



Contents lists available at ScienceDirect

Journal of Cardiology

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



Review

Functional foods for augmenting nitric oxide activity and reducing the risk for salt-induced hypertension and cardiovascular disease in Japan

Theodore W. Kurtz (MD)^{a,*}, Stephen E. DiCarlo (PhD)^b, Michal Pravenec (PhD)^c,
R. Curtis Morris (MD)^d

^a University of California, San Francisco, School of Medicine, Department of Laboratory Medicine, San Francisco, CA, USA

^b Michigan State University, College of Osteopathic Medicine, Department of Physiology, East Lansing, MI, USA

^c Institute of Physiology of the Czech Academy of Sciences, Prague, Czech Republic

^d University of California, San Francisco, School of Medicine, Department of Medicine, San Francisco, CA, USA

ARTICLE INFO

Article history:

Received 29 January 2018

Accepted 30 January 2018

Available online xxx

Keywords:

Salt sensitivity

Salt

Hypertension

Sodium

Nitrate

ABSTRACT

High salt intake is one of the major dietary determinants of hypertension and cardiovascular disease in Japan and throughout the world. Although dietary salt restriction may be of clinical benefit in salt-sensitive individuals, many individuals may not wish, or be able to, reduce their intake of salt. Thus, identification of functional foods that can help protect against mechanistic abnormalities mediating salt-induced hypertension is an issue of considerable medical and scientific interest. According to the "vasodysfunction" theory of salt-induced hypertension, the hemodynamic abnormality initiating salt-induced increases in blood pressure usually involves subnormal vasodilation and abnormally increased vascular resistance in response to increased salt intake. Because disturbances in nitric oxide activity can contribute to subnormal vasodilator responses to increased salt intake that often mediate blood pressure salt sensitivity, increased intake of functional foods that support nitric oxide activity may help to reduce the risk for salt-induced hypertension. Mounting evidence indicates that increased consumption of traditional Japanese vegetables and other vegetables with high nitrate content such as table beets and kale can promote the formation of nitric oxide through an endothelial independent pathway that involves reduction of dietary nitrate to nitrite and nitric oxide. In addition, recent studies in animal models have demonstrated that modest increases in nitrate intake can protect against the initiation of salt-induced hypertension. These observations are: (1) consistent with the view that increased intake of many traditional Japanese vegetables and other nitrate rich vegetables, and of functional foods derived from such vegetables, may help maintain healthy blood pressure despite a high salt diet; (2) support government recommendations to increase vegetable intake in the Japanese population.

© 2018 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

Contents

| | |
|--|-----|
| Introduction | 000 |
| Functional foods and reducing risk for salt-induced hypertension. | 000 |
| A contemporary mechanistic framework for initiation of most instances of salt-induced hypertension. | 000 |
| Mechanisms mediating subnormal vasodilation and abnormal vascular resistance responses to increases in salt intake | 000 |
| The role of alterations in nitric oxide activity in determining blood pressure responses to increases in salt intake | 000 |
| Effects of augmenting nitrate intake on blood pressure | 000 |
| Functional foods with high nitrate content to reduce the risk for salt-induced hypertension | 000 |
| Implications for public health efforts to reduce the risk for salt-induced hypertension. | 000 |
| Acknowledgements | 000 |
| References | 000 |

* Corresponding author at: UCSF Department of Laboratory Medicine, 185 Berry Street, Suite 290, San Francisco, CA 94107, USA.
E-mail address: Ted.Kurtz@ucsf.edu (T.W. Kurtz).

<https://doi.org/10.1016/j.jjcc.2018.02.003>

0914-5087/© 2018 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

Introduction

Japanese-style diets [1–3] and Mediterranean-style diets [4] are associated with lower cardiovascular risk and greater longevity than many other diets worldwide. Nevertheless, according to the Global Burden of Disease Study, dietary hazards that promote cardiovascular disease remain among the top risk factors for death and disability in Japan [5]. In Japanese, as in other population groups, high salt intake is widely considered to be one of the major dietary determinants of high blood pressure and cardiovascular disease [6–9]. Thus, there is ongoing interest in developing improved dietary approaches to reducing the risk for salt-induced hypertension and cardiovascular disease in Japan as in other parts of the world.

Although dietary salt restriction may be of clinical benefit in salt-sensitive individuals, many individuals may not wish, or be able, to reduce their intake of salt to the level recommended by medical authorities in Japan (<6 g of salt/day) [8]. As discussed by Okuda and colleagues, salt intake decreased substantially in various regions of Japan between 1950 and 1990 [10]. However over the past two decades, it appears that educational efforts in Japan and throughout the world have met with only modest success in achieving further reductions in salt intake at the population level [11]. For example, Fig. 1 shows that in Japan, average daily salt intake (~10 g/day) changed very little between 2004 and 2014 and has remained well above the maximum level of 6 g/day recommended by the Japanese Society of Hypertension [8,10,12]. In most other countries, average salt intake also exceeds the levels recommended by scientific agencies and governmental authorities [13]. Takahashi and colleagues found that even in Japanese hypertensive patients who are well aware of the dietary guidelines on salt intake, average salt intake is nearly 10 g/day and is similar to that of patients with low awareness of the dietary guidelines [14].

Functional foods and reducing risk for salt-induced hypertension

Given limited recent progress in achieving reductions in average daily salt intake in Japan and elsewhere, and considering ongoing debate about the desirability of efforts to reduce salt intake at the population level [15–18], it is important to consider alternative dietary approaches to reducing risk for salt-induced hypertension. In this regard, increased intake of functional foods with ingredients that help protect against salt-induced increases in blood pressure may represent a promising dietary approach to reducing the risk for salt-induced hypertension in the population. Increased consumption of such functional foods might reduce the risk for salt-induced hypertension even if further reductions in average salt intake are not achieved.

The term “functional food” appears to have originated in Japan [19], and broadly refers to foods with physiologically active

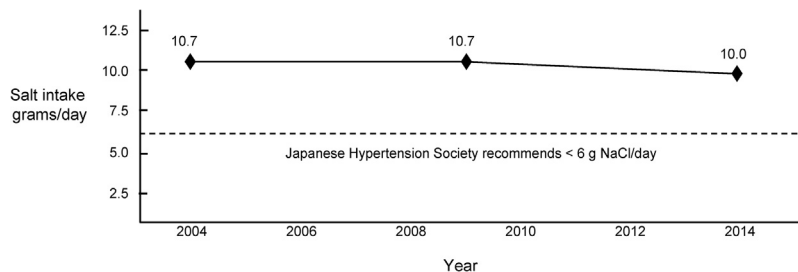


Fig. 1. Average daily salt intake in Japanese adults (males and females combined). Data taken from Kawano and colleagues for 2004 [82] and from the Japan Ministry of Health, Labor, and Welfare for 2009 and 2014 [83]. Average daily salt intake (~10 g/day) changed very little between 2004 and 2014 and has remained well above the maximum level of 6 g/day recommended by the Japanese Society of Hypertension [8,10,12].

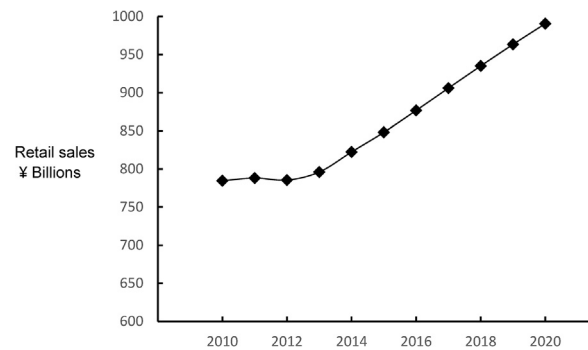


Fig. 2. Annual retail sales of functional foods in Japan, current and projected [24]. Retail sales of functional foods are substantially increasing in Japan [24].

components that provide health benefits beyond basic nutrition [20]. In contrast to other countries, Japan has formulated an explicit and detailed regulatory approval process for functional foods. Through this process, the Japanese Ministry of Health has approved the labeling of food products with various health benefits, including claims related to the control of blood pressure [21]. A variety of functional foods and nutrients with antihypertensive properties have been described that may help to maintain healthy blood pressure [22,23]. Recently, Japanese regulations for the labeling of certain types of functional foods were modified [21] and retail sales of functional foods appear to be substantially increasing (Fig. 2) [24].

Improved understanding of the mechanistic abnormalities that initiate salt-induced hypertension could provide insight into specific types of functional foods that might be useful for maintaining normal blood pressure in subjects consuming a high-salt diet. Accordingly, we next discuss the hemodynamic abnormalities most commonly involved in the initiation of salt-induced hypertension. We then consider how some groups of functional foods may ameliorate those abnormalities and help people maintain healthy blood pressure despite consumption of a high-salt diet.

A contemporary mechanistic framework for initiation of most instances of salt-induced hypertension

For decades, cardiologists have widely embraced the historical view of Guyton and colleagues on the pathogenesis of salt sensitivity and salt-induced hypertension. This view holds that salt-induced hypertension is usually initiated by a subnormal renal ability to excrete a salt load which causes abnormal increases in sodium balance, blood volume, cardiac output, and therefore blood pressure [25–33]. Thus, the historical view has encouraged the use of preventive interventions against hypertension that are based on reducing salt intake or increasing salt excretion. However, as we have discussed in detail elsewhere, the results of salt-loading

Download English Version:

<https://daneshyari.com/en/article/8667838>

Download Persian Version:

<https://daneshyari.com/article/8667838>

[Daneshyari.com](https://daneshyari.com)