico CL 361) and readings were recorded.

Note: Further dilutions were prepared for the sample solutions when required.

2.2.4. Calculations

$$\text{Sodium/Potassium}(\text{mg}/100\,\text{g}) = \text{Concentration obtained from standard graph}(\text{ppm}) \times \frac{\text{volume make-up}(\text{ml}) \times \text{dilution}(\text{if any}) \times 100}{1000 \times \text{sample weight}(\text{g})}$$

The reported values of Na and K on NFP were compared with the analyzed values to estimate the percent variation between the two. The percent variation between reported versus analyzed values was either declared as over-reporting (reported values >10% of the analyzed values), under-reporting (reported values <10% of the analyzed values) or acceptable variation (variation between reported and analyzed values $\leqslant$10%). The percent variation was calculated by dividing the difference in reported and analyzed values by reported values and multiplying by 100. Products that did not report Na and K values were termed as "not reported."

2.3. Quality control measures adopted in Na and K analysis

- Prior to taking the sample readings, diluted HCl was aspirated for 15 min and then de-ionized water for another 15 min to make the nebulizer inlet tube free from any ions.
- A blank was always run to set zero before sample analysis.
- Calibration was done each time before taking sample readings by aspirating the blank solution and standard solutions after every 10 samples.

All the samples were analyzed in duplicates for precision.

3. Results and discussions

Fig. 1 show that the most popular food in the studied population was sweet biscuits and it was consumed by 86% of the consumers. The consumption of sweet biscuits was followed by salty