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Risk Analysis of Sulfites Used as Food Additives in China*

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This study was to analyze the risk of sulfites in food consumed by the Chinese people and assess the health protection capability of maximum-permitted level (MPL) of sulfites in GB 2760-2011. Sulfites as food additives are overused or abused in many food categories. When the MPL in GB 2760-2011 was used as sulfites content in food, the intake of sulfites in most surveyed populations was lower than the acceptable daily intake (ADI). Excess intake of sulfites was found in all the surveyed groups when a high percentile of sulfites in food was intaken. Moreover, children aged 1-6 years are at a high risk to intake excess sulfites. The primary cause for the excess intake of sulfites in Chinese people is the overuse and abuse of sulfites by the food industry. The current MPL of sulfites in GB 2760-2011 protects the health of most populations.

According to Codex Alimentarius, risk analysis is a structural decision-making process consisting of risk assessment, risk management and risk communication which are interactive and interwoven with each other. Risk assessment and other factors for the health protection of consumers and all interested parties should be considered for food management process to select appropriate prevention and control measures. Apart from the interactive exchange of information and opinions among the participants and other interested parties, it is important to explain the risk assessment findings and the basis of risk management decisions to the public[1-2].

Food additives are synthetic chemicals or natural substances added to food for prolonging its preservation or improving its flavor, taste or appearance[3]. Sulfites refer to a series of multifunctional food additives, which are widely used in food industry as antioxidants, decolourants, flour treatment agents and preservatives. Sulfites approved as food additives in China include sulfur dioxide, potassium metabisulfite, sodium metabisulfite, sodium sulfite, sodium hygrogen bisulfite, and sodium hydrosulfite[3]. Sulfur dioxide is usually used to indicate the sulfite content in food[4].

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) reevaluated the dietary intake of sulfites at its 69th session, during which it was concluded that the dietary intake of sulfites in populations may exceed the ADI[4]. According to the National Food Safety Standard for Uses of Food Additives (GB 2760-2011), the usage of food additives should not be harmful to human health[3]. Therefore, the risk of sulfites used as food additives under current conditions must be assessed to provide information for the management of potential risks.

Risk assessment based on scientific knowledge consists of hazard identification, hazard characterization, exposure assessment and risk characterization[1]. As different dietary patterns may lead to different intake levels, the dominant sulphite sources for different Chinese population groups also need to be assessed respectively to support their specific management.

Point estimate is widely employed in the assessment of dietary exposure. If a rough estimate of dietary exposure among the surveyed populations is higher than the ADI or the provisional tolerable weekly intake (PTWI), more refined assessment methods such as point estimate are applied in further analysis. Point estimate uses the mean, median and high percentile values of the survey data or the maximum permitted level (MPL) of the target material proposed by national or international food authorities to estimate the dietary exposure in a certain population. It is comparatively accurate and easy to handle and is thus preferred by EFSA in modeling high consumers[5].

In the present study, the risk of sulfites in food was analyzed with food additive risk assessment techniques. The intake pattern of sulfites in different Chinese populations was estimated according to the Chinese dietary consumption pattern data and the

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actual sulfite content in food. The assessment was discussed and compared to the regulatory limits for sulfites in other countries with suggestions put forward for the risk management of sulfites in China.

Data Resources The dietary intake data of the 2002 China nutrition and health survey (CHNS) were used in this study. The survey was composed of inquiry, medical examination, laboratory tests and dietary survey. Of the 272 023 individuals included in this survey, 68 962 from 23 463 families (7 683 from urban areas) of 132 counties or areas participated in the dietary survey. A 3-day food intake was investigated in each family using the 24 h dietary recall method. The data of daily food intake in individuals were obtained using the information about both eating outside and at home[6].

The data of sulfites in different foods used in this study were derived from the national contaminant monitoring system (2003 to 2007)[7]. Intake of sulfites was assessed using the MPL of sulfites in GB 2760-2011 National Food Safety Standards for Uses of Food Additives.

Body weight from the 2002 CHNS was also used in this study[6].

Risk Assessment Method Hazard identification and hazard characterization have been applied in the assessment of food additives by JECFA for many years. The findings in their study are related to different races, genders and ages around the world. As a result, developing countries are able to rely on the determinations made by JECFA and do not necessarily set their own ADI or PTWI for food additives evaluated by JECFA[8]. The 17th Session of JECFA set the ADI for sulfite as 0-0.7 mg/kg·bw according to its evaluations[9]. Hazard identification and hazard characterization of sulfites reported by JECFA were used in this study.

Exposure assessment of dietary intake is the qualitative and/or quantitative evaluation of the likely intake of biological, chemical and physical agents via food, and exposures to other sources. It considers both food consumption data and food additive levels in food[5]. For this reason, the exposure assessment is closely related to the consumption patterns, thus varying significantly among different population groups. The surveyed populations in this study were divided into 1-3 years old group, 4-6 years old group, 7-10 years old group, 11-14 years old male group, 11-14 years old female group, 15-17 years old male group, 15-17 years old female group, 18+ years old male group, and 18+ years old female group according to their age and gender. Relative data about the 9 groups were further analyzed respectively. The exposure to sulfites in the 9 groups was assessed using the point estimate method.

The exposure values to sulfites in different groups were calculated according to the following formula:

$$Y = \sum_{k=1}^{p} x_k \cdot c_k / \overline{w}$$

Where y means the daily intake of sulfites in a specific group, x_k indicates the daily consumption of food, c_k refers to the sulfites in food, w is the average body weight.

The average daily intake of each kind of food in each population group was calculated using the SAS statistical software. The average sulfite content and the P50, P95, P97.5 value in different foods were computed by EXCEL 2007 using the data from the national contaminant monitoring system (2003 to 2007). In order to address all possible exposure scenarios for each kind of foods, the average value and the P50, P95, P97.5 value of daily food intake were multiplied by those of sulfite content to represent different consumption patterns.

Moreover, the ratio of sulfite intake in each food category was calculated by dividing the intake of each food category for assessing the contribution of each kind of foods to the total intake of sulfites.

Risk characterization is described as the qualitative and/or quantitative estimation of attendant uncertainties, probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, hazard characterization and exposure assessment[10]. If the ADI or PTWI determined from the hazard characterization is larger than the total sulfite intake in a particular population group determined from the exposure assessment, the safety of this kind of additives is not concerned[8-9].

Sulfite Content The sulfite content in different foods is listed in Table 1. The sulfite content in compotes, dried vegetables, pickled vegetables, dried edible fungi, edible fungi and algae cans and rice-flour products permitted to use sulfites as food additives, exceeded the permitted level in the standard. The mean value of sulfite content in dried edible fungi and edible fungi and algae cans was even higher than the MPL in GB 2760-2011[3].

Sulfites were found in several kinds of food in which sulfites are not permitted, such as nuts and seeds, steamed bread and fresh edible fungi. For