



Presence and consumption of sugars and low and no-calorie sweeteners in the Spanish diet: an updated overview

Presencia y consumo de azúcares y edulcorantes, bajos en calorías y sin calorías, en la dieta española: una visión actual

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Abstract

Introduction: the term “sugars” describes a specific group of carbohydrates and one of the most controversial components of our diet, as public health authorities worldwide acknowledge that there is an excessive intake. Reformulation practices with low and no-calorie sweeteners (LNCS) are being carried out worldwide. However, a lack of information about the present market status and evolution is highly recognized.

Materials and methods: review of the most recent studies.

Results: there is a lack of comprehensive Food Composition Tables (FCT) and Databases (DB) including sugar contents and many countries have developed their own for the estimation of sugar intakes or with the aim of monitoring changes in processed food composition. Moreover, surveys assessing carbohydrate and sugar consumption and their dietary sources are scarce and sometimes not comparable due to the different methodologies, FCT and DB used, and non-harmonised use of terms and nomenclature, especially for the estimation of added sugars. Results from studies show that total and added sugar intakes around the world are quite comparable in terms of percentage of total energy from diet and major dietary sources. WHO's recommendations are being exceeded, especially amongst the younger population groups.

Conclusions: future research on sweeteners, both caloric and low or non-caloric, should comprise the development of comprehensible, harmonized and updated databases of added sugar and LNCS, the evaluation of the frequent consumption of LNCS from foods and beverages and its potential association with an improved food model/pattern and lifestyles. Finally, intervention studies with LNCS are urgently needed.

Key words:

Low- and no-calorie sweeteners. Additives. Food groups. Processed foods. Beverages. Spanish population.

Resumen

Introducción: el término “azúcares” engloba a un grupo específico de carbohidratos. Constituye uno de los componentes más controvertidos de la dieta, ya que su consumo excesivo se asocia con varios aspectos de la salud, de manera específica, los azúcares añadidos. Ello ha llevado a recomendaciones que limitan su consumo y a políticas de reformulación con edulcorantes bajos o sin calorías (LNCS). Sin embargo, se constata una falta de información actualizada sobre la presencia de azúcares y LNCS en la dieta, así como su evolución en el mercado alimentario.

Material y métodos: revisión de los estudios más recientes disponibles.

Resultados: se observa un número limitado de estudios representativos sobre la presencia de azúcares y LNCS en la dieta. Igualmente, hay carencia de tablas de composición de alimentos (TCA) y bases de datos (BD) actualizadas y, además, en muchos casos poco comparables por la diferente metodología utilizada o la distinta nomenclatura. En los estudios disponibles –entre los que se incluyen españoles–, hay un consumo excesivo de azúcares totales, y añadidos en particular, en relación a las recomendaciones, y fundamentalmente entre los más jóvenes.

Conclusiones: resulta imprescindible disponer de TCA y BD actualizadas y homologables internacionalmente, igual que de estudios epidemiológicos que analicen la relación entre la presencia de LNCS en la dieta habitual y diferentes indicadores de calidad de la dieta y estilos de vida. Finalmente, se requieren de manera urgente estudios de intervención validados.

Palabras clave:

Edulcorantes. Aditivos. Grupos de alimentos. Alimentos procesados. Bebidas. Población española.

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INTRODUCTION

The term “sugars” describes a specific group of carbohydrates and one of the most controversial components of our diet, as public health authorities worldwide acknowledge that there is an excessive intake, and that this is increasingly contributing to the global obesity pandemic (1). Furthermore, as part of a high-calorie diet, sugar has been recognised as a cause for dental caries and major non-communicable diseases (NCDs) such as diabetes (1). At present, research concerns are aimed not only at the implications of high sugar intakes on diet and human health (2), but also to the lack of use of harmonized nomenclature in nutritional and food consumption surveys when referring to different types of sugars. Carbohydrates comprise a chemically diverse macronutrient group that have the main role of providing energy to the human diet (4 kcal/g) by delivering glucose to body cells, and also adding sweet flavour and texture in food and beverage products (3). The definitions and terms used to identify them vary and can be very complex: carbohydrates, complex carbohydrates, simple carbohydrates, polysaccharides, sugar, total sugars, total available sugars, free sugars, added sugars, refined sugars, simple sugars, intrinsic and extrinsic sugars, caloric sweeteners, low and no-calorie sweeteners (LNCS), total carbohydrates and “by difference” (3,4). Each of these encompass a different concept and include specific chemical forms, thus it is essential that they should be clearly defined.

Food composition tables (FCT) and databases (DB) are essential tools to assess carbohydrate and added sugar consumption, but this information is not always available (5,6). In fact, there is a lack of comprehensive FCT and DB including sugar contents and many countries have developed their own for the estimation of sugar intakes or with the aim of monitoring changes in processed food composition (7,8). Moreover, surveys assessing carbohydrate and sugar consumption and their dietary sources are scarce and sometimes not comparable due to the different methodologies, FCT and DB used, and non-harmonised use of nomenclature, especially for the estimation of added sugars (9,10).

DEFINITION AND INTAKE RECOMMENDATIONS OF DIETARY SUGARS

Carbohydrates can be classified based on their chemical structure by their degree of polymerization into (a) sugars, monosaccharides or disaccharides; (b) Oligosaccharides and (c) polysaccharides (4). Sugars or monosaccharides and disaccharides are commonly known as “simple” and polysaccharides as “complex” carbohydrates concerning their hydrolysis, digestion and absorption rates. In addition, sugars can be categorised as “intrinsic”, meaning those that are naturally present in the structure or matrix of whole, fresh fruits and vegetables without further processing; and “added”, when referring to those which are extrinsically added to foods and beverages during their processing over manufacture, by cooking methods or by the consumer (4). Consequently, dietary sources of carbohydrates and sugars can be found over an extensive varie-

ty of food products, either naturally as in cereals and derivatives, legumes, tubers, fruits and vegetables; or added, as in bakery and sweets, dairy products, sweetened beverages and processed products, amongst others.

Worldwide sugar consumption has triplicated over the past 50 years, and this increase is expected to continue, mainly in emerging countries (11). For this reason, the World Health Organization (WHO) issued in 2015 a strong recommendation towards the reduction of free sugar intake to less than 10% of total energy (TE) in both adults and children and even a further reduction of free sugars to below 5% of the TE intake (1). The WHO defines “free sugars” as those monosaccharides and disaccharides that are added to foods and drinks by the manufacturer, cook, or consumer, and those sugars that are naturally present in honey, syrups, fruit juices, and nectars (1). According this definition, “free sugars” are like “added sugars”, as the term includes all sugars and syrups added to foods; however, chemically “free sugars” also refers sugars naturally present in fruits. By following the WHO recommendations, a healthy adult consuming approximately 2000 kcal/d should only consume 200 kcal, that corresponds to 50 g/d of sugar (12 small spoons) to comply with the 10% suggested limit and 25 g/d of sugar (6 small spoons) to meet the < 5% recommendation. Estimating and monitoring intakes at population level is challenging because “free sugars” cannot be analytically distinguished from naturally occurring sugars and, as mentioned earlier, most FCT and DB do not include food composition data on free or added sugars.

LOW AND NO CALORIE SWEETENERS

LNCS, also known as artificial, non-nutritive or intense sweeteners, are food additives that have a higher sweetness intensity per gram than their caloric counterparts (12). Therefore, they may be used in very small quantities and provide no or fewer calories, replacing added sugars in a variety of products (5,13). The use of LNCS in foods and beverages has become progressively more common for manufacturers to develop new products and to comply with food reformulation to reduce energy derived from added sugars (13). Moreover, there is an increased consumer interest in reducing energy intake (EI) and food products containing LNCS have become more popular. At present, we can find LNCS in products labelled as “sugar-free” but also in regular products together with added sugars.

There are nineteen LNCS authorized by European regulations: sorbitol, mannitol, acesulfame K, aspartame, cyclamate, isomalt, saccharine and its sodium, potassium and calcium salts, sucralose, thaumatin, neohesperidine DC, steviol glycosides or “stevia”, neotame, salt of aspartame-acesulfame, polyglycitol syrup, maltitols, lactitol, xylitol, erythritol and advantame (14,15).

Controversy has been related to LNCS intakes for potential detrimental effects on health (16). However, their safety has been subject of an extensive risk assessment evaluation by the European Food Safety Authority (EFSA) Panel on Food Additives and Flavourings and also scientific consensus documents (17,18). Further research is needed to clarify the potential benefits and harms of LNCS consumption (19).

TOTAL, INTRINSIC AND ADDED SUGAR INTAKES AND DIETARY SOURCES

Population's carbohydrate and sugar intakes have always been a relevant concern throughout nutrition surveys in western countries. In the US, Makarem et al. (20) evaluated carbohydrate intakes and their major food sources. Findings show that the contribution from total carbohydrates (51-46%) and total sugars (18-16%) to daily EI has decreased. There was a reduction in the percentage of energy from fructose (5.4-4.7%) and sucrose (9.8-8.8%). Regarding food sources, the number of weekly servings of bread, soft drinks, cakes, cookies, doughnuts, potatoes, milk, pasta, rice and cooked grains, fruit juice/drinks, potato chips, and lunch foods (e.g. pizzas and burgers) decreased, while the intake of ready-to-eat cereals, legumes, fruits, dairy products, candy and ice cream/sherbet/frozen yogurt increased significantly.

The ANIBES Study has described the median macronutrient profile of the Spanish population (21), where total carbohydrates accounted for 41% of TE. The median total sugar intake was 71 g/d (17% TE), the intrinsic sugar intake was 38.3 g/d (9.6% TE), and the added sugar was 28 g/d (7.3% TE) (22). Noteworthy, children and adolescents consumed significantly higher quantities of added sugars than adults and the elderly, and the latter had higher intrinsic sugar intakes (21,22). This was also observed in a review that analysed representative surveys from 11 European countries including Spain (9), where relative intakes were higher in children than in adults, with total sugars ranging between 15 and 21% of TE in adults and between 16 and 26% in children. In this work, added sugars contributed 7 to 11% of TE intake in adults and represented a higher proportion of children's EI (11 to 17%) (9). There was a strong age effect: added sugar contributed at least 30% more to TE intake in children vs adults (from +32% in Ireland up to +50% in the Netherlands) (9).

Major dietary sources of total sugars from the ANIBES study population were milk and dairy products (23%), non-alcoholic beverages (18%), fruits (16.8%), sugars and sweets (15%) and grains (12%) (21, 23). When examining intrinsic sugar contributors, fruits (31%), milk (19%), juices and nectars (11%), vegetables (10%) and yoghurt and fermented milk (7.18%) were the major providers. However, added sugar sources were mainly sweetened beverages (soft drinks, 25%), sucrose (table sugar, 17%), bakery and pastry (15%) and chocolate (11%) (21,22). Food sources of dietary sugars visibly changed their patterns consumption according to age groups. Total sugars provided by fruits were higher in the elderly (29%) compared to children (10%); in contrast, those from sweetened beverages in adolescents (16.41%) were much higher than in the elderly (3%) (22). When assessing intrinsic sugars, the pattern was obviously opposite between the elderly and adolescents, as the former age group had a higher contribution from fruits (45%) than the latter (21%). Milk was the main source of intrinsic sugars for adolescents (27%) and children (25%), followed by juices and nectars (21 and 22%, respectively) (21). Adults showed the highest contribution levels of intrinsic sugars from fruits (31%), milk (19%) juices and nectars (10%) and vegetables (10%) (22). Main added sugar contributors

amongst children were chocolate (22%), sweetened soft drinks (18%) and bakery and pastry (16%); adolescents had sweetened soft drinks (30%) as main added sugar sources, chocolate (17%) and bakery (13%). Adults and the elderly revealed a lower contribution from sweetened soft drinks (26% and 9%, respectively) but higher from sucrose (table sugar) (19 and 25%, respectively), and the elder had a high contribution from jams (12%) that no other group had ($\leq 3\%$) (22).

When assessing the adequacy of the dietary intake levels of total and added sugars in the ANIBES study, it was observed that 58% of children achieved the WHO recommendations ($< 10\%$ TE), a lower proportion amongst adolescents (52%), and higher for adults (76%) and the elderly (89%) (23). In the HELENA study (24), where diet from European adolescents was evaluated, total sugars intake (137 g/d) represented 23% and free sugars (110 g/d), 19% TE. Girls had significantly lower EI, carbohydrates, total sugars and free sugars but overall, 94% of adolescents had a consumption of free sugars above 10% of TE. These results show that there is an urgent need for improvement regarding food consumption patterns as dietary habits of Spanish and European children and adolescents are increasingly moving away from the Mediterranean diet (21,25). Some authors suggest that a diet high in added sugars could have a worse micronutrient profile, also regarded as a diet high in "empty calories" (26). In fact, a systematic review concluded that increased added sugar consumption was associated with poorer micronutrient intake, which was supported by positive conclusions from 42 out of 52 studies investigating the effect of added sugar intake on diet quality (27).

DIETARY SOURCES OF ADDED SUGARS LOW AND NO CALORIE SWEETENERS (LNCS)

Although there is an important number of studies assessing the dietary sources of added sugars worldwide (9,28,29), the interest in LNCS as their substitutes has also increased. Still, only limited information is available in Spain (30). In a publication derived from the ANIBES study, the presence and type of LNCS jointly with added sugars was also assessed amongst consumed food groups [5]. A final sample of 1164 foods and beverages was studied. Overall, 42% of foods and beverages presented added sugars in their composition, 10% included LNCS and 5% contained both. Sucrose was the most frequently declared added sugar (50%) and acesulfame K (30%) and sucralose (30%) were the most common LNCS. Added sugars were present in 85% of "sugars and sweets" but only 15% included LNCS; cereals and grains (including bakery, cookies, ready-to-eat breakfast cereals, etc.) declared added sugars in 64% of assessed products and LNCS in 5%; up to 57% of ready-to-eat meals had added sugars while none had LNCS, 55% of milk and dairy products included added sugars and up to 12% LNCS. Conversely, non-alcoholic beverages were the group with a higher presence of LNCS, as 39% of products included one or more types of LNCS while 36% included added sugars and 15% declared inclusion of both. Within the "non-alcoholic beverages" group, 100% of diet soft drinks

contained LNCS and none added sugar, in turn, sugar sweetened soft drinks, which were characterized by 100% sugar addition, also included LNCS in up to 24% of studied beverages. Soya drinks also contained only LNCS in 45% of product sample. Energy and sports drinks comprised sugar in a very high percentage of studied products (96%) but LNCS were declared in 24% and 4%, respectively. In the “milk and dairy products” category “other dairy products” (milkshakes, dairy desserts and ice cream, etc.) and yogurt and fermented milks had a higher number of products that declared added sugar contents (82% and 63%, respectively), but only the later included LNCS in a significant proportion (18% vs. 1%, respectively). As such, chocolates, table sugar and jams declared added sugars in 100% and 89% of studied products, respectively. On the other hand, the “other sweets” group that include candies and chewing gum contained LNCS in a higher number of products (89%) than added sugars (13%). Although “jams and other” are a category which frequently uses added sugars as a fruit preservative, up to 10% of products declared LNCS amongst their ingredients.

In the US, trends in consumption and sources of LNCS have been extensively studied (31,32). Popkin et al. (31) used representative samples of all bar coded foods purchased by Americans from 2000, 2006 and 2013 and analysed the extent of use of added sugars and LNCS in the US food supply. Amongst their results, 68% of all US barcoded food products had added sweeteners, of which 63% were added sugars. In addition, an increasing proportion of foods and especially beverages contained both added sugars and LNCS. LNCS were found mainly in beverages. Interestingly, between 2000 and 2010, Piernas et al. (32) observed a decrease in US household purchases of products containing added sugars, while those products including LNCS and both added sugars plus LNCS increased among households, especially those with children. Sylvestsky et al. (33) have also described a high prevalence of LNCS consumption in the US, amongst both children and adults. Most relevant results showed that 25.1% of children and 41% adults reported consuming LNCS and most consumers declared their use once daily (80% of children, 56% of adults) with frequency of consumption increasing with body weight in adults. LNCS consumption was higher in females compared with males among adults, and in obese individuals, compared with overweight and normal-weight individuals. Most LNCS consumers informed consuming LNCS with meals (64% of adults, 62% of children) and the majority of LNCS consumption occurred at home (71% and 72% among adults and children, respectively) (33).

CONCLUSIONS

As worldwide population has an excessive total and added sugar intake, public health authorities and the food industry must work towards effective strategies to reverse this trend. The use of LNCS is increasing as an alternative to added sugars but data about frequency of use and consumption levels is still scarce. Future research on sweeteners, both caloric and LNCS, should

comprise the development of comprehensible, harmonized and updated databases of added sugar and LNCS, the evaluation of the frequent consumption of LNCS from foods and beverages and its potential association with an improved food model/pattern and lifestyles but also a complete design of intervention studies with LNCS.

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