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Demographic differences in the saltiness intensity perception and pleasantness ratings of salty solutions and foods among Malaysian subjects

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ABSTRACT

In order to determine how individual differences in saltiness intensity perception and pleasantness rating might be associated with demographics and anthropometric measurements among Malaysians, 300 university students (114 males, 186 females; 259 ethnic Chinese, 41 Indians) tasted three increasing suprathreshold concentrations of NaCl aqueous solutions and low and high sodium versions of chicken stock soups, eggs and biscuits. They then rated the saltiness intensity perception and pleasantness using the generalised Labeled Magnitude Scale and Labeled Affective Magnitude scales, respectively. Taken together, as the sodium content of solutions/foods increases, the saltiness intensity perception increased; while the opposite was only true for the pleasantness ratings of NaCl solutions and eggs. Principle Component Analysis showed that food stimuli that were generally perceived as 'tasted less salty' did not predict the differences among genders, ethnicities and BMI groups, but those that 'tasted more salty' were perceived as significantly higher among females and those with normal weight. The pleasantness of soups and high sodium food stimuli was rated significantly higher by males, while the pleasantness of low and high sodium foods was rated significantly higher by Chinese. Finally, it also seemed that the intensity perception and pleasantness ratings of salty foods did not correlate well with the obesity and cardiovascular health indices. Taken together, saltiness intensity perception and pleasantness rating are dependent on the demographics, but not on anthropometric measurements and blood pressures of the young Malaysian subjects in this study.

1. Introduction

Saltiness is one of the essential tastes perceived by humans and is possibly a trait that is developed in order to identify foods containing the salt required for regular physiological functions (Doyle & Glass, 2010). Salt taste is perceived when the sodium ions directly penetrate the special ion channels on the apical surface of the taste buds, named amiloride-sensitive epithelial Na channel, ENaC (Chandrashekar et al., 2010). The 2003 Malaysian Adult Nutrition Survey (MANS) revealed that the sodium intake by Malaysians was 2575 mg per day (Mirnalini et al., 2008), about 30% higher than the limit set by the Malaysian Dietary Guidelines 2010 (NCC (National Coordinating Committee on Food & Ministry of Health Malaysia), 2010). The survey also revealed that Malaysian men consumed about 500 mg sodium more than women did, while its consumption declined with age. Although there was no significant difference in the rural–urban intake, it was found to be highest in the group with the highest educational level, and among the ethnic Chinese (Mirnalini et al., 2008) – a group where the usage of soy-based sauces with high sodium content and salting as a processing and preservation method (such as vegetables, tofu-derived products, seafood, poultry and eggs) are culturally common (Li & Hsieh, 2004).

Elevated dietary salt intake is associated with health implications such as cardiovascular and bone diseases (reviewed in Doyle & Glass, 2010). More importantly, it is also well accepted that a reduction in the dietary salt intake will decrease the mean population blood pressure and reduces the prevalence of hypertension and left ventricular hypertrophy, a strong risk factor for cardiovascular disease (Doyle & Glass, 2010; He & MacGregor, 2004; Hooper, Bartlett, Davey, & Ebrahim, 2002). In Malaysia, according to the 2006 Third Health and Morbidity Survey, the prevalence of hypertension among adults aged 30 years and above has increased to 42.6% (Institute of Public Health Malaysia, 2008). Therefore, in order to reduce the prevalence of cardiovascular diseases (which account as the main reasons for mortalities), the Malaysian Dietary

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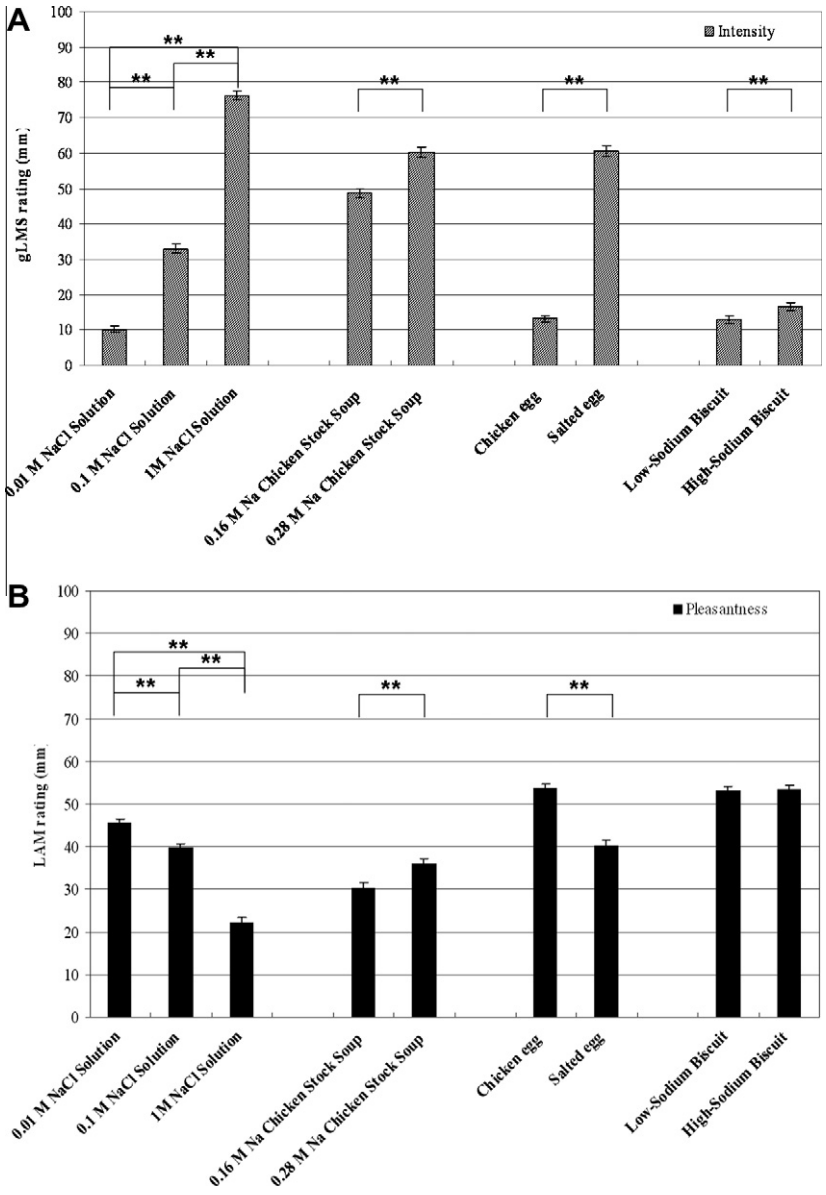

Fig. 1. Overall perceived intensity (A) and pleasantness ratings (B) of increasing concentrations of NaCl, and low and high-sodium high sodium versions of chicken stock soups, eggs, potato chips and biscuits. Significance was compared by Friedman test or Wilcoxon Signed Rank test, significant at $^{**}p < 0.01$, as indicated. Error bars are SEM.

Guidelines 2010 has recommended the use of salt sparingly – based on the World Health Organization (WHO) (2007) recommendation of one teaspoon or 5 g of salt or NaCl (or 2000 mg sodium) per day (NCC (National Coordinating Committee on Food & Ministry of Health Malaysia), 2010).

Perceived taste intensity is one of the assessable components of direct taste function (Lawless & Heymann, 1998). The taste molecules usually impart intensity whereby saltiness raises as the concentration increases, up to some maximum above which no further saltiness perceived (Henney, Taylor, & Boon, 2010). People with high taste detection for a particular chemical tastant are less sensitive as they require a greater concentration of the chemical to elicit a perception and vice versa (Lawless & Heymann, 1998). Another measure is the degree of which a person likes or accepts a salty food or beverage and considers it to be pleasant or desirable. This is often referred to as 'liking' or 'pleasantness' (Lawless & Heymann, 1998). Various studies revealed that individual difference in perceived saltiness intensity and pleasantness ratings are associated with gender (Hayes, Sullivan, & Duffy, 2010; Verma, Mahajan, Mittal, & Ghildiyal, 2005) and ethnicity (Bertino, Beauchamp, & Jen, 1983; Bertino & Chan, 1986). Hence, consideration of these associations with the perceived saltiness intensity and pleasantness of certain foods can help to plan for strategies to reduce sodium contents in them, sequentially to prevent the detrimental health effects of high salt intake.

To date, there is limited research on understanding how the reported high sodium intake among Malaysians (especially the college/university students) is influenced by biological determinants like gender, ethnicity and BMI status. Therefore, the main objective of this study was to quantitatively measure among students of different ethnicities in a northern Malaysian university, the saltiness intensity perception and pleasantness ratings of increasing suprathreshold concentrations of NaCl solutions and low and high sodium versions of chicken stock soups, eggs, potato chips and biscuits. Demographic data, anthropometric measurements and cardiovascular function indicators were taken – to associate how