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Repercusión de diversos alimentos y componentes de los alimentos en la salud

Low and no calorie sweeteners, diet and health: an updated overview

Edulcorantes bajos en calorías o sin calorías, dieta y salud: una visión actual

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Abstract

Introduction: currently, there is a great deal of controversy surrounding the potential health benefits and risks associated with the use of low and/or no calorie sweeteners (LNCS).

Objective: in the present work, the objective was to briefly address the current role of LNCS consumption in the diet and its effects on health.

Methods: a brief narrative review of the most recent studies and policies available was carried out.

Results: a limited number of representative studies on the consumption of LNCS and their effect on health are presently available. However, these mostly indicate that the consumption of LNCS can be a useful tool along with other nutritional strategies in the treatment of overweight, obesity, diabetes and the prevention of caries when used appropriately in the context of a balanced diet and physical activity. Still, it is necessary to be cautious with the consumption of certain sweeteners since the effects of LNCS on the intestinal microbiota or its effect on premature deliveries, among others, have not been fully elucidated.

Conclusions: it is essential to carry out further studies in order to clarify/establish the safety and value of sweeteners as food ingredients/additives in the medium/long term, in a model of increasing consumption as a consequence of the reformulation of many foods.

Keywords:

Added sugars. Low- and no-calorie sweeteners. Additives. Health. Disease.

Resumen

Introducción: en la actualidad, existe una gran controversia en torno a los beneficios y riesgos potenciales asociados al uso de los edulcorantes bajos en/o sin calorías (LNCS) en el modelo alimentario y su repercusión en la salud.

Objetivo: en el presente trabajo, el objetivo fue abordar brevemente el papel actual del consumo de LNCS y sus efectos en la dieta y salud.

Métodos: se llevó a cabo una revisión narrativa de los estudios más recientes disponibles.

Resultados: se observa un número limitado de estudios representativos sobre el consumo de LNCS y su efecto en la dieta y la salud. No obstante, los estudios disponibles indican que su consumo puede constituir una herramienta útil junto con otras estrategias nutricionales en el tratamiento del sobrepeso, la obesidad, la diabetes y la prevención de las caries cuando se utilizan adecuadamente en el contexto de una dieta equilibrada y ejercicio. Sin embargo, hay que aplicar el principio de precaución con el consumo de ciertos edulcorantes, ya que los efectos de los LNCS en la microbiota intestinal o su efecto en los partos prematuros, entre otros, no han sido completamente dilucidados.

Conclusiones: resulta imprescindible realizar más estudios para poder aclarar/establecer la seguridad de los edulcorantes como ingredientes/aditivos alimentarios a medio/largo plazo, en un modelo de potencial consumo creciente como consecuencia de la emergente reformulación de muchos alimentos.

Palabras clave:

Edulcorantes bajos en o sin calorías. Aditivos. Salud. Patologías.

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INTRODUCTION

Low and/or no-calorie sweeteners (LNCS) are a chemically heterogenous group of food additives, comprising natural and artificial compounds, that when added to foods are intended to deliver different degrees of sweetness but providing considerably less energy (1,2). These compounds have been actively used as table-top preparations (sugar substitutes in hot or cold beverages) or as ingredients to replace or decrease added sugar (AS) content in a variety of food products (2,3). Although the last decade has seen intensive work assessing LNCS safety, nutritional aspects and benefits (3,4), at present, there is still controversy and disinformation. In the present work, our objective was to briefly approach the present role of the LNCS in the diet and health.

CARBOHYDRATES INTAKE RECOMMENDATIONS FOR A HEALTHY DIET

In 2010, the European Food Safety Authority (EFSA) issued its Scientific Opinion on Dietary Reference Values (DRV) for carbohydrates and dietary fibre (5), which are now included in the Summary report of DRV for nutrients published in 2017 (6). These recommendations support the daily intake of 40-60 % of total energy intakes (TEI) as total carbohydrates and AS should account for < 10 % TEI (6). According to the EFSA, AS include sucrose, fructose, glucose and starch hydrolysates such as glucose syrup, high-fructose syrup, etc. consumed as such or added over food preparation and manufacturing.

In 2015, the World Health Organization (WHO) published the *Guidelines for sugars intake for adults and children* (7), in which it was strongly recommended that the population should decrease their AS consumption throughout the life cycle to less than 10 % TEI. In addition, they included a consideration that a further reduction to less than 5 % TEI would have additional health benefits. But how much sugar are we talking about? According to the WHO recommendations, for an adult consuming approximately 2,000 kcal/day: a) < 10 % TEI recommendation: 200 kcal corresponds to a maximum of 50 g of sugar/day, equivalent to 12 teaspoons; and b) < 5 %: 100 kcal equivalent to a maximum of 25 g of sugar/day, equivalent to six teaspoons. A review that assessed the total and AS intakes and dietary sources in Europe found that relative intakes were higher in children than in adults: total sugars ranged between 15 and 21 % of TEI in adults and between 16 and 26 % in children, whereas AS contributed 7 to 11 % of TEI in adults and represented a higher proportion of children's energy intake (11 to 17 %) (8). Specifically, in Spain, the energy corresponding to total carbohydrates represented 41.1 %, total sugars 17 % and AS 7.3 % of TEI from the population (9). In addition, Ruiz et al. (10) observed higher AS intakes amongst adolescents aged 13-17 y (10 %) and children aged 9-12 y (9.8 %) whereas seniors aged 65-75 y had the lowest intakes (5.1 %). Furthermore, when evaluating the contribution from different food groups to AS intakes across age groups, authors (10) found that sugar sweetened drinks represented the major source among adolescents and adults (30.2 % and 26 % of total AS, respectively), while sugar (25 %), bakery products and pastries (21 %), jams (12 %) and yogurt and fermented milks (11 %) were the main contributors amongst elders. Relevant sources amongst children were chocolates in several presentations (22.7 %) followed by sugar sweetened drinks (17.9 %) and bakery products and pastries (16.1 %) (10).

FOOD REFORMULATION

This practice involves improving the content of selected nutrients (i.e., decreasing AS) in food products, by modifying some of their ingredients without increasing the energy content or that of other nutrients, maintaining food safety, flavour and texture so that the product continues to be accepted by consumers. If the composition of manufactured foods is designed to contribute to the enhancement of the overall quality of diets, food reformulation can be regarded as a useful mechanism for achieving the goals of population nutrient intake in current food environments (11). Food reformulation practices by food industry in Spain have been on a voluntary basis. In 2018, the Spanish Agency for Food Safety and Nutrition (AESAN) (12) developed a Collaboration Plan for the improvement of the composition of food and beverages and other measures to be achieved by 2020. This plan included the progressive reduction of AS, saturated fats and salt in more than 3,500 products that represented 44 % of daily energy intake from Spanish consumers, including 13 food groups and 180 voluntary agreements by involved stakeholders from food industry, catering services and distribution. A total of 398 stakeholders from Spanish food industry such as associations, manufacturers and distribution companies already adhered (12). Specifically, food reformulation plans for AS included decreasing different proportions of this ingredient contents in food products such as: 10 % decrease in dairy products (natural and flavoured yogurt, liquid yogurt, etc.), meat derivatives (cooked ham, turkey cuts, sausages, chorizo, etc.), fruit nectar, sauces, sugar-sweetened drinks (lime-lemon), chocolate breakfast cereals; 3.5-7.4 % in "indulgence" dairy products or deserts; and 5 % decrease in bakery and pastry, cookies, and sauces like ketchup (12).

PRESENCE OF LNCS IN THE SPANISH FOOD MARKET

Recently, Samaniego et al. (13) developed a database including brand names, ingredients and typology of LNCS and found that there was a widespread distribution across different food product categories, of which the most predominant were: refreshing drinks (20 %), juices and nectars (14 %), yogurts and fermented milks (13 %), chewing gum/candy (12 %) and bakery and pastry products (8 %) (13). However, due to the lack of information on added levels this description was purely of qualitative nature. Levels of LNCS addition within different brands and products are

a proprietary formulation issue and are not readily available for consumers or scientists. Furthermore, these levels can frequently change over time (14).

In other study conducted by Samaniego et al. (15), they found that the most frequent type of AS was sucrose (50 % of total products) while acesulfame K (30.5 %) and sucralose (30.2 %) accounted for most prevalent LNCS. There is room for reformulation as sugar remains the main ingredient for technological and sensory reasons. Still, they found that a significative number of products presented a combined addition of LNCS and AS. The main groups that showed this combination were drinks and beverages (energy drinks, sugar sweetened and others), bakery and pastry and yogurt and fermented milks (15).

LNCS AND ORAL HEALTH

Oral health problems globally affect almost 3.5 billion people worldwide, being caries of permanent teeth the most common condition (16). In Spain, caries affects 33 % of children under the age of five, a percentage that rises to 40 % in those under 15 years of age, 95 % in adults from 30 years of age and 100 % in the elderly (17). The WHO acknowledges that the marketing of food and beverages high in sugar has led to a growing consumption of products that contribute to detrimental oral health conditions (18). In fact, the guidelines on sugar consumption were based in scientific evidence connecting AS consumption and oral health. LNCS like sorbitol and xylitol, which are non-fermentable and non-cariogenic, can be found in sweets, candy, chewing gum and drinks (13,15), but also in toothpaste and excipients (19,20). This can be of special relevance when considering children and elders, whose oral hygiene habits might be limited and/or incomplete, as a tool to prevent plaque and caries development.

MAY LNCS AFFECT OUR MICROBIOTA?

Increasing the intake of simple sugars and reducing the consumption of dietary fibre could have detrimental and lasting effects on the microbiome (21). LNCS based on amino acid derivatives, such as aspartame, due to their low concentration and because the constituent amino acids are absorbed in the duodenum and ileum, and do not exert modifications (22). It has been described that saccharin and sucralose might have the ability to change the microbiota, but more human studies are required to confirm these changes (22). It is noteworthy that polyol-type sweeteners, which are poorly or not absorbed, such as isomaltose, maltitol, lactitol and xylitol, behave like true prebiotics, being able to reach the intestine and increase the number of bifidobacteria, both in animals and in humans (21). Further research is needed on the effects of LNCS on the composition of the human gut microbiome, thus confirming any effects that may have been found in experimental animal studies. Also, at different life stages and physiological conditions.

LNCS IN WOMEN OF REPRODUCTIVE AGE

Recently, Bailón-Uriza et al. (23) evaluated a number of relevant questions regarding the consumption of LNCS amongst women of reproductive age and controversial deleterious outcomes. In this consensus document, the authors found no prospective, controlled intervention studies evaluating the effect of LNCS in pregnant women. Therefore, LNCS do not seem to cause weight gain and, by substituting sugars in the diet, could contribute modestly to weight reduction. Neither they found any prospective controlled intervention studies evaluating the effect of LNCS on blood glucose in pregnant women. Contrarily, they found that LNCS safety was sustained in animal studies in several generations. However, the precautionary principle should be applied to raw Stevia leaf, cyclamate, and saccharin. They also reported that the available evidence is limited about promote preterm birth since: a) there are no controlled clinical trials that might establish a cause-effect relationship between the consumption of LNCS during pregnancy and the outcome of preterm labor; and b) the results of observational studies are inconclusive. Moreover, they found limited studies on LNCS consumption and breast milk. Sylvestky et al. (24) carried out a study collecting samples of breast milk from 20 lactating volunteers and saccharin, sucralose and acesulfame K were found in 13 of 20 milk samples. However, Bailón-Uriza et al. (23) report a lack of rigor in the analytical and statistical methods. More prospective clinical studies are necessary to determine whether early exposure to infants through breast milk may have clinical implications.

ARE LNCS AN EFFECTIVE TOOL IN BODY WEIGHT MANAGEMENT?

The premise of LNCS being considered as a tool for controlling body weight relies in that their ability to reduce the energy density of food and beverages can potentially lead to lower energy intake. LNCS are not the "panacea" to cause weight loss *per se.* Therefore, their impact will depend on the amount of sugar/energy that is replaced (25). The American Heart Association (AHA), the American Diabetes Association (ADA) (26), and the US Academy of Nutrition and Dietetics (AND) (27) support that LNCS can be used in a well-structured diet in order to replace AS. Substitution can lead to a moderate reduction in energy intake and body weight, provided there is no "compensation" with other foods (27). Interventional clinical trials show efficacy of the use of LNCS in greater adherence to body weight reduction and maintenance programs (28).

LNCS, GLUCOSE REGULATION AND DIABETES

Recommendations by international organizations regarding the role of LNCS in diabetes management sustain they can be used safely in diabetic patients, as they do not cause elevation of blood glucose or "peaks" in the glycemic curve (26). Although LNCS *per se*

do not lower blood glucose, they do act as potential modulators of a better eating model and lifestyle (more active individuals, and less likely to be smokers) (26,27). Indeed, Toews et al. (29) showed that populations including LNCS as part of their diets consumed on average 1,064.7 kJ (254 kcal/day) less than those who consumed sugar.

CONCLUSIONS

Food flavour is an organoleptic property that may be determinant in choice and consumption. A great deal of research has been recently published for the evolving relevance that LNCS are acquiring in food patterns worldwide and as shown, they may be an effective tool for: a) consumers: achieving AS reduction within the overall diet; and b) food industry: product reformulation and variety. Nonetheless, the promotion of a balanced, varied and moderated diet should always be encouraged from nutrition and health professionals.

AUTHOR CONTRIBUTIONS

M.L.S.V. and T.P. drafted the manuscript and G.V.-M. reviewed the manuscript. All authors gave final approval for publication.

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