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Incentives and disincentives for reducing sugar in manufactured foods

An exploratory supply chain analysis



A set of insights for Member States in the context of the WHO European Food and Nutrition Action Plan 2015–2020

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Keywords

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Definitions

Sugars

Sugars are carbohydrates that are soluble in water. They are usually crystalline and have a sweet taste. The two main categories of sugars are *monosaccharides*, which are simple sugars, and *disaccharides*, which consist of two monosaccharide molecules joined together.

Total sugars are free sugars + intrinsic sugars + milk sugars.

Free sugars include monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.

Intrinsic sugars are sugars that are naturally contained within fruit and vegetables.

Milk sugars are sugars naturally contained in milk.

Added sugars are sugars added to foods and beverages by the manufacturer, cook or consumer.

Alternative sweeteners

These encompass non-caloric and caloric sweeteners that can either be natural or produced artificially.

Non-caloric sweeteners

Natural sweeteners include stevia, luo han guo (monk fruit), thaumatin (katemfe fruit), pentadin (oubli plant), monellin (serendipity berry) and brazzein (oubli climbing plant). They provide sweetness but no bulk to food and drinks.

Artificial sweeteners are also referred to as "high-intensity" sweeteners and are up to 3000 times sweeter than sugar (sucrose). Ten types of artificial sweeteners are allowed to be used in food and drink under European Union (EU) regulations. Artificial sweeteners provide no bulk to food and drinks.

Continued on next page

Caloric sweeteners

Polyols or sugar alcohols are a group of artificial and natural sweeteners that contain fewer calories than sugar (2.4 kcal/g) and also have a lower sweetness index. They are useful because they provide bulk to food. There are seven polyols permitted for use in food under EU regulations but only in small quantities as they have a laxative side effect.

Modified sugars are typically produced by converting starch using enzymes. They include isoglucose (known as high-fructose corn syrup in the USA), caramel and golden syrup. These sugars tend to be very sweet and highly calorific.

Source: Sugar and Sweetener Guide; 2017 (<http://www.sugar-and-sweetener-guide.com>)

Abbreviations and acronyms

ACP	African, Caribbean and Pacific (countries)
AMSP	Accompanying Measures for Sugar Protocol countries
AVMSD	Audiovisual Media Services Directive
EBA	Everything But Arms
EPA	Economic Partnership Arrangements
EU	European Union
HFCS	high-fructose corn syrup
LDCs	least developed countries
OQALI	Observatoire de la Qualité de l'Alimentation
VCS	Voluntary Coupled Support
WCRF	World Cancer Research Fund
WHO	World Health Organization
WTO	World Trade Organization

Executive summary

The amount of free sugars consumed in Europe exceeds levels recommended by the World Health Organization (WHO). A significant proportion of free sugars in the diet comes from manufactured foods, such as baked goods, breakfast cereals and sugary drinks. Excess sugar intake increases the risk of weight gain and diet-related noncommunicable diseases (NCDs) and is one of the major challenges in Europe in relation to the promotion of healthy diets. Yet the high free sugars content of certain manufactured products and the significant variation in composition, within product categories and between countries, indicate that there is significant scope to reduce the amount of sugar added to manufactured foods.

Several countries have initiated national actions to reduce sugar intake, including reformulation, targeted taxation and interpretative front-of-pack labelling. These actions align with the policy tools recommended in the WHO European Food and Nutrition Action Plan 2015–2020 to create healthier food environments. Nevertheless, more fundamental action is needed.

The publication of the WHO guidelines on sugar intake in 2015 has led to increasing demand from countries for more specific guidance on policies to reduce sugar intake. One recommendation for more fundamental change made by the WHO Action Plan, which is also supported by an increasing number of international reports, is to align wider “food systems” goals with the goal of making healthy diets available, affordable and appealing.

In this context, this policy brief presents the results of a novel food supply chain analysis that identifies insights for governments to consider when designing sugar reduction strategies. It explores the incentives and disincentives to using sugar in manufactured foods throughout the “sugar supply chain” – the actors and activities that take sugar from farm to fork. It draws on the perspectives of entities working inside this sugar supply chain to explore the following key questions:

- What are the incentives and disincentives for industry to reduce the amount of sugar in manufactured food and drink products?
- At what point along the supply chain do these incentives and disincentives operate?
- Are there opportunities to effectively enhance the incentives and/or lessen the disincentives for reducing sugar?

The sugar supply chain consists of a series of stages: production (of sugar cane and sugar beet); trade (export and import of raw and refined sugar); processing (refining sugar cane and processing sugar beet); manufacture (adding sugar to foods and drinks); and retail (sale of manufactured sugary foods and drinks). This brief focuses on manufactured food and drink products from the perspective of industry actors in the supply chain, including producers, manufacturers and retailers.

The analysis reveals that, throughout the supply chain, there are currently more incentives than disincentives to use sugar in manufactured foods (Table). Major incentives for manufacturers and retailers to use sugar in manufactured foods include the perception that sugar is the gold standard for sweetness, that sugar is needed to provide essential functional properties in manufactured foods, and that providing a range of products, including those high in sugar, is necessary to maintain “consumer choice” and competitiveness with other brands and retailers. The fact that sugar is a relatively cheap and abundant ingredient is not a direct incentive to use it, but means there is little incentive from the supply side *not* to use it.

Incentives to use sugar in manufactured foods	<ol style="list-style-type: none"> 1. Sugar is perceived as the gold standard for sweetness. 2. Competitiveness among manufacturers and retailers. 3. Maintaining “consumer choice”. 4. Sugar provides essential functional qualities in manufactured foods.
Lack of incentives to reduce sugar in manufactured foods	<ol style="list-style-type: none"> 5. Sugar is a relatively cheap and abundant ingredient available from multiple sources.
Disincentives to reduce sugar in manufactured foods	<ol style="list-style-type: none"> 6. Consumer concern about the use of artificial sweeteners. 7. Current regulations on nutrition claims and use of sweeteners.
Incentives to reduce sugar in manufactured foods	<ol style="list-style-type: none"> 8. Increasing consumer awareness of the health effects of sugar. 9. Government policy and actions to reduce sugar intake. 10. Availability of a greater range of non-caloric sweeteners.

There are also incentives for reducing sugar. As consumer awareness of the negative impact of sugar on health grows, that manufacturers and retailers are seeing a growing market in less sugary products. Policy action by governments to stimulate reformulation or influence consumer demand for sugary products through labelling, marketing restrictions and taxes, is also stimulating efforts to reduce sugar content in manufactured foods and drinks. The role of alternative sweeteners is mixed, with their presence creating an opportunity to reduce sugar levels but with consumer concern about them creating disincentives.

This framework of incentives can be used as a starting point to understand how incentives and disincentives throughout the supply chain are influencing food environments, identify the most powerful leverage points for change, and test out how actions taken in one part of the supply chain may have intended or unintended consequences on the rest of the chain. It can also help to identify the range of elements needed to make comprehensive sugar reduction strategies effective.

While it is a pilot study, the analysis of incentives and disincentives presented here leads to six interconnected insights for the design of sugar reduction strategies.

- Insight 1* Creating disincentives for manufacturers and retailers to add sugar to manufactured foods and drinks should be a strong focus of any sugar reduction strategy if the nutritional quality of the food supply is to improve.
- Insight 2* Using policy to set a level playing field for manufacturers and retailers across the sector would allow a “race to the top” by ensuring they are competing to achieve public health goals.
- Insight 3* Policies that reduce *demand* for sugar (for example, by helping children develop healthy taste preferences at an early age) will support the efforts of progressive manufacturers and retailers to grow demand for less sugary foods and drinks.
- Insight 4* Since sugar is inherent to the functional properties of many manufactured foods, measures will be needed that encourage substitution of manufactured foods and drinks with fresh, non-manufactured foods with no added sugars. This will be necessary if sugar intake goals are to be achieved.
- Insight 5* Careful consideration of the potential “substitution” effect of different policies is also needed. If sugar is replaced in different foods, what is it replaced with? This question must be considered to prevent unintended consequences.
- Insight 6* Over the longer term, sugar reduction strategies also need to consider how to engage with a fuller transformation of the “sugar system”. Reformulation of manufactured foods has its limitations, and there are many incentives that mean sugar is an attractive and affordable ingredient for manufacturers. Changing these incentives more fundamentally will require a rethink of the whole sugar production system towards quality, rather than quantity, of production in the longer term.

Overall, the results of the study identify opportunities for increasing coherence between the economic and public health goals of food systems, while also highlighting some of the important challenges. The analysis shows that there is a strong case for more research and policy discussions about the most effective ways to bring about a health-oriented transformation of modern food systems.

1 Background

1.1 Sugar and health in Europe

This policy brief explores the incentives and disincentives to the use of sugar in manufactured foods from supply to demand.* Focusing on the perspectives of entities working within the “sugar supply chain” on the (dis)incentives that affect them, the aim is to identify insights for public health policy-makers to consider when designing sugar reduction strategies, while also testing out a novel methodology for identifying how food systems can be leveraged for better diets and health. The context is the World Health Organization (WHO) recommendation that intake of free** sugars should be less than 10% of total energy intake in both adults and children (strong recommendation) and preferably below 5% of total energy intake (conditional recommendation***).¹

This WHO guidance is based on evidence that shows, first, that adults who consume less sugar have lower body weight and, second, that increasing the amount of sugars in the diet is associated with weight gain.² In addition, research shows that children with the highest intakes of sugar-sweetened drinks are more likely to be overweight or obese than children with a low intake of sugar-sweetened drinks. This is in a context where more than half of Europe’s adults are now overweight (58.6%), including 23% who are obese.³ At the same time, overweight and obesity among school-aged children (6–9 years of age) affect more than one in every four children in Europe.⁴ The highest levels of childhood overweight are observed in southern European countries, where the prevalence of overweight is closer to 30%. In the majority of countries in Europe, rates of obesity and overweight are higher among low-income groups.⁵

The recommendation to reduce sugar in the diet is further supported by evidence showing higher rates of dental caries (commonly referred to as tooth decay) when the intake of free sugars is above 10% of total energy intake, compared with an intake of free sugars below 10% of total energy intake, which justifies the conditional recommendation of 5%. Evidence shows that sugar has a role in the aetiology of dental caries, with a clear dose–response relationship.⁶ Despite improvements in dental prevention and treatment, dental caries remains a significant problem.⁷ In some European countries, up to 94% of children aged 5 years old have tooth decay.⁸

Finally, excessive consumption of sugar, especially in the form of sugar-sweetened drinks, is also reported to heighten the risk of developing type 2 diabetes and cardiovascular disease.⁹ The effects for cardiovascular disease are most evident when sugars are consumed in excess – that is, when accompanied by weight gain. However, some effects independent of weight gain may also be present.¹⁰

In Europe, the available evidence indicates that sugars are consumed above recommended levels. The data typically report in terms of *added* sugars, rather than *free* sugars, as used by WHO (see “Definitions”). Added sugars are more narrowly defined, indicating that the level of free sugars intake is likely to be even higher. Moreover, evidence suggests that dietary intake surveys may underestimate sugar intake.¹¹

Eighteen countries in the WHO European Region report data on sugar intake, and in 13 of these countries the data are recent (from 2010 onwards).¹² Eight countries report on added sugars in at least one age group. While intake varies across countries, the available data show that adults are universally consuming more than 5% of energy from added sugars (roughly 25 g/day of added sugars, assuming an average 2000 Kcal diet) (Fig. 1). Some population groups exceed 10% (roughly 50 g/day), with young men having the highest absolute intakes. Children and adolescents have a higher percentage of their total energy intake coming from added sugars than adults, consuming more than 10% of their daily energy intake from added sugars in Austria, Denmark, Estonia, Norway, Slovenia and the United Kingdom. In the United Kingdom and Denmark, for example, children as young as 4 years old consume more than 40 g/day of

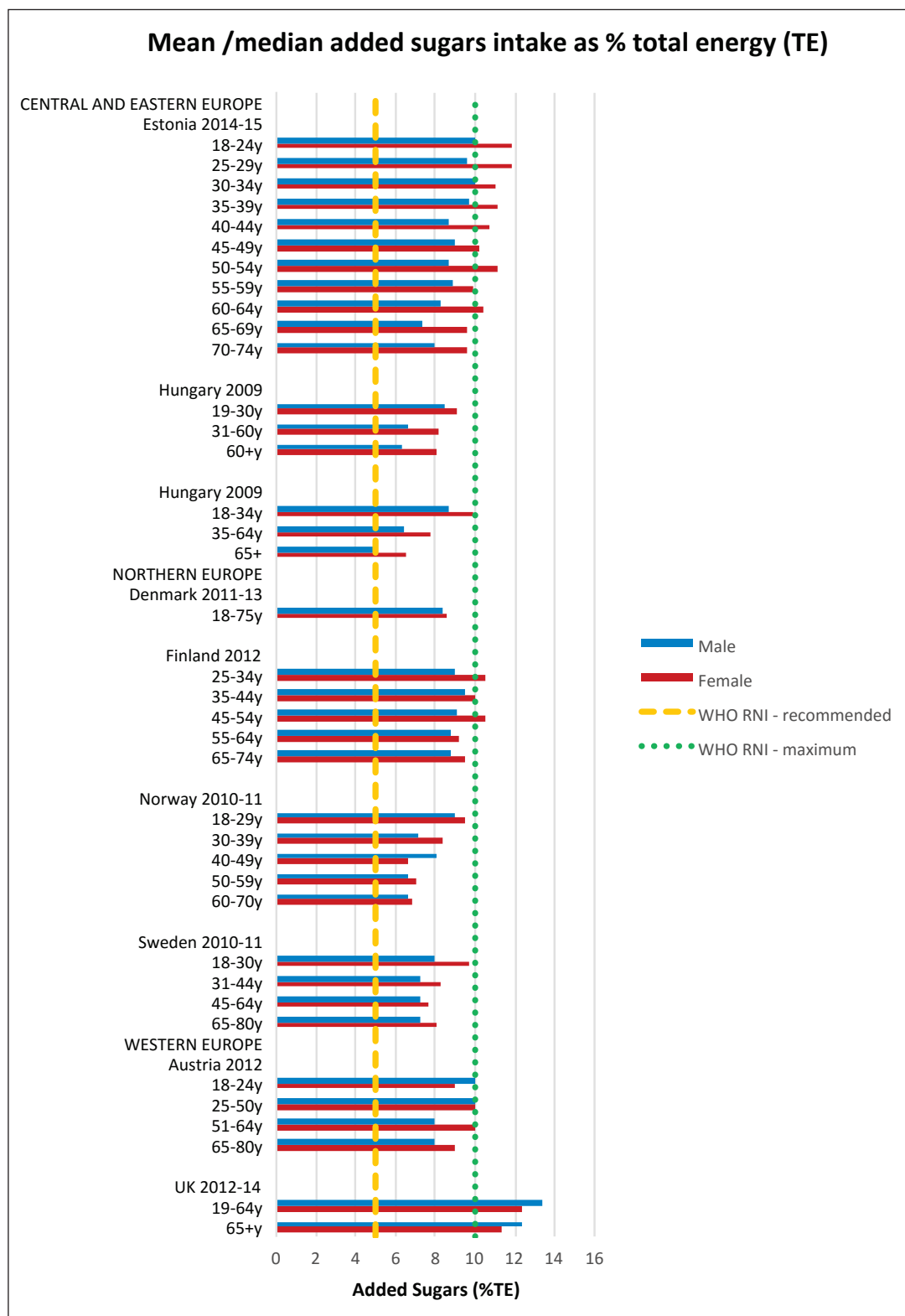
* The term “manufactured foods” is used throughout this policy brief to describe food and drink products that have been manufactured from different ingredients through an industrial process.

** The terms “free” and “added” sugars are used throughout this policy brief; their definitions are similar but not interchangeable (see “Definitions”). WHO has based its recommendation on free sugars intake. Dietary surveys and food labels often use added sugars.

*** A conditional recommendation is one where the desirable effects of adhering to the recommendation probably outweigh the undesirable effects.

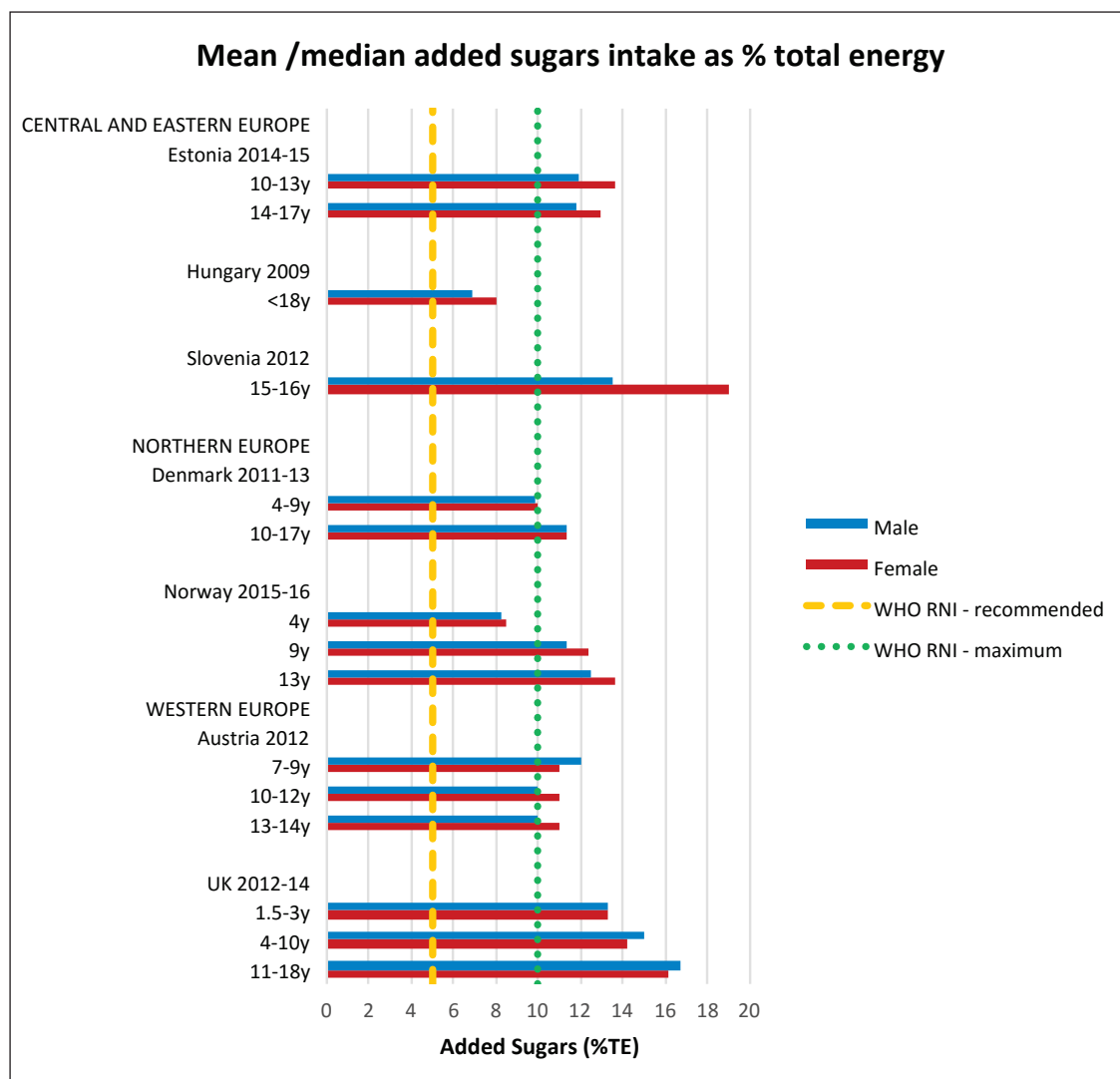
added sugars (Fig. 2).^{*} In Portugal, more recent data not yet incorporated into the cross-country comparisons show that 95% of the national population obtains more than 10% of their total energy intake from added sugars and one quarter of children under 10 years of age consume more than 32 g/day.¹³

Fig. 1. Added sugars intake of adults in eight European countries



* The Netherlands also provided nutrient intake data for total sugars, but then reported food group contributions based on mono/disaccharides and polysaccharides separately. However, a further analysis of the data for population aged 7–69 years calculated free sugars intake as 14% of total energy intake, and added sugars intake as 12% of total energy intake. Sugar consumption was higher in children than in adults.

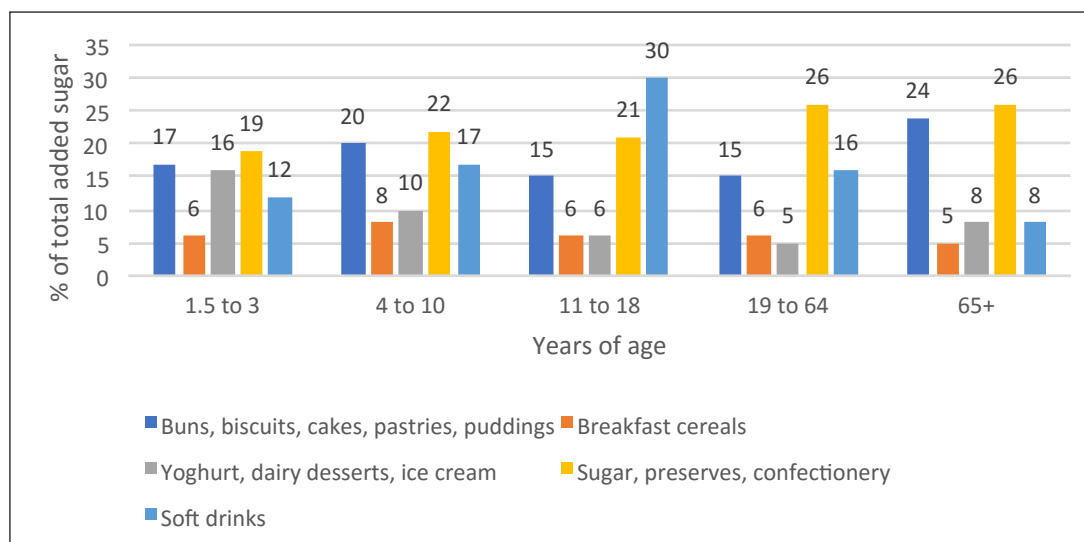
Fig. 2. Added sugars intake of children in seven European countries



1.2 Leading sources of sugar in Europe

The available data suggest that the major sources of sugars in the European diet are sugary drinks and sweet foods, including confectionery (sweets/candy), chocolates, cakes, pastries and biscuits.¹⁴ These manufactured foods and drinks are a significant source of energy in Nordic and central European countries,¹⁵ while recent data from southern European countries reveal the same trend.¹⁶ In Iceland, the main sources of added sugars were sugar-sweetened beverages at 34%, with sweets, cakes and pastries the second largest contributor at 22%.¹⁷ Adults in the Netherlands also get most of their added sugars (defined as mono/disaccharide intake) from non-alcoholic beverages (22%).¹⁸ In the United Kingdom, manufactured foods also contribute most added sugars to the diet; the leading sources are sugary drinks, baked goods, confectionery and breakfast cereals (Fig. 3). This is similar to findings from other high-income countries, including the United States.¹⁹ It has been estimated that up to 90% of added sugars in the US diet comes from manufactured foods.²⁰

Fig. 3. Sources of added sugars in the UK diet

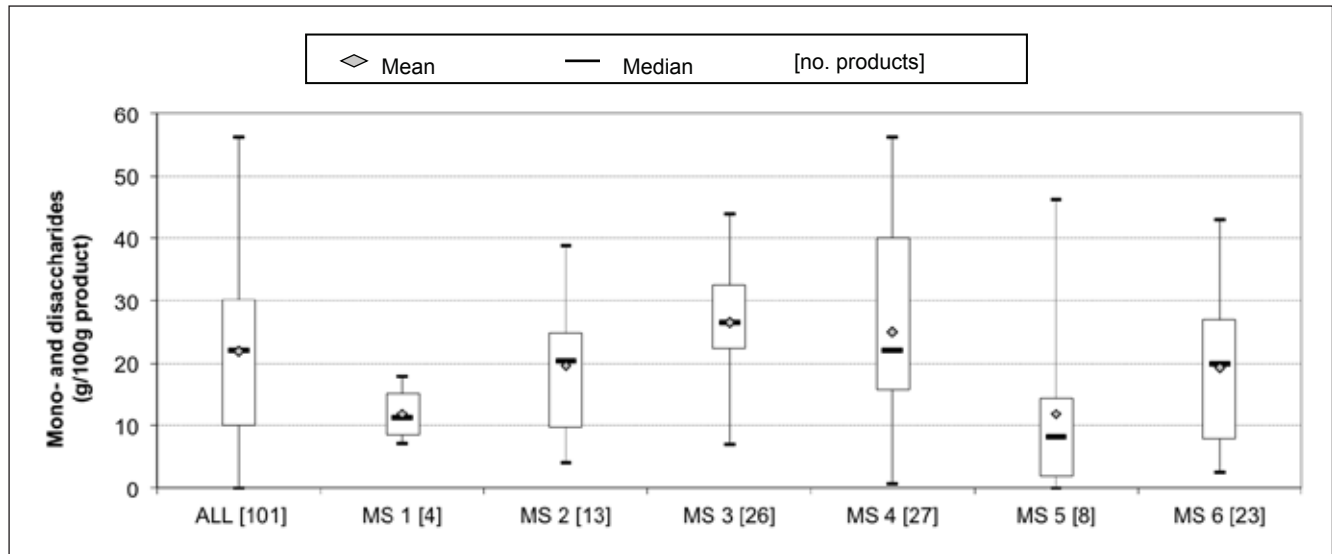


Source: National Diet and Nutrition Survey 2008/09 to 2011/12. London: NatCen; 2014.

There are significant variations in sugar levels in manufactured foods between countries throughout Europe. For example, one leading breakfast cereal manufactured by a top international brand contains up to 5 g/100 g more total sugars when marketed in the Russian Federation compared to the United Kingdom.²¹ A similar variation in the sugar content of one international brand of sugar-sweetened soft drinks has been observed across Europe.²² For example, the same soft drink had 23 g/330 ml can of total sugars when marketed in the United Kingdom compared to 38 g/330 ml can in the Russian Federation and 40 g/330 ml can in Turkey and Turkmenistan. Variation also exists within countries. Taking the example of breakfast cereals in the United Kingdom, some flake options contain up to 35 g total sugars per 100 g (Kellogg's Crunchy Nut Cornflakes), while possible substitutes such as Kellogg's Special K (17 g total sugars per 100 g) and Kellogg's Corn Flakes (8 g total sugars per 100 g) have completely different values.²³ Comparable children's varieties such as Kellogg's Frosties can contain even higher amounts of sugar (37 g total sugars per 100 g).

In 2015, the Dutch National Institute for Public Health and the Environment conducted an inventory of food composition within product groups in the Netherlands, Germany, France, Italy, Finland, the United Kingdom and Slovakia and found a large variation both within and between countries.²⁴ The selected food groups (bread, soup, sausages, cheese and breakfast cereals) were judged to make a significant contribution to the intake of salt, saturated fat, and/or sugar among European populations. For sugar in foods, the study investigated the mono- and disaccharides content of ready-to-eat breakfast cereals and found a large variation within and across countries (inter-quartile range = 20 g) (Fig. 4). The highest median sugar content identified in a study country was 27 g/100 g, while the highest sugar content identified in an individual breakfast cereal was 56 g/100 g. The authors concluded that the wide variation in nutritional content points to significant scope for improving product composition, including by reducing sugars in manufactured foods.

Fig. 4. Variations in sugar content of breakfast cereals sold in different European Union Member States (MS)*

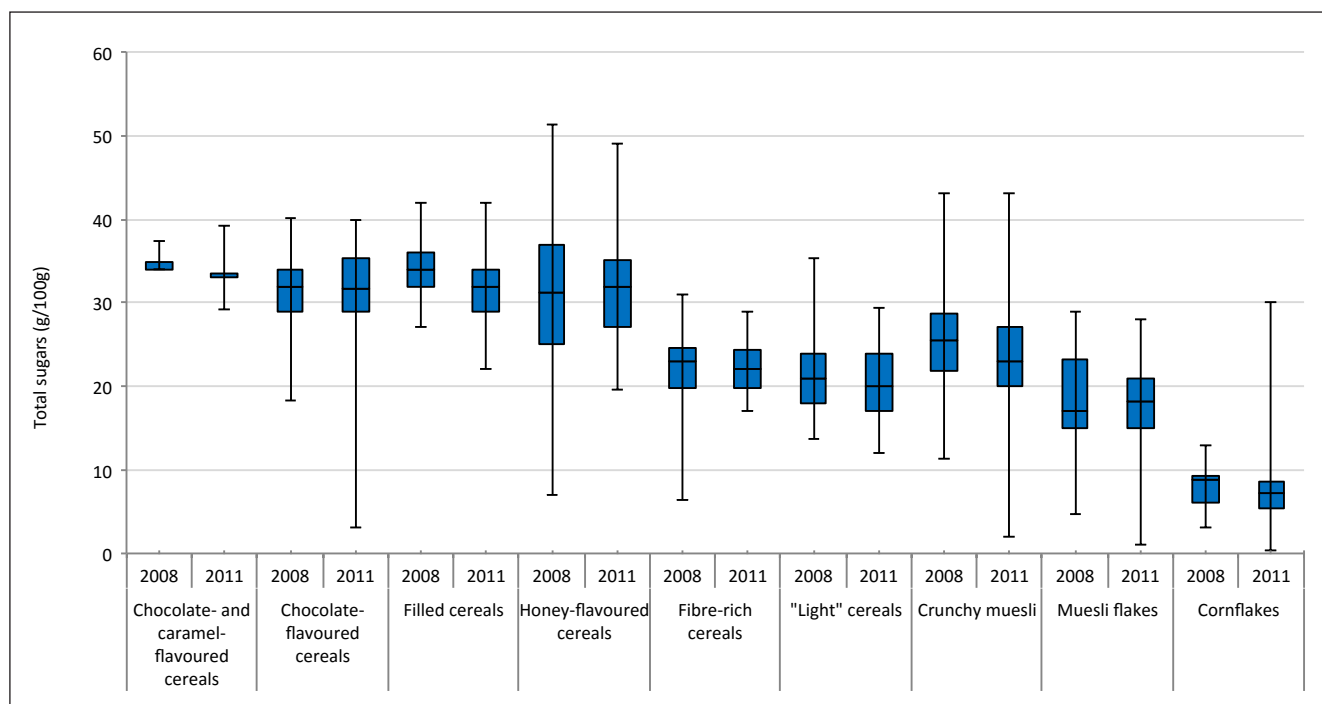


Source: EuroFIR, edited by Dutch National Institute for Public Health and the Environment.²⁵

In France, the Oqali (Observatoire de la Qualité de l'Alimentation) initiative has been monitoring the composition of specific food product categories since 2008, tracking changes in nutritional content but also exploring associations between composition, presence of labels and claims on packaging, and price.²⁶ In the case of breakfast cereals, the initiative has also found significant variability in nutritional composition. For total sugars, the variation in some product categories (e.g. muesli flakes with added sugar or frosted cornflakes) was as high as 39%, with a median sugar content of 27 g/100 g and 31 g/100 g respectively.²⁷ Similar results were found for cakes and biscuits, with, for example, a variation for "breakfast biscuits" at 28% (median = 25.7 g, but with some products exceeding 29 g) and as high as 53% for fruitcake (median = 29.5 g, but with some products exceeding 43 g).²⁸ Comparison between 2008 and 2011 shows that there have been some changes in median sugar content in breakfast cereals, but both the overall amount and variation in sugar content within categories remain high (Fig. 5). Monitoring found no systematic cross-category differences in composition between "entry-level" products or retailers' own-brand (private label) ranges when compared to other "higher-end" market sectors such as national brands.²⁹

* In the boxplot, the mean is indicated with a diamond (◊), the median with a horizontal line (—), and the 25th and 75th percentiles (P25 and P75) are indicated by the bottom and top of the boxplot; the minimum and maximum are indicated with the whiskers below and above the box. "ALL" indicates data of the countries combined. "MS" indicates Member State. The number of products for which data were available is indicated between brackets [n]. To describe the variation, the inter-quartile range (IQR), and the coefficient of variation (CV%) are presented. The IQR is the difference between P25 and P75. This gives an indication of the variation for the bulk of items within the food group. The CV% is the ratio of the standard deviation to the mean composition (%) expressed as a percentage.

Fig. 5. Variation in total sugars content of breakfast cereals sold in France (changes 2008 – 2011)*



Source: Oqali³⁰

1.3 Efforts to reduce sugar intake in Europe

Concerns about unhealthy diets in the WHO European Region are not limited to sugar. In general, diets in Europe are characterized by an overall energy imbalance and excessive intake not only of sugar but also of saturated fats, *trans* fats and salt, often consumed as manufactured foods and sugar-sweetened beverages. At the same time, inadequate consumption of vegetables, fruits and whole grains remains a significant challenge.³¹

With the aim of improving diets as a whole, the WHO European Food and Nutrition Action Plan 2015–2020 recommends that governments use a variety of policy tools to create healthier food environments, improve literacy and skills throughout the life-course, reinforce health systems, support surveillance and research, and take a “health-in-all-policies” approach.³² To create healthier food environments, the plan recommends that countries introduce restrictions on the marketing of foods to children and consider consumer-friendly labelling, pricing policies and school food standards, as well as “reformulation strategies”. This is a call echoed by many other actors, based on evidence of effectiveness but also cost implications.³³ A report by the McKinsey Global Institute called for implementation of as many interventions as possible, including reducing default portion sizes and introducing marketing restrictions, delivered “at scale and ... effectively by the full range of sectors in society” in order to “overcome obesity” and limit the damaging costs to economies.³⁴

With attention on sugar having increased since publication of the WHO guidelines, several of these strategies are being used with the goal of reducing sugar intake in Europe. Initiatives designed to encourage “reformulation” are now beginning to target sugar. European Union (EU) Member States have been working collectively since 2015 to encourage reformulation to reduce free sugars (Box 1). In 2017, 76% of countries in the WHO European Region reported that measures are being put in place to reformulate foods and beverages high in saturated fatty acids, *trans* fatty acids, free sugars or salt/sodium.³⁵ The largest proportion of these efforts still focus on salt (57%), but 37% of

* The methodology for monitoring food composition, based on collecting nutrition and ingredient information from food packaging for specific food categories and “families” of food products (i.e. subcategories), has since been incorporated into the Joint Action on Nutrition and Physical Activity (JANPA), involving 25 EU Member States and Norway (<http://www.janpa.eu/about/project.asp>). In Fig. 5, the 25th and 75th percentiles (P25 and P75) are indicated by the bottom and top of the boxplot; the minimum and maximum are indicated with the whiskers below and above the box.

countries report having specific initiatives to reduce sugar. In addition, 17% have reportedly agreed sugar reduction targets (76% of which depend exclusively on voluntary action). Examples of four countries – France, the Netherlands, Norway and the United Kingdom – explicitly working to reduce free sugars in manufactured foods, with well-defined actions and targets are described in Box 2.

Box 1. EU approach to reformulation of manufactured products

The EU platform for action on diet, physical activity and health is a forum for European-level organizations, including representatives of the food industry, consumer organizations and public health NGOs, willing to commit to “tackling current trends in diet and physical activity”.³⁶ It was set up in 2005, and since then platform members have made more than 300 voluntary commitments, including commitments by industry to reduce sugars in foods and/or reduce portion sizes.

In addition, the EU Framework for National Initiatives on Selected Nutrients was adopted in 2011 by the High Level Group on Diet, Physical Activity and Health (formed exclusively of EU Member States). This framework expanded previous work on salt to other nutrients, including saturated fat and sugar. In 2015 a specific Sugar Annexe was developed to support, guide and harmonize efforts across countries.³⁷ Priority is given to food categories that “commonly represent major sources of added sugars [in diets across Member States], that have a high public health impact or that are recommended to be consumed”. According to these criteria, the relevant food categories where efforts should be focused are sugar-sweetened beverages, dairy products, breakfast cereals, bread and bread products, confectionary, bakery goods (including cakes and biscuits), ready meals, sauces, savoury snacks, desserts, canned fruits, and school and catering offer. On the basis of experience in Member States, it was agreed to set a general benchmark for added sugars reduction of a minimum of 10% by 2020 in food products against 2015 baseline levels, and to adhere to the principles that reformulation should: (i) be mainstreamed across products with the largest market share; (ii) improve the overall nutrient profile of the products; (iii) apply to all food industry actors to ensure a level playing field; and (iv) pay due attention to the concerns of inequalities and children’s diets.

In 2016, the Dutch and Maltese presidencies* of the EU also focused attention on reformulation. A Roadmap for Action on Food Product Improvement was published in 2016.³⁸ The Council Conclusions** on Food Product Improvement that emerged following the Dutch presidency called on food business operators throughout the food chain to take responsibility for improving the mainstream products and meals they offer and, by doing so, to contribute to making the healthy choice the easy choice.³⁹ The Council Conclusions under the Maltese presidency restated the importance of food reformulation and consumer-friendly labelling in driving improvements to food products.⁴⁰

* The presidency of the Council of the European Union is responsible for the functioning of the Council. It rotates among EU Member States every six months. The presidency is not an individual, but rather a position held by a national government. The presidency’s function is to chair meetings of the Council, determine its agendas, set a work programme, and facilitate dialogue both at Council meetings and with other EU institutions.

** A process used to identify specific issues of concern for the EU and outline particular actions.

Box 2. Four examples of European countries with sugar reduction strategies

France

The French government has, since 2008, pursued a voluntary approach in the context of their national nutrition action plan. “Charters of voluntary engagement” have been signed with 37 food manufacturers and retailers, which include specific commitments to reduce sugar in certain products. While each engagement is agreed on a case-by-case basis with the government, a typical commitment might be for a breakfast cereal manufacturer to undertake to reduce sugar in their range of products by between 3.8% and 15%.⁴¹ Two notable examples include commitments signed with the main retailer chains in France, Casino and Leclerc, covering a range of product categories and private label products accessible to lower socioeconomic groups.⁴²

The Netherlands

In the Netherlands, sector-wide agreements have been reached covering the period 2014–2020 with the aim of making it easier for consumers to consume less salt, saturated fat and energy.⁴³ The agreements involve, alongside government authorities, the Dutch Central Bureau for the Food Trade, the Dutch Federation for the Food Industry, the Royal Dutch Hotel and Catering Association and the Dutch Catering Association. To achieve the objectives by 2020, manufacturers are encouraged, wherever possible, to reduce the energy density of products via a reduction in sugar and/or (saturated) fat and/or portion sizes. In relation to sugar, specific agreements have been reached for dairy drinks and desserts, and for soft drinks category-based benchmarks have been established.⁴⁴ In the case of soft drinks, in 2015 an agreement was made to lower the weighted average energy density per 100 ml to 10% by 2020 compared to the baseline year 2012. In January 2017, the reduction target was increased to 5%. The agreement consists of three tracks: (i) to increase sales of less energy-dense soft drinks and decrease sales of high energy-dense products; (ii) to lower the energy density of certain types of drinks through reformulation; and (iii) to decrease portion sizes of energy-dense products.

Norway

In Norway, the health minister established a Food Industry Group to address the industry’s responsibilities to improve public health. In late 2016, the members of this group signed a letter of intent for improving the Norwegian diet.⁴⁵ In this letter, the industry set specific population intake goals to be achieved:

- (i) reduction in salt intake from 10 g per day to 8 g per day (by 2021);
- (ii) reduction of added sugars intake by 12.5%, corresponding to about 11% of energy from added sugars (by 2021);
- (iii) reduction in intake of saturated fat from 14% of energy to 13% of energy (by 2018); and
- (iiii) increase in the intake of healthy foods such as fruit, vegetables, whole grain products and seafood by 20% (by 2021).

The signatories are free to choose the approach they would like to take in order to contribute to the common goal, but possible actions include:

- reformulating existing products, creating new healthy products or shifting advertising to healthier products;
- helping consumers to make healthier choices, such as through placement, portion sizes, pricing, packaging, labelling and advertising.

Continued on next page

A specific goal has already been set for sweetened beverages; in other areas, discussion is underway. When it comes to actions relating to sugar, the prioritized categories are the most common sources of added sugar, based on food consumption data:

- breakfast cereals
- bakery goods (including cakes and biscuits)
- fruit and berry products (including jams and drinks)
- dairy products (including milk, yoghurts and ice cream)
- sugar and confectionery (including chocolate, sweets and sweet spreads)
- sugary beverages.

A process of evaluation is planned on an annual basis in which signatories are invited to publicly show their contribution in the preceding year.

United Kingdom

In the United Kingdom, guidelines have been developed for all actors in the food and drink industry; these include 14 targets specific to particular food categories, and the aim is to reduce overall sugar across a range of products that contribute most to children's sugar intakes by at least 20% by 2020, including a 5% reduction in the first year of the programme.⁴⁶ The guidelines recognize that, depending on the product category, different approaches will be more effective. In the case of confectionery, portion size reductions will potentially achieve more; in the case of sugary drinks, a two-tiered tax has been introduced to drive down sugar content.⁴⁷

Some governments have also introduced taxes on sugary drinks (N = 9), along with "consumer-friendly front of pack" labelling using words, colours or symbols (N = 13), school food standards (N = 40), and some limited marketing restrictions (N = 25), with the aim (among others) of reducing sugar intake by influencing the availability and promotion of foods high in sugar and reducing consumer demand. Notable developments include adoption of the Nutri-Score front-of-pack logo in France,⁴⁸ and a system of warning symbols (or "negative front-of-pack labelling") on foods packages in Israel to highlight their nutritional content, using easily identifiable icons.⁴⁹ Some of these measures, such as taxation and front-of-pack labelling, also explicitly aim to influence reformulation,⁵⁰ while other initiatives aim to directly target consumers by limiting access to some products (e.g. in public and childhood settings), influencing social norms (e.g. through mass media) or providing advice at an individual level.⁵¹

Some leading food manufacturers and supermarket chains have also committed to reducing free sugar levels through voluntary reformulation efforts, as exemplified in Box 3, and the largest 10 global food and drink companies now have sugar reduction policies (Appendix 2). These reformulation efforts involve either reducing or removing added sugars without replacement, replacing sugar with non-caloric/low-energy sweeteners, or replacing sugar with alternative ingredients. For foods where sugar provides bulk, the entire composition of the product has to be modified to ensure that replacement of sugar is feasible while at the same time maintaining the product's form and ensuring replacement ingredients do not replicate or increase energy density. A brief insight into considerations manufacturers make when formulating and reformulating a product is found in Box 4. Evidence from France suggests the products chosen for reformulation have higher (or much higher) sugar content than the market median.⁵² So, while this indicates willingness to reformulate products across the full market range, it also indicates that sugar reduction efforts are made in the context of a very "sweet" starting point.⁵³

Box 3. Examples of reformulation

Reducing added sugars without any replacement

In the United Kingdom, Tesco has lowered the sugar content of its own-brand fruit yoghurt. Tesco reports that consumers found this to be acceptable because the fruit flavour was enhanced when not masked by sugar.⁵⁴ Similarly, in France, Nestlé committed to reduce sugar in infant foods; specifically, they committed to no added sugars in fruit-based desserts or snacks in 90% of their product ranges, and an increase from 11% to 57% of cereal-based products for infants that have no added sugars.⁵⁵ Also in France, Orangina Schweppes committed to a 7–12% reduction in added sugars in their leading drinks products.⁵⁶ In the Netherlands, a different approach has been adopted, with sector-wide agreements to achieve specific benchmarks. For example, a benchmark of 11.6 g maximum sugar content for yoghurts has been calculated on the basis of a 5% reduction in sugar from baseline; for desserts and puddings, a benchmark of 18.2 g was calculated.⁵⁷

Replacing sugar with low-energy sweeteners

Globally, Unilever has a commitment to reduce sugar in its sweetened tea beverages by 25% by 2020. Between 2010 and the end of 2016, a 12% reduction had been reported worldwide. Unilever markets beverages globally, including unsweetened, diet (zero calories), and sugar-reduced teas. All variants on the UK market are sugar-reduced using stevia (steviol glycosides), a natural sweetener, and are low-calorie. As stevia has a bitter taste and affects the mouthfeel of iced tea, 4.5 g/100 ml of sugar is still added.⁵⁸ Similarly, in France, Quick – a major “fast food” service chain – committed to reduce sugar in drinks by between 19% and 100%. The major vehicle for achieving this was also to introduce stevia-based drinks.⁵⁹

Replacing sugars with alternative ingredients: Dolmio Original Bolognese Sauce

Dolmio Original Bolognese Sauce is sold throughout Europe and the added sugars content has been gradually reduced over time. It now contains 5.6 g total sugars per 100 g, of which 1.7 g is added sugars. In other words, 70% of the total sugars originate from the tomato.

Added sugars/100 g

1994	3.8 g
2006	2.6 g
2012	1.9 g
2016	1.7 g

When added sugars were removed, the remaining ingredients had to be rebalanced to replicate the taste preferred by customers. Herbs such as fennel and basil were used to balance the flavour and deliver taste. The largest volume of Dolmio tomato sauces (90%) is sold in the United Kingdom and Ireland, and a whole range of “No added sugars” items were launched in these countries in 2017. If successful, they will be sold in other European countries as well.⁶⁰

Capitalizing through rebranding: Honey Monster Puffs

In the United Kingdom, following falling sales, Sugar Puffs were rebranded as Honey Monster Puffs in 2014. Added sugars were replaced with 20% more honey, lowering the total sugar content from an initial 31 g/100 g to 28.6 g/100 g. The packaging was redesigned with traffic light labelling included on the front of the pack. The launch of the new product was supported by a £3 million marketing campaign. More recently, the recipe was changed again and the total sugars content reduced to 22 g/100 g, which meant that the traffic light for sugars could be changed from red to amber.⁶¹

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Extending the range of products: tomato ketchup

Tesco now sells four variants of its own-brand tomato ketchup in the United Kingdom, with variations in the amount of total sugars to suit a range of consumer preferences.⁶²

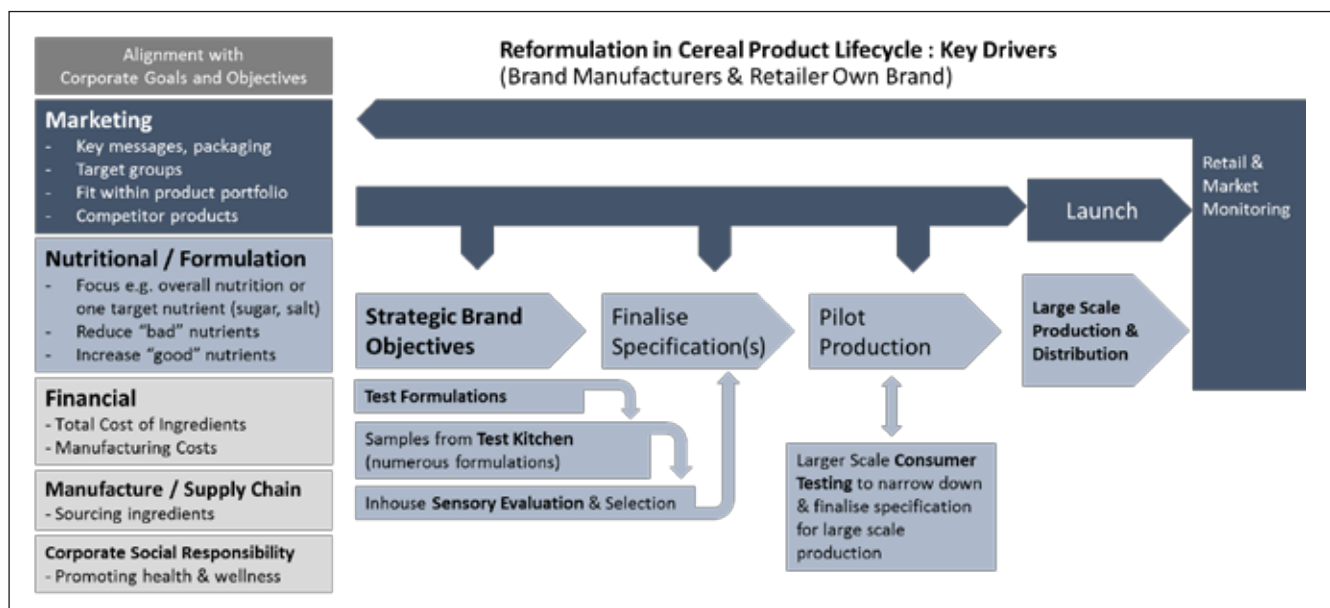
	Organic	Standard	Everyday	Reduced salt and sugar
Total sugars/100 g	18.8 g	18.1 g	13.4 g	5.7 g
Price/100 g	32 p	11 p	8 p	11 p

Box 4. Considerations when formulating and reformulating manufactured food and drinks

Reformulation is a complex process involving many actors and numerous departments within an organization, as illustrated for breakfast cereals in Fig. 6. It takes up to six months to complete and involves many factors, including product specification, packaging, testing and quality control. For retailers, existing stock has to be sold before being replaced with reformulated products, and this can take up to three months.

Product development requires input from the technical team, who will be heavily involved in developing formulations, while finance will ensure that costs are controlled. Manufacturing must also ensure that new formulations are compatible with the existing production process. The corporate social responsibility department will be involved with setting and driving nutritional commitments; it will also monitor aspects such as ingredient sourcing to ensure that it is in compliance with factors such as responsible sourcing and sustainability.

Fig. 6. Reformulation of cereal products to reduce sugar content



Source: Euromonitor International⁶³

1.4 A food systems approach to reducing sugar intake

It is evident that, from a health perspective, more fundamental action is needed to bring down the levels of sugar in manufactured foods in Europe. A “food systems” approach is increasingly being discussed to drive forward more fundamental change in improving diets as a whole. Food systems can be defined as “all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socioeconomic and environmental outcomes”.⁶⁴ A food systems approach to improving diet and health means aligning the way that food systems function, and the incentives and disincentives that influence the behaviour of food system actors, with the availability, affordability, acceptability and appeal of healthy, nutritious diets.

The proposal that food systems should align to produce healthier, available, affordable and acceptable diets has been made by a series of recent international initiatives and reports. The WHO European Food and Nutrition Action Plan 2015–2020 specifically states that creating healthier food environments will require:

creating or adjusting incentives along the food supply chain, such as through investments in production, supply chain logistics and procurement policies, in order to realign broader food system policies with public health goals and improve the availability and affordability of healthy diets.⁶⁵

The report *Nutrition and food systems*, published in 2017 by the High Level Panel of Experts of the Committee on World Food Security, recommends that food systems should be reoriented to improve diet and nutrition outcomes.⁶⁶ The *Work programme of the United Nations Decade of Action on Nutrition (2016–2025)* states that “Coherent and innovative actions covering the entire food system – from inputs and production, through processing, storage, transport and retailing to consumption – are needed to ensure access to sustainable, healthy diets for all”.⁶⁷ In its report *Food systems and diets* (2016), the Global Panel on Agriculture and Food Systems for Nutrition calls for “incentives for private sector actors throughout the food system so that they can make decisions more favourable to the adoption of higher-quality diets”.⁶⁸

Recommendations on improving food systems to improve diets have also featured in government-endorsed strategies and advocacy strategies of civil society organizations. For example, the EU Action Plan on Childhood Obesity 2014–2020 identifies agricultural producers, retailers and manufacturers as key actors influencing the supply of foods,⁶⁹ and EU Member States have started to put transforming food systems for healthy diets on the policy agenda.⁷⁰ A landmark publication on food policies to prevent cardiovascular diseases from the European Heart Network recognized that today’s food systems are intricate – with long food chains that involve many different actors – and called for action along the supply chain to positively influence what food is produced, how it is sold and at what price.⁷¹

1.5 Overview of policy brief

In this context, the remaining sections of this policy brief present the results of an exploratory food systems-oriented analysis for sugar. It explores the perspectives of the industries that make up the sugar supply chain, along with some supply chain experts, on the incentives and disincentives to the use of sugar levels in manufactured foods. The aim is to identify insights for governments to consider when designing sugar reduction strategies, while also testing out a novel methodology for identifying how food systems can be leveraged for better diets and health.

The method focuses on one element of food systems: food supply chains, also sometimes termed “value chains”.⁷² While the term food supply chains is widely used to describe the actors and activities that take food from farm to fork, gate to plate, boat to throat (see, for example, Fig. 7), analysing supply chains from a nutrition and health perspective is relatively new. The method used here builds on studies that have proposed and begun to use supply chains as a framework for better understanding how to improve diets.⁷³ It adopts this supply chain approach as a means of examining the incentives and disincentives from upstream supply to downstream demand. This enables, for example,

an exploration of whether an “upstream” supply-side change, such as the significant changes to EU sugar policy in 2017 involving liberalization of the sugar beet and isoglucose markets, would alter incentives for the use of sugar.*⁷⁴

As an exploratory scoping exercise, the analysis focuses in on just one aspect of sugar reduction through the supply chain – reducing the use of sugars in manufactured food and drink products; and in exploring largely one perspective – the perspective of the industry actors in the supply chain, including producers, manufacturers and retailers. These specific aspects were selected because manufactured foods contribute the overwhelming majority of free sugars in European diets; reformulation is being widely considered as a policy option; and understanding the perspective on the (dis)incentives from an industry standpoint could provide novel insights into the barriers and opportunities for government sugar reduction strategies.

A secondary aim was to test out a novel way to analyse sugar supply chains taking account of nutrition and public health aspects. As indicated, the method adopted is exploratory in nature. It involved desk research to map the supply chain; interviewing informants from this supply chain; and reviewing relevant literature to inform, complement and validate the interviews. The primary source of data was information gained from 34 interviews with informants with experience and expertise across the sugar supply chain. These included eight interviews with informants involved in sugar production, trade and processing; 15 interviews with those involved in manufacture of food and drink; nine interviews with informants involved in retail; and two with academic experts.

These interviews were carried out by an academic institution (Centre for Food Policy, City, University of London) and a market research company (Euromonitor International). Euromonitor International focused on interviewing those involved along the supply chain in the manufacture of breakfast cereals, including those active in the United Kingdom and the Russian Federation. The rationale for involving both an academic institution and a market research company was that Euromonitor International had better access to business informants and thus could increase the number of interviews, while the Centre for Food Policy was able to ensure that academic rigour was used in the analysis of the interviews. The methods are described in greater detail in Appendix 1.

This brief consists of four sections. Following this Background section, Section 2 describes a generic supply chain for sugar. Section 3 then presents the results of the supply chain analysis that addresses a series of questions:

- What are the incentives and disincentives for industry to reduce the amount of sugar in manufactured food and drink products?
- At what point along the supply chain do these incentives and disincentives operate?
- Are there opportunities to effectively enhance the incentives and/or lessen the disincentives for reducing sugar?

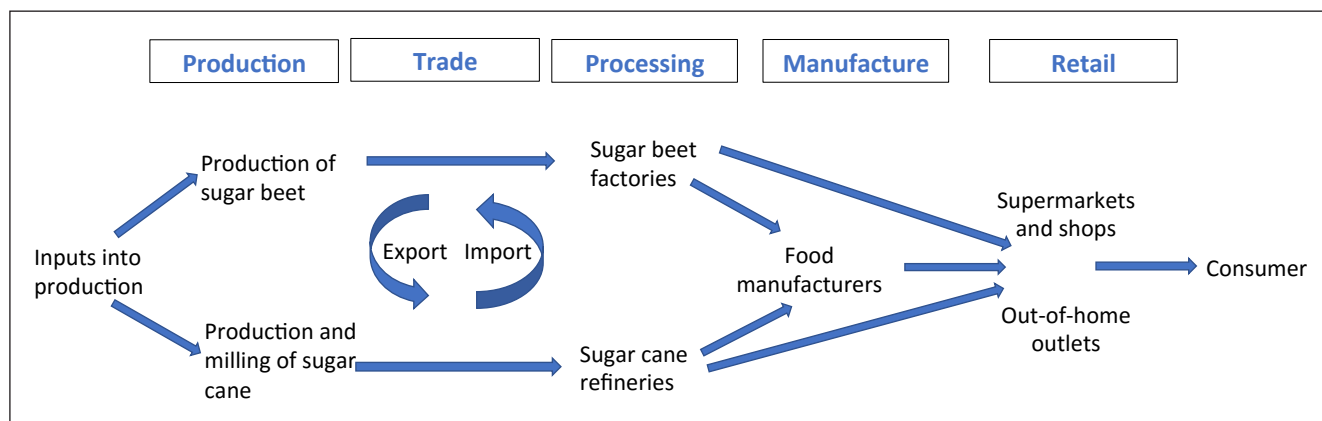
On the basis of these findings, Section 4 sets out six key insights for governments to consider when designing sugar reduction strategies.

* Isoglucose is a sweetener made from corn, wheat or rice starch. When made from corn, it is also referred to as high-fructose corn syrup (HFCS).

2 Stages in the sugar supply chain

Fig. 7 depicts a simplified version of the sugar supply chain in Europe. It shows that there are five broad stages: production, trade, processing, manufacture and retail.

Fig. 7. Stages in the sugar supply chain in Europe



2.1 Production

A total of 130 countries in the world produce around 170 million tonnes of sugar a year.⁷⁵ The majority (more than 80%) is in the form of sugar cane cultivated in warm temperate to tropical regions, while the remainder is sugar beet grown in temperate climates. Most cane production is concentrated in a small number of countries. In 2014 the top ten producing countries accounted for 75% of global production.⁷⁶ Brazil produces 20% of the global supply of sugar, followed by India, China and Thailand. In addition, there are many thousands of sugar cane farmers growing sugar on a small scale and sometimes as the only crop in African, Caribbean and Pacific (ACP) countries and least developed countries (LDCs).⁷⁷ The fact that Fairtrade sugar, which makes up 40% of UK supermarket sugar sales, is grown by 62 000 smallholder sugar cane farmers in 17 countries gives an idea of the scale of sugar production.⁷⁸ Tens of millions of people are estimated to be dependent on the sugar industry.⁷⁹

The EU is the world's leading producer of beet sugar, accounting for around half of the total. Leading producers include France, Germany, the United Kingdom and Poland. A further 15 EU Member States grow sugar beet, and of these, eight countries grow significant quantities (Austria, Belgium, Czechia, Denmark, Italy, Spain, Sweden and the Netherlands).⁸⁰ Outside the EU, the Russian Federation, USA, Turkey, Ukraine, Egypt and China also produce significant amounts of sugar beet.⁸¹

Producers of sugar are "supported" by various forms of protection and subsidies.⁸² EU sugar policies have been instrumental in protecting the European sugar market (Box 5), while European countries outside the EU are also pursuing policies to support their farmers in sugar production. In the Russian Federation, for example, development of the sugar industry is part of the State Programme on the Development of Agriculture 2013–2020; a target of 41 million metric tonnes of sugar beet production has been set for 2020, which would make the Russian Federation 80% self-sufficient in sugar. The programme is supported through investment loans to processors, although state support is modest.⁸³

Box 5. A short history of EU agricultural policy on sugar

EU sugar policy was first established in 1968 to regulate all aspects of the industry, ranging from production quotas and guaranteed prices to export subsidies and import restrictions. The EU subsidized sugar beet farmers with high production costs, including sugar beet growers, and (to a smaller extent) companies that refined imported raw cane sugar.

The ACP–EU Sugar Protocol

The Sugar Protocol, instituted in 1975, was attached to the first Lomé Convention and granted preferential access to the EU market for cane sugar from a group of African, Caribbean and Pacific (ACP) countries. Under the Protocol, 18 countries – mostly in Africa and the Caribbean, plus Fiji – benefited from a trade agreement whereby the European Community undertook to purchase and import certain quantities of cane sugar from these countries, which in turn undertook to deliver it at guaranteed prices that were negotiated in line with the intervention prices granted to EU farmers under the Common Agricultural Policy (CAP). The quantity of sugar traded under the Sugar Protocol was around 1.3 million tonnes of sugar per campaign. The Sugar Protocol was unilaterally denounced by the EU in 2007 with a notice period of two years.

Everything But Arms

The EU's "Everything But Arms" (EBA) arrangement was initiated in 2001 to give all least developed countries (LDCs) full duty-free and quota-free access to the EU for all their exports with the exception of arms and armaments. Sugar, along with rice and bananas, was subject to gradual liberalization between 2001 and 2009 to avoid protest from the EU sugar sector. This opened up the European market for sugar to LDCs, many of which were ACP Sugar Protocol countries.

World Trade Organization ruling

In 2002–2004, Australia, Brazil and Thailand complained to the World Trade Organization (WTO) that EU countries were receiving export subsidies above the level of the EU's commitments under the WTO Uruguay Round agreement. The Dispute Settlement Body of the WTO upheld the complaint that EU sugar policy was not compliant with international trade rules.

Sugar reform

Over the period 2006 to 2009, the EU sugar policy was reformed in response to the WTO ruling and the EBA initiative. The EU sugar beet production quota was reduced by 6 million tonnes to 13.5 million tonnes, divided between 19 Member States. Sugar factories were bound to pay a minimum price for sugar beet bought from farmers that was in-quota; however, the minimum beet and intervention prices were reduced by 36%. Only 1.4 million tonnes could be exported – a limit set by the WTO. The small production quota of 0.7 million tonnes for isoglucose was maintained. The consequence was a significant decline in sugar production, including the end of production in a number of Member States, and the closure of around 80 sugar beet processing factories. A system of compensation (worth €5.4 billion) was available to producers who left the industry. As a result of the sugar reform, the EU became one of the largest importers of cane sugar.

Having given notice that the ACP–EU Sugar Protocol would end in 2009, the EU negotiated Economic Partnership Agreements (EPAs) – regional trade agreements between the EU and six (now seven) groups of ACP countries. The EPAs are reciprocal but asymmetric trade agreements, in which the EU, as one regional block, provides full duty-free and quota-free market access to EPA countries and/or regions, while ACP countries/regions commit to open at least 75% of their markets to the EU. To cushion the negative impact of the EU sugar policy reform on countries formerly supplying sugar under the Sugar Protocol, the EU agreed to an "Aid for Trade" programme called the Accompanying Measures for Sugar Protocol countries (AMSP). This earmarked

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almost €1.3 billion to assist the affected ACP countries by enhancing the competitiveness of their sugar industry, diversifying economic activity in the cane-growing areas, and addressing the social and environmental impacts of adaptation.

Lifting of quotas

In 2013, the EU Member States and the European Parliament reached agreement on the abolition of sugar beet production quotas to take effect from 1 October 2017. Quotas were also lifted on the production of isoglucose. The system of CAP direct payments to EU farmers had already been extended to include sugar beet farmers after the 36% price cuts implemented in 2009, with the result today that most farmers are no longer paid to cultivate a particular crop (so-called “coupled payments”); instead, they are paid decoupled payments as a “caretakers” of the land. However, coupled payments for particular crops were not entirely removed in 2013 because Member States can still pay “voluntary coupled support” (VCS) to specific sectors including sugar beet, but only to the extent necessary to maintain current levels of production. Ten EU countries are applying coupled payments for sugar beet under the VCS heading. Farmers collectively receive between €169 million and €179 million per year up until 2020 to grow sugar beet.⁸⁴ Poland is by far the greatest beneficiary of the VCS system, which, for the EU as a whole, supports the production of around 3.5 million tonnes of sugar per annum (or about 20% of the total), which would not, according to the terms of the VCS legislation, otherwise be produced.

Impact of lifting the quotas on production and prices

There is a general consensus that European sugar beet production will increase substantially as a result of the lifting of production quotas and that the EU will become a leading exporter of sugar.⁸⁵ Between 2016 and 2025, the EU expects sugar production to increase by 5% from 16.7 to 17.7 million tonnes. Imports are expected to be reduced from around 3.5 million to 1.8 million tonnes, while exports are expected to increase from 1.3 to 2.5 million tonnes. Isoglucose production is also expected to increase threefold from 0.7 to 2.3 million tonnes. The price of sugar in Europe is expected to decline and become more aligned with world prices, which are not projected to increase substantially over the next 10 years.

Sources:⁸⁶

The EU agricultural policy on sugar has been effective in assuring growers a guaranteed market and in maintaining a higher price for sugar than the world price. The world price of sugar has been volatile over the last 20 years due to a complex array of factors affecting both demand and supply.⁸⁷ Despite this volatility and the protections given to producers in Europe, sugar is frequently perceived as a cheap commodity and the indications are that it will become even more abundant and lower-priced in Europe after the lifting of quotas.

There will be competition, however, from competing supplies of cheap sugar from outside Europe and because of the greater availability of isoglucose produced both within and outside Europe. Isoglucose, known as high-fructose corn syrup (HFCS) in the US, is a caloric sweetener which competes with sugar and has been widely used in the US to sweeten beverages and other foods. The consumption of HFCS in the US increased by 1000% between 1970 and 1990, far exceeding the changes in intake of any other food or food group.⁸⁸ The production of isoglucose has been controlled in EU countries through a quota system which has limited production to 5% of the total EU sugar market. To date, this has effectively limited access to isoglucose in Europe (Box 5).⁸⁹ Again, with the expected increase in supply of isoglucose in the EU, this will contribute to sugar (in all its forms) becoming more widely available and cheaper.

2.2 Processing

Sugar cane is initially processed in mills located within or close to plantations, where sugar is extracted from the stalks. The raw brown sugar that is produced is transported to sugar refineries either within the same country (as for most sugar grown in Brazil) or in another country (as for sugar grown in ACP countries and LDCs that is transported to the EU to be refined). Sugar refineries transform raw brown sugar to white refined sugar. Sugar beet is processed into white sugar at factories which operate during the “campaign” or harvesting period of four to seven months. These factories are normally located close to the sugar beet fields to minimize transport costs.

Refined white sugar, whether it is from beet or cane, is either produced as branded, packaged sugar directly for retail or sold to manufacturers as an ingredient of food and drink products. By-products of processing sugar beet and milling sugar cane include livestock feed, fibre and co-generation of electricity (cane bagasse). Sugar can also be used to produce the biofuel ethanol, which is particularly significant in Brazil. In 2015–16, Brazilian ethanol production reached 30.2 billion litres (8 billion gallons), compared to 33.8 million tonnes of sugar. Most of this ethanol production is absorbed by the domestic market and 42% of Brazil’s gasoline needs are now covered by sugar cane ethanol.⁹⁰

A huge and complex web of transnational millers, refiners, traders and processors with operations across the world control the supply of sugar.⁹¹ American Sugar Holdings (ASR Group) is the largest sugar refiner in the world; it has an annual processing capacity of approximately 6 million tonnes, of which 1.5 million tonnes is processed in Europe at three refineries and associated manufacturing sites. It also has operations and owns plantation interests in North America and Central America. ASR is Europe’s leading supplier of sugar for soft drinks, confectionery, pharmaceutical products and food manufacturers.⁹² AB Sugar (part of Associated British Foods) is one of the largest sugar producers and refiners in the world, employing around 32 000 people and operating 24 plants in 10 countries. It produces 4.3 million tonnes of sugar per year, 45% from sugar beet and 55% from sugar cane.⁹³ Other large multinationals include Alvean (based in Switzerland), Mitr Phol Sugar Crop (based in Thailand) and Raizen (based in Brazil).⁹⁴

Within the EU, there are 61 sugar and refinery companies across 20 EU Member States.⁹⁵ Südzucker has a significant segment of the sugar market, running 29 sugar factories and two refineries in Germany, Belgium, Bosnia, France, the Republic of Moldova, Poland, Austria, Romania, Slovakia, Czechia and Hungary.⁹⁶ Tereos, a French-based union of farmers, is another major player in the European market,⁹⁷ as is Louis Dreyfus Company, based in the Netherlands.⁹⁸ European refiners of sugar cane and processors of sugar beet are highly reliant on demand. Their main market is currently manufacturers who add sugar to food. Industrial usage (beverages, bakery and confectionary products) represents the biggest end-use market of sugar.⁹⁹

2.3 Imports and exports

Of the 170 million tonnes of sugar produced per year, around 56 million tonnes is internationally traded and transported in bulk loads from one country to another.¹⁰⁰ Raw brown sugar (unrefined sugar from cane) accounts for more than 60% of the volume of international trade. Nine countries dominate global raw sugar exports, with Brazil, Australia, Thailand, Cuba, Guatemala, Colombia, Mexico, Pakistan and Swaziland accounting for 95% of the trade in 2014. Brazil, as the largest producing and exporting country in the world, dominates world trade, accounting for 40% of global export trade in 2014, up from 21% in 2000.¹⁰¹ China, Indonesia, USA, the EU-28 and Malaysia were the world’s largest importing nations of raw sugar in 2014. Key destinations for white sugar include USA, Iraq, Sudan, Saudi Arabia and Sri Lanka.¹⁰²

The sheer quantity of sugar produced, its ease of storage and transport, and continuing high levels of demand make sugar one of the most important and sought-after commodities on the international trading market.¹⁰³

2.4 Use of sugar in manufactured foods and drinks

Most sugar that is produced for human consumption is used by food and drink manufacturers.¹⁰⁴ Manufactured foods now dominate diets in high-income countries.¹⁰⁵ The food and drink industry is the largest manufacturing sector in Europe, with a turnover of over €1 trillion contributing 1.8% to the economy of the EU. It employs 4.25 million people and has experienced sustained growth over the last 20 years.¹⁰⁶ Products include items that are inherently sweet, such as biscuits, cakes, confectionery and sugary drinks, and savoury products such as pasta sauces, soups and savoury ready meals. Through their own brands, supermarkets also form part of the manufacture segment.

Food manufacturers make decisions about how much sugar to use in their products when they manufacture products with sugar. They also make decisions about what products to include in their portfolios, and decisions about reformulation of existing products, where to place and promote them, and how to price them.

2.5 Retail and food service

In Europe, food retail is dominated by supermarket chains.¹⁰⁷ Supermarkets are largely the places where European consumers buy manufactured foods containing sugar, as well as a certain amount of packaged sugar in various forms for home cooking.

Out-of-home dining is also a channel through which Europeans consume sugar. A market research study in 2015 found that 23% of Europeans ate out at least once a week, and of these, 4% ate out once a day or more.¹⁰⁸ This includes fast food, high-end restaurants, and coffee chains. There are no specific data on sales of sugary foods from major chains of coffee shops, but it is worth noting that their dominant offer includes cakes and related baked goods.

3 Industry perspectives on the (dis)incentives to the use of sugar in manufactured foods and drinks

From the analysis, there emerged a range of ten incentives and disincentives to the use of sugar in manufactured foods as seen from the perspective of industry across the supply chain. While not all informants mentioned each and every one of the incentives and disincentives, there were no cases of disagreement in which informants presented conflicting viewpoints. The incentives and disincentives, which span across supply and demand, can be categorized into four main groups:

- (i) Incentives to use sugar: these are factors that make sugar an attractive ingredient to include in manufactured products.
- (ii) Lack of incentive to reduce sugar: these are factors that are not the primary reason why sugar is used in manufactured products, and are not active disincentives to reducing it.
- (iii) Disincentives to reduce sugar: these are factors that present active disincentives to reducing sugar.
- (iiii) Incentives to reduce sugar: these are factors that stimulate the industry to take action to reduce the addition of sugar to manufactured products.

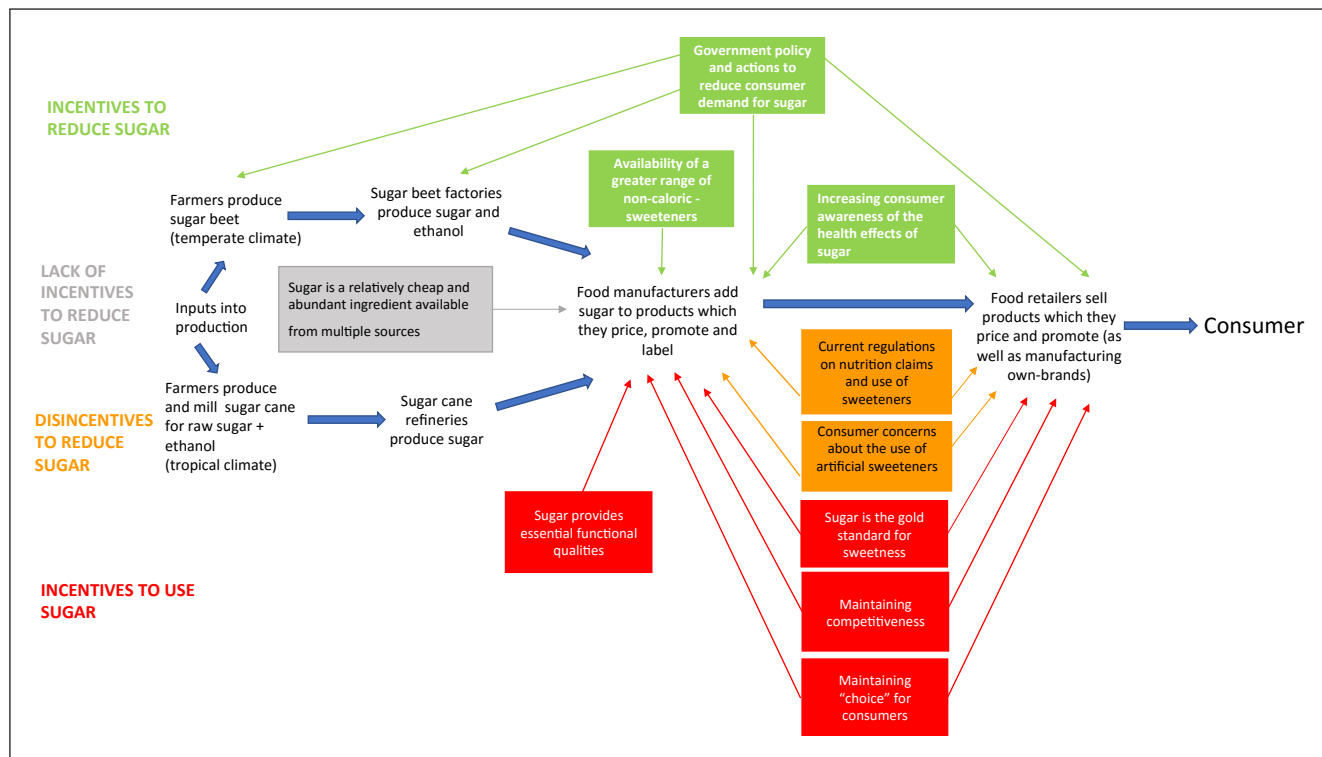
Table 1 summarizes the framework of incentives and disincentives that emerged, while Fig. 8 represents how they operate along the supply chain.

Table 1. Framework of (dis)incentives influencing the use and reduction of sugar in manufactured foods*

Incentives to use sugar in manufactured foods	<ol style="list-style-type: none"> 1. Sugar is perceived as the gold standard for sweetness. 2. Competitiveness among manufacturers and retailers. 3. Maintaining “consumer choice”. 4. Sugar provides essential functional qualities in manufactured foods.
Lack of incentives to reduce sugar in manufactured foods	<ol style="list-style-type: none"> 5. Sugar is a relatively cheap and abundant ingredient available from multiple sources.
Disincentives to reduce sugar in manufactured foods	<ol style="list-style-type: none"> 6. Consumer concern about the use of artificial sweeteners. 7. Current regulations on nutrition claims and use of sweeteners.
Incentives to reduce sugar in manufactured foods	<ol style="list-style-type: none"> 8. Increasing consumer awareness of the health effects of sugar. 9. Government policy and actions to reduce sugar intake. 10. Availability of a greater range of non-caloric sweeteners.

* This is a preliminary framework based on the exploratory analysis presented in this policy brief.

Fig. 8. Incentives to use and reduce sugar in manufactured food and drink



3.1 Incentives to use sugar in manufactured foods

3.1.1 Sugar is perceived as the gold standard for sweetness

That sugar is the “gold standard” for sweetness was considered by informants to be the number one incentive for adding it to food and drink products. Sugar is viewed as the gold standard for sweetness in terms of the time to onset of sweetness and the peak and the drop-off of sweetness. In addition, sugar is used to balance sour, salty and spicy tastes in “savory” products such as pasta sauces, marinades and salad dressings.

A commonly expressed view was that, below a certain level of sweetness, consumers find foods unpalatable and unacceptable. As one retailer reported, the biggest barrier to reducing sugar in their products is that consumers will no longer like the taste. Research on sensory profiles and consumer acceptability for a range of products also demonstrates that consumers tend to prefer sweeter products over less sweet products when one is directly compared with the other.¹⁰⁹ On the other hand, informants stated that there is an optimum level of sweetness above which consumers are said to find a product too sweet and sickly. This assertion is also supported by the research literature, which shows that, above a certain level of sugar content, foods are perceived to be too sweet and are less acceptable.¹¹⁰

Informants reported that their companies invest significant resources in customer focus groups to gather “insights” into their product preferences. They also frequently conduct consumer testing of different formulations to identify what level of sugar is preferred by their target consumers. The results of testing are not made available externally. However, industry informants indicated that, in focus groups, consumers often say they prefer less sweet products, but when side-by-side taste comparisons are conducted, they gravitate towards the sweeter product.

Alternative sweeteners were reported to be unable to meet the gold standard set by sugars. According to informants, the difference in taste profile provided by most alternative sweeteners poses a significant disincentive to using them (see Section 3.3.1). Newly emerging lower-calorie sweeteners like stevia leave a bitter aftertaste, so they have to be

used in combination with some sugars. For products where stevia is used to replace sugars – for example, iced tea – it is possible to reduce the sugar content to about 4.5 g/100 g, but any lower leads to the introduction of a bitter taste and changes in “mouthfeel”.

Manufacturers recognize that consumer tastes are subject to change.¹¹¹ Informants provided several examples where gradual reduction of sugar content had taken place successfully without consumer rejection (Box 3). For breakfast cereals, informants reported that a 3–4% reduction in sugar is achievable without significant impact on the perceived sweetness of the product, but beyond that it becomes more challenging to remove sugar without noticeable changes to the flavour.

Scientific evidence is clear that children have an innate preference for sweet taste shaped by the evolution of the sensory system and pleasure-generating brain circuitry¹¹² – but there is likewise strong evidence that tastes are modified by experience,¹¹³ cultural and culinary milieu,¹¹⁴ child feeding practices, influence of parents,¹¹⁵ peers and the food environment.¹¹⁶ Children who eat sweet foods in infancy have been found to be more likely to go on to prefer sweeter tastes in later childhood.¹¹⁷ When children become accustomed to a highly sweetened diet, they find naturally sweet foods, such as fruit, not sweet enough for their tastes.¹¹⁸ Further research is needed that establishes and quantifies how people’s preferences for sweetness evolves and changes over time in the context of exposure to manufactured foods with added sugars.¹¹⁹ There is some evidence that when people consume gradually less sugar in food or drink over time, their perception of sweetness changes (i.e. they perceive sweet foods as sweeter than before, with the effect wearing off over time), but the evidence base at this stage is very limited.¹²⁰

3.1.2 Competitiveness among manufacturers and retailers

Competition for sales exerts a strong influence on company behaviour. The majority of informants highlighted that competition can be based on the level of sweetness of food and that this can drive company behaviour. One informant characterized this as an “arms race for taste” in which the sugar content of certain categories of food such as breakfast cereals has slowly crept up over the last 30 to 40 years as companies competed against each other for customers and sales.

Unlike areas such as food safety, where industry has a common interest in ensuring that all foods are safe, one informant said that discussions around sugar reduction can be uncomfortable and companies are wary of setting out their strategies publicly or with competitors. Informants reported that they are keen to ensure that sugar reduction does not lead to a noticeably less sweet-tasting product, which may have the effect of reducing sales, while their competitors continue to provide sugary products. In countries where sugar reduction is largely left to voluntary action by industry, companies are able to claim that consumers would abandon their products if they were less “tasty” than those of competing companies and that there is no level playing field for sugar reduction.

Progressive companies (or “first movers”) which are independently reducing sugar say they are therefore at a disadvantage, as they risk losing sales if consumers dislike their lower-sugar products. This claim has also been made in articles. For example, the chairperson and CEO of Nestlé UK and Ireland has asserted that “companies that voluntarily invest to reformulate their products are disadvantaged compared to those that take time to act, or take only limited action”.¹²¹ She went on to “acknowledge the case for regulation” and argued that both voluntary action and regulation have an important role to play in an overall obesity strategy. Some of the world’s largest food firms have called upon the EU to create nutrient profiles for nutrition and health claims to provide a level playing field that industry needs to compete. They include the Coca-Cola Company, PepsiCo, Unilever and Nestlé.¹²² A growing number of industry voices are willing to call for regulation where first movers feel dissatisfied with the progress that their competitors are making.¹²³

3.1.3 Maintaining “consumer choice”

Related to competitiveness, maintaining choice for the consumer is an important incentive for continuing to manufacture and sell products containing higher amounts of sugar. Industry informants said that product ranges are frequently formulated with different amounts of sugar to suit both consumers who want a lower- or reduced-sugar product and those consumers who prefer a higher sugar content. Manufacturers and retailers therefore use different product ranges to reach different groups of consumers. Those consumers who are health-conscious and read labels are different to those who are not motivated by health concerns.¹²⁴ For example, one retailer said that 40% of their customers are not interested in healthy eating and a further 35% are put off by barriers when trying to translate intention into practice (e.g. taste, cost, confusion with labelling). The retailer stated that it is important for them to ensure that they have products for these groups as well as for the 25% of consumers – mainly young professionals – who are “actively engaged” in healthier eating. The retailer said it was not their intention to remove this choice of higher-sugar foods from their customers.

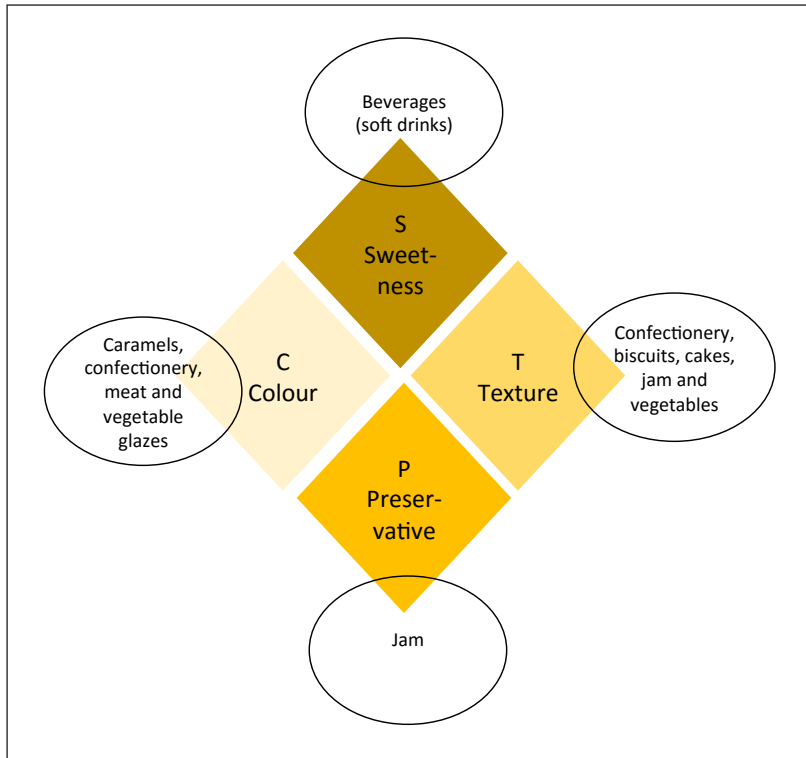
Moreover, in certain markets the number of consumers demanding lower-sugar products is small. For example, the Euromonitor International analysis of breakfast cereals in the Russian Federation found that, while the healthy eating trend is growing, it is still confined to higher socioeconomic groups living in the larger metropolitan areas. This, then, reduces the incentive to manufacture lower-sugar products.

There may also be differences between products. One informant noted that companies were more concerned with reducing sugar mainly in products with a “healthy halo” (for example, those products that consumers consider to be healthier types of products, such as yoghurts and granolas). They are less concerned with the sugar content of foods such as cake, which do not have this “healthy halo” and are considered by many consumers to be inherently unhealthy.

3.1.4 Sugar provides essential functional qualities in manufactured foods

The multiple functions of sugar have been widely documented (Fig. 9).¹²⁵ Sugar affects the texture and appearance of food and drink. It can provide body, smoothness, “mouthfeel”, softness and a yellow-brown colour through caramelization. Sugar also has microbial properties that play a role in the preservation and fermentation of products. Sugar plays different functional roles in different foods. As noted by Clemens et al:¹²⁶ “Given the many functionalities of sugars in foods and beverages, it is not always possible to eliminate or replace sugars without affecting the quality and stability of particular foods.” These functional properties emerged as a strong incentive for using sugar in products, since sugar cannot easily be replaced by other ingredients with the same level of sweetness or without side effects.

Fig. 9. The effects of sugar on food quality



Source: Adapted by authors from Clemens et al., 2016

The main functional factor identified by industry informants as an incentive was that sugar provides bulk in many foods, which is not easily replaced. Manufacturers said that in many breakfast cereals, for example, sugar is the second most important ingredient, by volume, after wheat or corn. As one informant noted, the cheapest option would be to replace bulk with air or water, but this would affect taste. Another possibility is to replace sugar with other healthier product ingredients, such as nuts, fruits, seeds and/or whole grains, but, as recognized by industry, this is frequently at a higher cost. Bulk cannot be replaced by alternative sweeteners with the exception of the polyols, but these have side effects which limit their use and also have a calorific value (Box 7). As informants noted with regard to breakfast cereals, challenges in the chemical structure of many sweeteners mean that they are unable to survive the manufacturing process for cereal products and do not possess the bonding properties that allow cereals to maintain their texture and bulk. The alternative is to replace sugar with added fibre, which – while addressing the bulk and structural issues – does not compensate for the loss of sweetness. Thus, there is a strong incentive for continuing to provide bulk by using sugar as an ingredient in breakfast cereals.

A second functional advantage is the gain in texture through the addition of sugar, which is not easily replaced when sugar is taken out. Sugar is also used in products to improve colour. The warm brown of many bakery products is produced through the process of sugar caramelization, while sugar can enhance the texture and colour of tomato sauces. Ready-to-drink beverages are an exception, as the bulk is provided by water rather than sugar. In this case, sugar provides texture and a syrupy mouthfeel, which can be replicated when artificial sweeteners substitute for sugar. A third functional challenge reported by informants is that sugar continues to play an important role as a preservative and to extend the shelf life and shelf stability of many products. These are all important factors in a time-delayed supply chain.

Finally, there is a small group of foods that would not be the same food if sugar was completely removed or replaced. Examples include jam, ice cream and confectionery, in which sugar is a basic ingredient. For some products, there are no technical solutions that would allow reduction of sugar without affecting other fundamental functionalities.

3.2 Lack of incentives to reduce sugar

3.2.1 Sugar is a relatively cheap and abundant ingredient available from multiple sources

The lifting of sugar production quotas by the EU on 1 October 2017 is predicted to lead to lower sugar prices in Europe and an increase in the production of European sugar beet; this has given rise to concerns that manufacturers will be driven to use greater quantities of sugar.¹²⁷ Analysis also suggests that lower sugar prices will reduce the price of sugary drinks.¹²⁸ However, none of the informants reported that the cost of sugar for manufacturers is a prime factor in determining how much sugar they add to their products. Nor did the cost of sugar emerge as an important influence on the prices of the products they sell.* Rather, the role of price was in influencing decisions made by manufacturers about who to buy their sugar from. Informants reported that manufacturers would generally opt for the cheapest source of sugar, saying, for example: “Food and drink manufacturers tend to be the bit of the market place which is most price-sensitive ... They tend to be the people who treat sugar as a commodity.” One informant thus noted that, as cane sugar becomes more expensive relative to beet sugar in Europe, manufacturers may turn away from buying cane sugar from refineries in preference for beet sold through the big sugar processors in France, Germany, Belgium and the Netherlands. Informants noted also that having a regular, highly dependable and clean supply of sugar that meets all the food safety and traceability requirements is just as important as the price they pay.

Thus despite the fact that manufacturers clearly seek to pay as little as possible for sugar, the relatively low price of sugar did not as a direct incentive to use sugar.** Rather, what emerged was that there was no real incentive *not* to use sugar (as may have been the case if it was very expensive). It seems that sugar has simply never been scarce enough, or risen to a price level high enough, that manufacturers question whether alternatives may provide a better option. If prices rise for one source of sugar, manufacturers can turn to another.

Consequently, agricultural and trade *policies* that influence the price of raw and refined sugar in Europe did not emerge as a strong influence on manufacturers’ decisions. Agricultural policy interventions were not viewed as making sugar cheaper or more expensive across all sources. Rather, they were viewed as changing the price of one source of sugar, which could then be replaced by another. For example, one informant spoke about how sanctions against South Africa in the mid-1980s boosted the industry in Swaziland; in a similar way, further opening of the EU sugar tap by lifting sugar beet production quotas will begin to turn off the tap of sugar cane grown in ACP countries and refined in Europe. Logically, then, if a policy acted to close off the tap of European sugar beet, it would simply provide a greater market space for cane. There are also numerous incentives to continue producing sugar and no real incentives to shift production away from sugar (Box 6).

Also of note, the seven interviews conducted with informants at the production end of the supply chain noted that it was not health-related policies or reduced consumer demand for sugar that were of primary concern to their businesses but the threat of competition from other suppliers. Several informants noted that, as the beet sector is deregulated in Europe, it is increasingly difficult for smallholder cane farmers and refiners to compete in the European market. As a result, cane production in some ACP countries is in rapid decline. They said that competition is a far greater challenge to the viability of their businesses than reduced consumer demand for sugar. The European cane industry is, for example, extremely concerned about the impact that the change of EU sugar policy will have on their business.

* This may be because informants did not come from industries where low prices may be a more important driver, such as sugary drinks and jams. In addition, the higher cost of alternative ingredients only emerged from one interview, but may have been an area manufacturers were less willing to talk about.

** Added sugars are similar to free sugars, but the terms are not interchangeable; see “Definitions”

Box 6. Incentives for continuing to produce sugar

Sugar is a reliable crop suitable for certain ecosystems

Informants noted that there are many reasons why sugar cane and sugar beet are favoured crops and why farmers continue to cultivate them to supply the world market. Sugar beet is a good crop to grow in rotation with other crops because of its nitrogen-fixing properties.¹²⁹ It grows well in temperate climates in a range of soil types and water drainage conditions, and does not require a lot of labour to harvest. In addition, informants highlighted that yields continue to go up as a result of investment in research on improving production techniques and knowledge transfer. Sugar cane can also grow in a variety of soil types, and although it has a high water requirement, it is drought-tolerant and relatively storm-resilient.¹³⁰ Informants noted that in some areas it is not viable to grow alternative crops. Vanilla, for example, is time- and labour-intensive to produce and process, which is why it is the second most expensive spice in the world.¹³¹

Guaranteed markets and investment in sugar production

Up until 1 October 2017, farmers growing in-quota sugar beet for the EU market were guaranteed a set price for their crop that was agreed in advance. The same was true for sugar cane growers with preferential trade agreements with the EU. This changed with the lifting of quotas, after which growers would compete on the international market. However, in many European countries, sugar beet growers' cooperatives will continue to collectively negotiate the sale price of sugar beet in advance of the campaign and so have an assured market.¹³² Informants reported that, unless the price of beet falls significantly, it may still be more profitable for farmers to supply sugar beet than to invest in alternative crops.

Growers' collectives have other advantages, such as enabling farmers to share expensive high-tech equipment. In some European countries, farmers are deeply invested in the processing of sugar as well as its cultivation. For example, Royal Cosun, a Dutch agro-industrial cooperative, was established nearly 120 years ago by Dutch sugar beet growers who decided to establish their own sugar beet factory. Today, the cooperative has grown into a business with around 8800 members and a group turnover of about €2 billion annually.¹³³ Cristal Union is an agro-industrial cooperative group that was established in 2000 and operates primarily in France; a total of 10 000 beet growers are partners in the cooperative.¹³⁴ In the Russian Federation, the majority of successful sugar beet growers are vertically integrated (through contracts) with large processing companies, or even belong to those companies. These processing companies typically supply farmers with imported planting seeds and chemicals, and even provide foreign equipment and beet harvesters, which comprise about 60% of the cost of sugar beet production.¹³⁵

There have been similar investments in the sugar cane industry, although investment has not been uniform. Over the last three decades, there has been substantial investment in Swaziland, for example. Sugar production has become the biggest industry in Swaziland, accounting for almost 60% of agricultural output and 35% of agricultural employment, and contributing about 18% to Swaziland's Gross Domestic Product.¹³⁶ Around half of the sugar produced in Swaziland goes to Europe to be refined. This level of national investment cannot be quickly replaced by cultivating alternative crops or developing alternative industries.

An additional reason for cultivating sugar crops is that, beyond the market for sucrose, there are markets for other products derived from sugar, including the biofuel ethanol, animal feed and fertilizers. Brazil is the world's largest sugar cane ethanol producer largely as a result of substantial government investment and subsidies between 1975 and 1989.¹³⁷ In 2015–16, ethanol production reached 30.2 billion litres (8 billion gallons), and Brazil has replaced almost 42% of its gasoline needs with sugar cane ethanol.¹³⁸

Continued on next page

Investment in sugar crop production and processing, together with access to a variety of markets for sugar products, are strong incentives for sugar producers and processors to continue business as usual.

Maintaining the livelihoods of dependent populations

Historically, the global sugar industry has been shaped by geopolitical interests regardless of the health consequences. The heightened demand for sugar in the 18th century meant that large sugar cane plantations were established in European colonies, particularly in the Caribbean, where they were reliant on slave labour.¹³⁹ During the Napoleonic Wars of the early 19th century, a sugar beet industry emerged in response to blockades which prevented sugar transported by sea from reaching Europe. The 1973 oil crisis prompted Brazil to promote sugar cane production as a source of alternative fuel in the form of ethanol.¹⁴⁰ Another recent example, highlighted by an industry informant, is the growth of the sugar industry in Swaziland, which resulted from sanctions imposed on the apartheid regime in South Africa. Sugar production moved to neighbouring Swaziland and has become a major industry there.¹⁴¹

There has been much debate about the impact of lifting EU sugar quotas on the livelihoods of farmers and agricultural workers.¹⁴² Several informants noted that the lifting of EU tariffs will advantage sugar beet producers but disadvantage cane refiners in Europe and the small-scale farmers who supply them. According to research which modelled the impact of the lifting of EU quotas, as many as 200 000 people in ACP countries could be pushed into poverty by 2020.¹⁴³ The countries most affected include those that are highly dependent on sugar, such as Swaziland, Belize and Guyana, and those with high poverty rates, such as Ethiopia, Malawi, Mozambique, Zambia and Zimbabwe. While the EU has allocated over €1.2 billion for restructuring or diversification in the 18 countries that traditionally supplied raw sugar to the EU, there are limited opportunities for diversification in some of these countries, and substantial dependence on the sugar industry. Informants said that ensuring a fair agricultural and trade policy for sugar cane refiners and sugar beet producers was fundamental. They highlighted the potential for unintended and negative consequences if the sugar supply market was manipulated.

3.3 Disincentives to reducing the use of sugar

3.3.1 Consumer concern about the use of artificial sweeteners

The availability of artificial sweeteners has created an incentive to reduce sugar in manufactured foods (see Section 3.4.3) - but consumer concern about them also creates a disincentive to using them and thus reducing sugar. Manufacturers named several disincentives to using them.

Taste The difference in taste profile provided by alternative sweeteners poses a significant challenge to manufacturers as they say consumers do not accept such dramatic changes in the taste of their products (see Section 3.1.1). Common drawbacks are a delay in the onset of perceived sweetness, a lingering sweetness, a bitter or metallic aftertaste, and a lack of mouthfeel or body. Sweeteners such as stevia, while natural, have a distinctly bitter aftertaste. In many non-cereal products where stevia has been introduced, it has usually served as a partial replacement in combination with sugar.

Function Non-caloric sweeteners do not have the same functional qualities as sugar in terms of bulk and mouthfeel. For example, in the case of breakfast cereals, challenges in the chemical structure of many sweeteners mean that they are unable to survive the manufacturing process for cereal products and do not possess the bonding properties that allow cereals to maintain their texture and bulk.

Regulations There are restrictions under EU regulations on the use of sweeteners in some food and drinks (Box 7). One example is EU Commission Regulation No. 1129/2011, which states that sweeteners may only be used in breakfast cereals with a fibre content of more than 15%, and containing at least 20% bran, energy-reduced or with no added sugar.¹⁴⁴

Negative public opinion The “health and wellness” trend in certain European countries means that consumers are increasingly keen to see “natural” ingredients in their food and drink rather than “artificial” ingredients like non-caloric sweeteners. There have been numerous scares over the years about links between certain sweeteners and cancer and media reports about negative health impacts of sweeteners.¹⁴⁵

3.3.2 Current regulations for labelling and use of artificial sweeteners

A series of EU-wide regulations are currently in place relating to the use of sugar in manufactured food and drinks (Box 7). Two of these regulations were seen by informants as creating disincentives to sugar reduction: the regulation on the use of artificial sweeteners (see Section 3.3.1) and the “reduced-energy claim” regulation. The EU regulation on nutrition and health claims requires a 30% reduction in energy before a claim of “reduced energy” can be included on packaging. Manufacturers said this reduced their incentive to reduce sugar as gradual reductions in sugar were not recognized and they considered the conditions for the claim too stringent. This is a commonly voiced concern from industry – that the rules on making claims provide no incentive to reformulate. However, it is unclear what would be gained for consumers by loosening the rules in relation to claims. Consumers may perceive foods to be healthier than they are, and eligibility to bear a claim could impart a “health” halo.¹⁴⁶ In addition, there is still debate among policy-makers and consumers over the desirability of replacing sugars with sweeteners.¹⁴⁷

Overall, there was some concern from industry informants that legislation should not become a burden or create perverse incentives for industry. The role of regulation should be to provide clarity and standards, not to stifle innovation and competition. One informant also highlighted the importance of going at the same pace as consumers to avoid moving too far ahead of them. Industry is prepared to make changes in response to regulation, they said, if it helps to nudge behaviour, but not if changes are imposed that customers are not really prepared to accept.

Box 7. EU regulations governing the use, description, labelling and advertising of sugary products and artificial alternatives

Nutrition and health claims

EU Nutrition and Health Claims Regulation 1924/2006.¹⁴⁸ The objective of the regulation is to ensure that any claim on food or drink labels, presentations or advertisements in the EU is clear, accurate and based on scientific evidence. It aims to protect consumers by ensuring claims are substantiated, but also to promote innovation and ensure fair competition. The following definitions apply to the use of sugar-related nutrient claims:

- Low-sugar: product contains no more than 5 g of sugars per 100 g for solids or 2.5 g of sugars per 100 ml for liquids.
- Sugar-free: product contains no more than 0.5 g of sugars per 100 g or 100 ml.
- No added sugar: product does not contain any added mono- or disaccharides or any other food used for its sweetening properties. If sugars are naturally present in the food, the following indication should also appear on the label: “CONTAINS NATURALLY OCCURRING SUGARS”.
- Energy-reduced: product where the energy value is reduced by at least 30% as compared with the original food/drink with an indication of the characteristic(s) which make(s) the food reduced in its total energy value.

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Since its adoption in 2006, implementation of this regulation has remained incomplete, as nutrient profiles, which were due to be set by January 2009, have not been established.¹⁴⁹ The application of nutrient profiles, as envisaged in the legislation, would aim to avoid a situation where nutrition or health claims mask the overall nutritional status of a food product, which in turn could mislead consumers when trying to make healthy choices in the context of a balanced diet. Nutrient profiles would govern the circumstances in which claims could be made.¹⁵⁰

The claims regulation also permits countries to use “endorsement” schemes – for example, the Nordic Keyhole logo or the Finnish Heart logo. These general nutrient claims are underpinned by government-endorsed nutrient profiles (i.e. criteria that foods must meet in order to bear the positive logo), which typically establish the sugar threshold in relevant product categories.¹⁵¹

Use of sweeteners

EU Food Additives Regulation 1333/2008.¹⁵² Sweeteners and substitute sugars are considered additives. Their use is prohibited in infant food. There are seven polyols or bulk sweeteners permitted for use in food (with E numbers). Compared to sucrose, they have fewer calories (2.4 kcal/g) but taste less sweet, so they are used with intense sweeteners. Foods containing more than 10% added polyols should bear the following statement: “excessive consumption may produce laxative effects”. Ten types of intense sweeteners, used in very small quantities, are allowed; they are up to 3000 times sweeter than sucrose.

EU Food Additives (amendment to 1333/2008 Annex II) Regulation.¹⁵³ This sets out conditions of use for certain foods. These include the use of high-intensity sweeteners in breakfast cereals with a fibre content of more than 15% and containing at least 20% bran, energy-reduced or with no added sugar.

EU Regulation 1131/2011.¹⁵⁴ Steviol glycosides (commonly known as stevia) were added to the list of permitted sweeteners that could be used in certain specified foods at permitted maximum levels (expressed as steviol equivalents). Stevia is a high-intensity sweetener, 250–300 times sweeter than sucrose; it tends to have a metallic taste and is frequently used to partially replace sugar.

Food labels

EU Regulation on provision of food information to consumers 1169/2011.¹⁵⁵ This regulation aims to provide consumers with better access to clear, comprehensive and reliable food information. It requires that the following nutrition information is provided on the nutrient declaration: (a) the energy value; and (b) the amounts of fat, saturates, carbohydrate, sugars, protein and salt.

Front-of-pack labelling is not mandatory and is a voluntary measure, whereby information from back of pack can be repeated on the front. Countries can adopt a national scheme for interpretative front-of-pack labelling if they wish, on a voluntary basis, but mandatory front-of-pack labelling is currently not permitted under the EU Regulation. Several countries in the EU have adopted national schemes that food manufacturers can apply on a voluntary basis. For example, in the United Kingdom the traffic light logo uses red, amber and green to indicate levels of nutrients in food, while the Nutri-Score logo in France uses colour-coding to indicate the overall “healthfulness” of a product.

3.4 Incentives for reducing sugar

3.4.1 Increasing consumer awareness of the health effects of sugar

The most important incentive for reducing sugar was said to be increasing consumer awareness of the health effects of sugar, which industry informants said was rising. This is backed up by surveys indicating that sugar levels are increasingly driving food choices in Europe. An international survey polled the views of more than 30 000 respondents with online access in 60 countries, of which 32 were European. According to the survey, 29% of respondents in Europe reported that no or low sugar was a very important attribute of their purchasing decisions, while 42% of respondents reported that natural ingredients were a very important attribute.¹⁵⁶

Nevertheless, as discussed in Section 3.1.3, manufacturers still produce higher-sugar products for consumers not actively concerned about sugar levels, indicating that this incentive may be limited to specific consumer segments.

3.4.2 Government policies and actions to reduce sugar intake

A second important incentive is government actions designed to reduce sugar intake. For example, government policies and actions taken in the United Kingdom were seen by informants as an incentive to reduce sugar, notably the reformulation strategy establishing specific targets and the “sugar levy” (tax on sugary drinks).¹⁵⁷ In contrast, there was the perception that minimal government action had been taken to date in the Russian Federation to lower sugar levels in manufactured foods. One UK industry informant said that government policies, when well designed, acted as “enablers” for manufacturers because they support consumer demand for less sugar in products, thus increasing the incentives for companies to take action. One enabler highlighted was government guidance on nutrition labelling (ingredients lists, nutrient declaration and interpretative front-of-pack elements), Labelling (Box 7) was said to create an incentive for reformulation by providing easy-to-access information about the sugar and sweetener content of a product (Box 3 also presents an example of how simplified colour-coding on the front of pack encouraged one manufacturer to reformulate a breakfast cereal). Research evidence also indicates that interpretative labelling (using symbols, colours or words) can encourage reformulation.¹⁵⁸ (Box 7).

Other enablers are government policies and regulations that seek to improve the food environment through measures such as controls on the marketing of foods, school food policies and/or imposition of taxes. All these enablers were said to have an effect on the decisions taken by companies as to their reformulation, labelling and sales strategies.

Along with consumer concerns about health, these enabling actions taken by governments were said to be a strong factor in stimulating manufacturers to make commitments to sugar reduction and leading to greater attention on reformulation to reduce sugar (Box 2). The retailers interviewed by Euromonitor International reported, for example, that they now conduct regular annual reformulation of their own-brand breakfast cereals, whereas previously reformulation was undertaken infrequently. Informants also said that companies are responding by investing in research to support reformulation – for example, to gain a better understanding of the scientific process whereby sugar creates the sweet sensation and of the properties of sugar in ice cream and the structure that it imparts. The imperative to reformulate is also reflected by the emergence of reports by investment companies on the risks companies incur by using sugar.¹⁵⁹

3.4.3 Availability of a greater range of non-caloric sweeteners

While concerns about artificial sweeteners were named as a disincentive to reducing sugar, informants also highlighted that this development has enabled them to reformulate foods and drinks and to develop new products without increasing energy content. Industry informants noted that one of the major changes over the last 10 years has been the increased range of alternative sweeteners that can be used in food and drink products to partially or wholly replace sugar.

A number of different artificial sweeteners are permitted for use in food by the EU and which can be used to substitute for sugar (Box 7). The high-intensity sweeteners can be 100 to 25 000 times sweeter than sugar. Data from the United States suggest that 2% of foods and drinks contain non-caloric sweeteners, and that this has increased over time.¹⁶⁰

Given consumer concerns about artificial sweeteners, industry has also benefited from the increasing availability of natural high-intensity sweeteners extracted from various plant sources such as monk fruit and stevia. Stevia was approved by the EU for use in food in 2011 (Box 7). A report by the market intelligence agency Mintel stated that, in 2009, only 5% of food and drink products launched using intense sweeteners used solely plant-derived sweeteners (although a further 2% used a blend of artificial and plant-derived sweeteners). In contrast, in 2013 the share of food and drink products using solely plant-derived sweeteners jumped to 15% (while a further 3% used a blend of artificial and plant-derived sweeteners).¹⁶¹

Despite the problems in using sweeteners, a number of examples were cited where reduction of sugar through reformulation had been successful and allowed the flavour of other ingredients to become apparent, rather than being masked by the sugary taste (Box 3).

4 Insights for approaches to sugar reduction

4.1 Limitations of the analysis

This policy brief presents an initial exploration of the sugar supply chain as a means of better understanding why manufacturers use sugar in products and the incentives and disincentives to reduce sugar. It involved 34 interviews with growers and refiners of sugar cane and sugar beet, traders who buy and sell raw and refined sugar, food manufacturers who process food and drink, and retailers who sell food and drink to the consumer as well as manufacturing their own-brand products. From this it produced a novel framework of incentives for using and reducing sugar emerged (Table 1; Fig. 8).

The incentive structure that emerged from the analysis should be viewed as indicative rather than conclusive; this was an exploratory study which included testing the methodology among its aims and had several limitations. One limitation was reliance on industry interviews. It was a challenge to obtain a sufficient number of interviews. Over half the people approached by the academic team did not agree to be interviewed (Appendix 1), and while using additional interviews conducted by a market research firm (Euromonitor International) proved essential to ensure a sufficient number, there were still gaps. Thus a comprehensive understanding drawn from all major actors (e.g. out-of-home market, sugary drinks manufacturers) did not prove possible. This in turn meant it was not possible to indicate how the framework of incentives operated differently with respect to different types of manufactured foods and drinks (e.g. if incentives were different between sugary drinks, yoghurts and breakfast cereals). Interviewees also spoke from an industry framing. For example, their perspective is that they cater to consumer tastes. In contrast, public health perspectives are that the industry is shaping consumer tastes. Informants were also self-selecting, which may have led to a bias in perspectives. For example, all the manufacturers and retailers interviewed were actively making efforts to reduce the sugar level in their products. Companies not engaged in such efforts may have had a different perspective. Interviews were also skewed towards the United Kingdom. This policy brief should thus be seen as an exploratory analysis based on a scoping exercise and reflecting only the knowledge and experience of the industry informants, plus the two academic informants, who were willing to take part in the interviews.

Another limitation of the policy brief overall is the focus on sugar. Reducing sugar intake is just one aspect of promoting healthy diets more broadly. Complementary supply chain analyses should also be used to assess, for example, ways to increase fresh fruit and vegetable consumption or whole grains.

4.2 Using the framework of incentives

With these important caveats in mind, the incentives framework and the insights it provides can still be used as a starting point for public health policy-makers looking to enhance the effectiveness of sugar reduction policies. For example, it can be used as a starting point to:

- understand how incentives and disincentives throughout the supply chain are, or are not, influencing the healthiness of food environments;
- diagnose where the most powerful leverage points for change, from upstream to downstream, are located in the chain;
- test out how actions taken in one part of the supply chain (e.g. sugary drinks taxes which act to change retail prices) may have intended or unintended consequences on the rest of the chain; and
- identify the range of elements needed to make comprehensive sugar reduction strategies effective.

4.3 Six insights for effective sugar reduction strategies

In terms of the range of elements needed to make comprehensive sugar reduction strategies effective, the framework provides six key interconnected insights for public health policy-makers to consider when designing sugar reduction strategies.

Insight 1 Shifting the incentive structure for manufacturers and retailers should be a strong focus of any sugar reduction strategy. The supply chain analysis indicated that it is manufacturers and retailers who are the main decision-makers when it comes to how much sugar is added to manufactured foods and drinks. It highlighted that manufacturers and retailers have a strong incentive to compete with each other and maintain higher-sugar products to attract the full scope of the consumer market – incentives emanating from the need to be profitable. But they also respond to the incentives to change emanating from growing consumer demand for healthier products and (complementary) government actions such as front-of-pack labelling schemes, taxes and marketing restrictions. Nevertheless, manufacturers and retailers currently have a greater number of incentives to use sugar than to reduce its use: the framework shows that manufacturers and retailers currently have more incentives to use sugar (seven) than to reduce its use (three), which is a clear indicator that effective reduction strategies will need to rebalance this incentive structure for manufacturers and retailers. There are also ways that different parts of the supply chain can alter the incentives for other parts. For example, retailers could exert influence on brand manufacturers by stocking only lower-sugar products from manufacturers and lead the way by changing their own-brand products.

Insight 2 Set a level playing field to allow a “race to the top” for manufacturers and retailers. By highlighting that one of the strongest disincentives to reduce sugar is the imperative to be competitive in providing taste and choice – the “race for taste” – the supply chain analysis indicates that relying only on “first movers” and the relative minority of consumers who demand healthy products will never be enough. One way to change the incentives is to “level the playing field” to enable all relevant businesses to compete under the same framework of standards. While informants raised concerns about government intervention forcing them to move faster than consumer tastes, it nevertheless also emerged that government standards and regulations (e.g. on labelling, taxation and sector-wide reformulation), could have the effect of encouraging a “race to the top”. With regard to reformulation, gradual and discreet reductions in sugar content of products across the industry – rather than just a few companies – and a wide range of food groups could reduce consumers’ “sweetness index”, meaning they become more accepting of lower-sugar foods. Coordinated government targets at national and international level (given the cross-border trade in food) could be important to ensure all companies, big and small, make sector-wide improvements. Support to small and medium enterprises may be needed to help companies overcome the technological challenges and to plan routinely for periodic changes in their products’ composition. Relevant measures would need to be designed effectively on the basis of a understanding of dietary intake, market share, and the most appropriate policy intervention according to product category (i.e. reformulation; portion size reduction; taxation).

Insight 3 Build in policies to reduce demand for sugar to support the efforts of progressive manufacturers and retailers.

A related insight emerging from the analysis is that there are no major disincentives to the use of sugar on the supply side owing to its widespread availability. Given that this is predicted to continue into the future, and that changing availability and price on the supply side is complex (see Insight 6), reducing consumer demand for sugar emerged as key to the effectiveness of sugar reduction strategies. Increasing the size of the consumer segment demanding lower-sugar foods and drinks would support the goals of progressive manufacturers and retailers in reducing sugar levels. Arguably, policies to reduce exposure of young children to manufactured foods high in sugar would reduce the development of preferences for sweet foods and thereby benefit progressive manufacturers looking to reduce sugar by reducing consumer demand for sweetness among the next generation. Policy options already proposed to further these aims include ensuring that baby foods are not excessively sweet; restricting children's exposure to marketing;¹⁶² ensuring that all foods available in public and commercial settings targeted at children are not excessively sweet;¹⁶³ improving the food retail environment to reduce the appeal of sugary foods and limit "pester power" (e.g. at checkouts); and taxing sugary drinks to reduce demand, especially among adolescents.

Insight 4 Include measures to discourage intake of manufactured foods and drinks and to increase intake of non-manufactured foods.

By showing just how important the functional properties of sugar are as an incentive for manufacturers to include sugar in their products, the supply chain analysis reveals the limitation of focusing only on reducing sugar in manufactured foods to achieve sugar intake goals. Reducing sugar levels through reformulation – whether as direct reformulation strategies or encouraged by means of labelling, taxes, etc. – will always be limited by the constraints imposed by the functional properties of sugar inherent in the processing of manufactured foods. This is also the conclusion of an expert group which concluded that the practical difficulties of reformulation mean that it will "not achieve the desired reduction in free sugars".¹⁶⁴ In short, while reformulation can be an important driver and contributor to reduce sugar intake from manufactured products, ultimately, reducing sugar intake will also involve consuming fewer manufactured foods and drinks.¹⁶⁵ Governments should thus consider explicitly including actions to increase availability, affordability, acceptability and appeal of fresh foods containing no added sugars as direct substitutes for manufactured foods and drinks with added sugars.

Insight 5 Consider the impact of "substitutions" from a health perspective. By revealing the complexities around the use of artificial sweeteners, as well as the substitutability between sugar from different countries and sources, the supply chain analysis reveals the importance of considering what sugar will be substituted for. Anticipating these potential substitutions – across the supply chain – is important, because how sugar is replaced will have significant short- and long-term implications for the success of sugar reduction strategies. It is also important to anticipate them to avoid negative unintended consequences. For example:

- *Substitution between sugar and other nutrients/ingredients during reformulation processes.* Substitution could be with artificial sweeteners which maintain sweetness but reduce calories, or with more expensive and nutritious ingredients like fruit. Similarly, substitution could be with saturated fat or refined carbohydrates, which are not health-enhancing, and calorie levels may not be affected. Substitution with artificial sweeteners is particularly controversial since there is significant debate over whether this is a way to improve diets and health.
- *Substitution between sugar and isoglucose.* This is not yet a big issue in Europe, but it is predicted to become so after the changes in EU sugar policy in October 2017. In the United States, isoglucose (known as high-fructose corn syrup) began to be used much more by manufacturers when its price declined relative to sugar and other sweeteners.¹⁶⁶
- *Substitution between different manufactured foods in the diet.* For example, sugary drinks might be substituted with 100% fruit juices. While the latter are considered more nutritious, they contain a similar level of free sugars and calories.
- *Substitution between manufactured foods and non-manufactured, fresh foods.* Non-manufactured foods are inherently different from manufactured foods and contain no added sugars, but may not be viewed as direct substitutes by consumers.
- *Substitution between different sources of sugar.* The evidence suggests that agricultural and trade policy interventions to reduce sugar will only be effective if they are applied in equal measure to all sources of sugar.

Insight 6 Over the longer term, sugar reduction strategies should consider how to engage with a fuller transformation of the “sugar system”. By looking at the whole supply system, the analysis indicates that transformation of the sugar system will be needed for very significant reductions in sugar intake across populations. Manufacturers have access to readily substitutable sources of sugar to which they can easily turn to obtain a cheaper price. Additionally, isoglucose is now emerging on the European market as a further substitute. Prices may be volatile but are still lower than those of alternative ingredients. The basic quality of sugar is virtually the same from whatever source, so manufacturers have access to an open market. If one sugar “tap” is switched off, manufacturers can simply move to another. An extremely steep increase in price, or a breakdown in the functioning of sugar supply chains – a situation that has not happened in recent history – would undoubtedly influence manufacturers’ decisions about the use of sugar. But to have a real impact these changes would have to occur across all the various sugar taps (cane, beet and isoglucose), across all 130 countries which produce sugar around the world. Further complexity is introduced by the fact that the sugar supply system involves millions of people’s lives, many of whom live in poverty in low- and low-middle income countries. There are also significant environmental impacts of sugar production. The challenge for sugar reduction strategies over the longer term is thus how to be effective when producers have such enormous incentives to produce sugar and it supports so many livelihoods. One option to consider is to reorient the sugar system towards producing “less for more”, that is, producing less sugar at higher prices which would maintain economic livelihoods of its producers while mitigating health and environmental impacts. Another option is to switch to sugar production for alternative, health-enhancing crops such as tropical fruits and vegetables. Whatever the options, these shifts are likely to take time, increasing the imperative for policy makers to put in place measures designed to reduce consumer demand for sugar.

Overall, while the analysis highlights the challenges of creating coherence between economic and public health goals, it also identifies opportunities for increasing alignment. It shows that there is a strong case for further policy discussions around the most effective ways to bring about a health-oriented transformation of modern food systems.

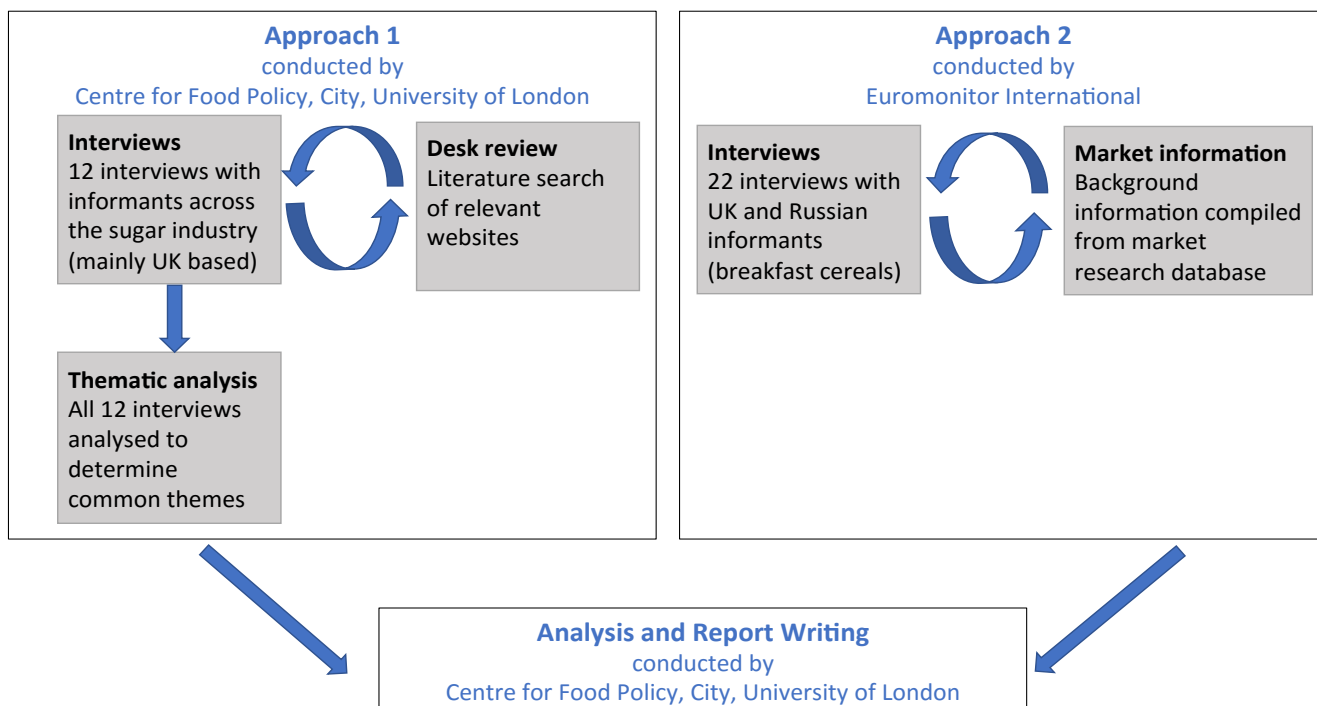
Appendix 1 – Methods

While food supply (or value) chains are not a new concept, analysing them from a nutrition and health perspective is a relatively new field.¹⁶⁷ The analysis of food supply chains requires an understanding of multiple fields, including agriculture, food technology, economics, marketing, retail, nutrition and public health. Because of this broad scope, research methods and operational understanding of food supply chains are not well developed. The method adopted here is thus exploratory in nature, rather than being based on well-established methodological techniques. Data were gathered through a “scoping” exercise rather than by application of a “systematic” method. There are thus methodological limitations in terms of representativeness and exhaustiveness, which are elaborated at the end of this appendix.

Approaches

Two complementary approaches were pursued to collect and analyse data capturing industry perspectives on the incentives and disincentives for including sugar in manufactured food and drinks. The first approach was undertaken by an academic institution, the Centre for Food Policy, City, University of London, and involved interviews with key informants selected through convenience sampling and collation of evidence through a desk review of literature. The second approach was pursued by a market research company, Euromonitor International, and involved in-depth interviews with industry contacts, focusing specifically on breakfast cereals sold in the United Kingdom and the Russian Federation, in addition to analysis of data from the Euromonitor International marketing database.

The rationale for adopting the dual approach was to maximize the potential information input from industry informants while ensuring sufficient academic rigour. Euromonitor International was able to conduct business-to-business in-depth interviews which allowed informants to be open and comfortable in expressing their views. The Centre for Food Policy did not have the same access to business informants (indeed, 13 companies declined to be interviewed by the Centre) and informants may have been more guarded in their responses to questions put by an academic institution involved in public health advocacy. On the other hand, the Centre for Food Policy was able to ensure that as much academic rigour as possible was employed in data collection, analysis and reporting of findings. As already noted, however, the exploratory nature of the study meant that the methods were limited and the findings based on fact-checked opinions rather than a robust, established methodology. The two approaches are described in greater detail and summarized in the figure below.



Approach 1

This approach was pursued by the Centre for Food Policy, City, University of London.

Objective To determine the incentives and disincentives for including sugar in manufactured food and drink from an industry perspective.

Interviews Convenience sampling was used to select key informants for interview across the sugar supply chain. Six individuals were approached and asked to participate in initial interviews. These were individuals known to the investigators either personally or because their contact details were provided to the investigators by colleagues with experience of industry. Two failed to respond. The other four agreed and the interviews were conducted. The four initial interviews served to test the questions and to provide further industry contacts.

A specifically designed set of questions was developed for the interviews informed by literature on “elite” interviewing techniques.¹⁶⁸ The purpose of the questions was to guide the interviews and the questions were sent to prospective informants in advance of the interview. The questions were deliberately broad in scope and the number of questions was kept to a minimum (four or five questions) to encourage maximum input and discussion from informants. An initial set of questions was refined following the first four interviews and adapted to make them relevant to different actors along the supply chain.

A total of 13 companies were approached by the investigators at the Centre for Food Policy and invited to participate in the study, but either failed to respond or declined to be interviewed. All the interviews were conducted by phone and were recorded. A transcript of the recorded interview was prepared and sent back to all key informants for their verification. A participant information sheet and consent form was prepared and completed by key informants in accordance with the ethical requirements of conducting research involving participants. Ethics clearance was obtained by the Department of Sociology Ethics Committee at City, University of London.

Analysis Thematic analysis of the interviews was undertaken. Two investigators from the Centre for Food Policy independently read through the interview transcripts and highlighted one theme. They then reread the transcripts to highlight a second theme. This iterative process was followed for eight themes. Scripts were compared after each theme to ensure that there was good inter-investigator reliability in thematic analysis. The themes were coded. If a theme was mentioned once or more than once in an interview, it was coded as “1”. If there was no mention of the theme, a “0” was recorded.

Desk review Background information on the sugar supply chain was gathered through a literature search of academic journals and industry, UN, EU and government websites. The evidence base produced was used to prepare the questions included in the key informant interviews and to “fact-check” information provided by informants.

Approach 2

This approach was pursued by Euromonitor International.

Objective To determine the incentives and disincentives for including sugar in breakfast cereals (flakes and children’s breakfast cereals) sold in the United Kingdom and the Russian Federation from an industry perspective.

Interviews In-depth trade interviews were conducted with key senior industry players across the breakfast cereal supply chain in the Russian Federation and the United Kingdom. In-country analysts conducted the interviews in English and Russian. Analysts used discussion guides to frame open-ended conversations with the goal of gathering deeper, frank insights from the experts. Key points from these in-depth discussions were tested against the results from the thematic analysis undertaken by the Centre for Food Policy and described above, to look for consistencies.

Market information Preliminary background information was gathered from the Euromonitor International Passport global market research database on packaged food/breakfast cereal. In addition, in-house expertise was sought and in-country desk research undertaken by local analysts. This information was used to prepare analysts for the interviews conducted by Euromonitor International and to identify key contacts for interviews.

Interviews completed

A total of 34 interviews were conducted through application of Approaches 1 and 2 with a range of industry informants across the sugar supply chain (see table below). One interview was with an informant from a nongovernmental organization working specifically in the area of sugar and a second interview was with an academic with specific knowledge relating to sugar beet production. All remaining informants were actively working (or had recently worked) in the food and drink or sugar industry. Some interviews included more than one informant from different branches of the same company, so the total number of informants exceeded the total number of interviews. Informants were all individuals at senior or middle management level with a broad range of experience and expertise, including: ingredient suppliers, sugar producers and refiners, traders, brand manufacturers and multiple-chain grocery retailers.

Number of interviews conducted						
	Production	Trade	Processing	Manufacture	Retail	Academics
Euromonitor International						
United Kingdom	3			3	4	
Russian Federation	2			7	3	
Centre for Food Policy						
United Kingdom	1	1	1	5	2	2
TOTAL	6	1	1	15	9	2

Themes emerging from the interviews conducted in Approach 1 (conducted by the Centre for Food Policy) were as follows:

Consumer taste and choice Consumer demand for a particular food or drink product, or attributes of a product (e.g. sweet taste, perceived healthiness, etc.), and consumer choice of food and drink.

Functionality Properties of food and drink products (sensory, physical, chemical and microbial) that are influenced by sugars.

Regulations and policies Government regulations and policies relating to production and trade of sugars, sugars content of foods, and health and nutrition claims on food and drink products.

Cost and affordability Price of sugars as an ingredient and affordability of food and drink products containing sugars.

External pressure Influence from health and nutrition pressure groups, scientific progress (e.g. development of alternative sweeteners) in relation to sugars in food and drink products.

Competition Competition between companies for production and sales of food and drink products containing sugars.

Internal company policy Leadership and policy approach of a company towards the use of sugars in food and drink products.

Limitations of the method

Bias towards the United Kingdom Most interviews were conducted with key stakeholders based in the United Kingdom. Discussion with key informants therefore tended to focus on the context in the United Kingdom, with less focus on other European countries.

Bias in participation by companies The selection of companies to interview was biased in two ways. First, an opportunistic sampling method was used to make initial contacts which depended on personal contacts and “cold calls” to key companies. The method of sampling was therefore neither systematic nor exhaustive, and certain areas were missed. The most notable of these were companies manufacturing soft drinks, though retailers selling soft drinks were interviewed, and out-of-home food service providers. Second, only some companies were willing to participate in the study. A total of 13 companies were approached by the investigators at the Centre for Food Policy and invited to participate in the study but either failed to respond or declined to be interviewed. The self-selection of informants for interview may mean that they represent companies already taking measures to contribute to lower sugar consumption and their views may not be representative of a broader range of companies.

Bias in key informant responses Existing tensions between industry and public health activists may have led key informants to be guarded in their responses to challenging questions.

Literature search The literature search was conducted through internet search based on key words or themes. This allowed access to a wide range of industry, academic, government and other sites from which information was gathered. Efforts were made to verify and validate evidence through more than one internet site that was considered to be authoritative. Evidence published in peer-reviewed journals and official government or United Nations sites were prioritized and all references are included in this policy brief.

Appendix 2 – Sugar policies of the largest 10 global food and drink companies

Company	Revenue 2014 (\$ billion)*	Policy with respect to sugar
Nestlé S.A.	103.5	Nestlé published its Policy on Sugars in 2014. The company is committed “to continue reducing the level of sugars in its food and beverage products and help consumers achieve target daily intake levels of sugars corresponding to recommendations from the WHO”. The policy target is “to further reduce the content of sugars by an average of at least 10% over three years (2014–2016) in those products that do not meet the Nestlé Nutritional Foundation criteria for sugars as defined in the Nestlé Nutritional Profiling System”. http://www.nestle.com/asset-library/documents/library/documents/about_us/nestle-policy-sugars.pdf
Unilever Group	68.5	Unilever has a Position Paper on Sugar Reduction which is part of its broader Sustainable Living Plan launched in 2010. Unilever “recognizes that energy intake from sugar should be limited, in line with recommendations by a number of organizations, such as the WHO and the American Heart Association”. The company has set a number of targets for reducing sugar in its food and drink with a focus on beverages and ice cream. https://www.unilever.com/Images/unilever-position-on-sugar-reduction_tcm244-423167_en.pdf
PepsiCo Inc.	66.4	In October 2016, PepsiCo launched its global sustainability agenda. As part of this agenda, PepsiCo set a series of goals for 2025, including a commitment that “at least two-thirds of its global beverage portfolio volume will have 100 calories or fewer from added sugars per 12-oz serving”. http://www.pepsico.com/live/pressrelease/pepsico-launches-2025-sustainability-agenda-designed-to-meet-changing-consumer-a10172016
Coca-Cola Co.	46.9	Coca-Cola launched its four global well-being commitments in 2015. The first relates to reduced, low and no-calorie beverages. Coca-Cola commits to offer low- or no-calorie beverages in every market. http://www.coca-colacompany.com/stories/our-commitment-to-well-being
Mondelēz International, Inc.	35.3	Mondelēz International launched its Call for Well-being programme in 2014. One of the four pillars is “Well-being snacks”. Five goals have been set for 2020. While none focus specifically on sugar, one is to “Expand our portion control options (200 calories or less) by 25%”. http://www.mondelezinternational.com/well-being/well-being-snacks
Mars, Inc.	33.0	Mars’ five Principles in Action were launched in 2014. Mars supports the position that energy (calorie) intake from sugars should be limited. While Mars has not set a specific target for reducing sugar, it has committed to “Not offer any Mars chocolate or confectionery products that exceed 250 calories per portion by the end of 2013”. http://www.mars.com/docs/default-source/doing-our-part/principles-in-action/summary-archive/marspiasummary2014updated.pdf?sfvrsn=6

Groupe Danone S.A.	29.3	Danone published its six “Nutrition Commitments” in October 2016. The second commitment is to “continuously improve the nutritional quality of our products”. There is no specific commitment on the reduction of sugar, but examples are given of successful reduction of sugar in different Danone products. http://danone-danonecom-prod.s3.amazonaws.com/user_upload/danonetemplates_elementinv/DANONE_NUTRITION_COMMITMENTS_VF_2.2.pdf
Associated British Foods plc	21.1	In the Corporate Responsibility Report published in 2016, the Associated British Foods chief executive notes that “it is more important to show, as transparently as possible, proof of the good we have already done, than to set a target of what we may do in the future”. Associated British Foods does not have a specific goal with regards to the reduction of sugar; rather, it has “a clear agenda to sustain the well-being of our customers by reformulating our products to reduce the salt, sugar and fat content, making it easier for them to eat a healthy, balanced diet”. http://www.abf.co.uk/documents/pdfs/ar_cr_2016/2016_corporate_responsibility_report.pdf
General Mills, Inc.	17.9	In 2009, General Mills pledged to reduce sugar in all of its cereals advertised to children under 12 to single-digit grams of sugar per serving. https://www.generalmills.com/Health/improving-health/reducing-sugar
Kellogg Co.	14.8	Kellogg’s has a set of five “Global Breakfast Food Beliefs”. These include a commitment to continue “to reduce sugar and sodium in our Kellogg’s cereals”. http://www.kelloggcompany.com/content/dam/kelloggcompanyus/corporate_responsibility/pdf/2015/GlobalFoodBeliefs.pdf

*Source: 10 companies that control the world’s food, Market Watch; 2014 (<https://www.marketwatch.com/story/10-companies-that-control-the-worlds-food-2014-09-01>)

References

All websites were accessed on 15 November 2017.

- 1 Guideline: sugars intake for adults and children. Geneva: World Health Organization; 2015 (http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028_eng.pdf).
- 2 Morenga, LT. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ* 2013;346:e7492 (<http://www.bmj.com/content/346/bmj.e7492>).
- Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. *N Engl J Med*. 2011;364(25):2392–404 (<https://www.ncbi.nlm.nih.gov/pubmed/21696306>).
- 3 European health report 2015. Copenhagen: WHO Regional Office for Europe; 2015 (<http://www.euro.who.int/en/data-and-evidence/european-health-report/european-health-report-2015>).
- 4 Ninth Meeting of the WHO European Childhood Obesity Surveillance Initiative (COSI). Meeting report. Copenhagen: WHO Regional Office for Europe; 2016.
- 5 Adolescent obesity and related behaviours: trends and equalities in the WHO European Region, 2002–2014. Copenhagen: WHO Regional Office for Europe/HSBC; 2017.
- 6 Guideline: sugars intake for adults and children. Geneva: World Health Organization; 2015 (http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028_eng.pdf).
- 7 Sugars and dental caries. Geneva: World Health Organization; 2017 (<http://apps.who.int/iris/bitstream/10665/259413/1/WHO-NMH-NHD-17.12-eng.pdf?ua=1>).
- 8 Oral health: data and statistics. Copenhagen: WHO Regional Office for Europe; 2017 (<http://www.euro.who.int/en/health-topics/disease-prevention/oral-health/data-and-statistics>).
- 9 Type 2 diabetes: Herman WH, Ye W, Griffin SJ, Simmons RK, Davies MJ, Khunti K et al. Early detection and treatment of type 2 diabetes reduce cardiovascular morbidity and mortality: a simulation of the results of the Anglo-Danish-Dutch study of intensive treatment in people with screen-detected diabetes in primary care. *Diabetes Care* 2015;38(8):1449–55.
- Vervloet M, van Dijk L, de Bakker DH, Souverein PC, Santen-Reestman J, van Vlijmen B et al. Short- and long-term effects of real-time medication monitoring with short message service (SMS) reminders for missed doses on the refill adherence of people with Type 2 diabetes: evidence from a randomised controlled trial. *Diabetic Med*. 2014;31(7):821–8.
- Cardiovascular disease: Yang Q, Zhang Z, Gregg E, Flanders W, Merritt R, Hu F. Added sugar intake and cardiovascular diseases mortality among US adults. *JAMA Intern Med*. 2014;174(4):16–24 (<https://www.ncbi.nlm.nih.gov/pubmed/24493081>).
- 10 Transforming European food and drink policies for cardiovascular health. Brussels: European Heart Network; 2017.
- 11 Macdiamid J, Blundell J. Assessing dietary intake: who, what and why of under-reporting. *Nutr Res Rev*. 1998;11(2):231–51 (<https://www.ncbi.nlm.nih.gov/pubmed/19094249>).
- Gemming L, Jiang Y, Swinburn B, Utter J, Mhurchu C. Under-reporting remains a key limitation of self-reported dietary intake: an analysis of the 2008/09 New Zealand Adult Nutrition Survey. *Eur J Clin Nutr*. 2014;68(2):259–64.
- 12 Rippin H, Hutchinson J, Evans C, Jewell J, Breda J, Cade J. Adult nutrient intakes from current national dietary surveys of European populations. *Nutrients* 2017;9.
- Rippin H, Hutchinson J, Evans C, Jewell J, Breda J, Cade J. How much do we know about dietary intake across Europe? *Food and Nutrition Research* (forthcoming).
- 13 Lopes C, Torres D, Oliveira A et al. Inquérito Alimentar Nacional e de Atividade Física, 2014–2016. IAN-AF; 2017.
- 14 Azaïs-Braesco V, Sluik D, Maillot M, Kok F, Moreno L. A review of total and added sugar intakes and dietary sources in Europe. *Nutr J*. 2017;16(1):6.
- 15 National Diet and Nutrition Survey 2008/09 to 2011/12. London: NatCen; 2014.
- Porgeirsdóttir H, Valgeirsdóttir H, Gunnarsdóttir I, Gísladóttir E, Gunnarsdóttir BE, Þórsdóttir I et al. Hvað borða Íslendingar? Könnun á mataræði Íslendinga 2010–2011 Helstu niðurstöður. Embætti landlæknis, Matvælastofnun, Rannsóknastofa í næringarfræði við Háskóla Íslands, Landspítala-háskólasjúkrahús; 2011 (<https://www.landlaeknir.is/tolfraedi-og-rannsoknir/rannsoknir/kannanir-a-mataraedi>).
- Sluik D, van Lee L, Engelen A, Feskens E. Total, free, and added sugar consumption and adherence to guidelines: the Dutch National Food Consumption Survey 2007–2010. *Nutrients* 2016;8(2):70.

- 16 Lopes C, Torres D, Oliveira A et al. Inquérito Alimentar Nacional e de Atividade Física, 2014–2016. IAN-AF; 2017.
Ruiz E, Avila J, Valero T, del Pozo S, Rodriguez P, Aranceta-Bartrina J et al. Energy intake, profile, and dietary sources in the Spanish population: findings of the ANIBES study. *Nutrients* 2015;7(6):4739–62.
Santiago S, Zazpe I, Martí A, Cuervo M, Martínez JA. Gender differences in lifestyle determinants of overweight prevalence in a sample of Southern European children. *Obes Res Clin Pract.* 2013;7(5):e391–400.
- 17 Þorgeirsdóttir H, Valgeirsdóttir H, Gunnarsdóttir I, Gísladóttir E, Gunnarsdóttir BE, Þórsdóttir I et al. Hvað borða Íslendingar? Könnun á mataræði Íslendinga 2010–2011 Helstu niðurstöður. Embætti landlæknis, Matvælastofnun, Rannsóknastofa í næringarfræði við Háskóla Íslands, Landspítala-háskólasjúkrahús; 2011 (<https://www.landlaeknir.is/tolfraedi-og-rannsoknir/rannsoknir/kannanir-a-mataaraedi>).
- 18 Van Rossum C, Fransen H, Verkaik-Kloosterman J, Buurma-Rethans E, Ocké M. Dutch national food consumption survey 2007–2010: diet of children and adults aged 7 to 69 years. Bilthoven: RIVM; 2011.
- 19 Huth P, Fulgoni V, Keast D, Park K, Auestad N. Major food sources of calories, added sugars, and saturated fat and their contribution to essential nutrient intakes in the US diet: data from the National Health and Nutrition Examination Survey (2003–2006). *Nutr J.* 2013;12:116.
- 20 Steele E, Baraldi L, Louzada M, Moubarac J-C, Mozaffarian D, Monteiro C. Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study. *BMJ Open* 2016;6(3).
- 21 Passport Packaged Food database. Euromonitor International; 2017 (<http://www.euromonitor.com/packaged-food-industry>).
- 22 Action on Sugar. International Sugar-Sweetened Soft Drink Survey 2015 (<http://www.actiononsalt.org.uk/actiononsugar/Press%20Release%20/164348.pdf>).
- 23 Passport Packaged Food database. Euromonitor International; 2017 (<http://www.euromonitor.com/packaged-food-industry>).
- 24 Milder IEJ, Toxopeus IB, Westenbrink S, van den Bogaard CHM, van Raaij JMA, Temme EHM. Salt, saturated fat and sugars in selected foods in EU Member States. Dutch National Institute for Public Health and the Environment (RIVM); 2015 (available at: <http://www.akkkoordverbeteringproductsamenstelling.nl>).
- 25 Ibid.
- 26 Oqali. Études transversales (<https://www.oqali.fr/Publications-Oqali/Etudes-transversales>).
- 27 Oqali. Caractérisation des produits reformulés dans le cadre d’engagements volontaires de progrès nutritionnel: positionnement avant amélioration en termes de composition nutritionnelle et de prix. INRA/ANSES/Oqali; 2016.
- 28 Ibid.
- 29 Oqali. Caractérisation de l’offre alimentaire, par secteur et segment de marché. Etude des produits transformés disponibles sur le marché français entre 2008 et 2011. INRA/ANSES/Oqali; 2015.
- 30 Oqali. Étude d’évolution du secteur des céréales pour le petit déjeuner. INRA/ANSES/Oqali; 2013.
- 31 Imamura F, Micha R, Khatibzadeh S, Fahimi S, Shi P, Powles J et al. Dietary quality among men and women in 187 countries in 1990 and 2010: a systematic assessment. *Lancet Glob Health* 2015;3(3):e132–42.
- 32 European Food and Nutrition Action Plan 2015–2020. Copenhagen: WHO Regional Office for Europe; 2014.
- 33 Obesity Update 2017. OECD; 2017 (<https://www.oecd.org/els/health-systems/Obesity-Update-2017.pdf>).
- 34 Dobbs R, Sawers C, Thompson F, Manyika J, Woetzel J, Child P et al. How the world could better fight obesity. McKinsey Global Institute; 2014 (<https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/how-the-world-could-better-fight-obesity>).
- 35 Monitoring the implementation of food and nutrition policies: a progress report for the WHO European Region. Copenhagen: WHO Regional Office for Europe; 2017.
- 36 Diet, physical activity and health: a European platform for action. European Commission; 2005 (http://ec.europa.eu/health/archive/ph_determinants/life_style/nutrition/platform/docs/platform_charter.pdf).
- 37 Framework for National Initiatives on Selected Nutrients – Annex II: Added Sugars. European Commission; 2015 (https://ec.europa.eu/health/sites/health/files/nutrition_physical_activity/docs/added_sugars_en.pdf).
- 38 Roadmap for Action on Food Product Improvement. Amsterdam: Dutch Presidency EU Conference; 2016.
- 39 Council Conclusions on Food Product Improvement. European Council; 2016 (<http://www.consilium.europa.eu/en/press/press-releases/2016/06/17/epsco-conclusions-food-product-improvement>).
- 40 Draft Council Conclusions to Contribute towards Halting the Rise in Childhood Overweight and Obesity. European Council; 2017 (<http://data.consilium.europa.eu/doc/document/ST-9977-2017-INIT/en/pdf>).

- 41 Les signataires des chartes d'engagements de progrès nutritionnels. Ministère des Solidarités et de la Santé; 2017 (<http://solidarites-sante.gouv.fr/prevention-en-sante/preserver-sa-sante/le-programme-national-nutrition-sante/article/les-signataires-des-chartes-d-engagements-de-progres-nutritionnels>).
- 42 Gontier J-P, Renaudin N. Charte d'engagements volontaires de progrès nutritionnel. Paris: SCAMARK; 2009 (http://solidarites-sante.gouv.fr/IMG/pdf/scamark_charte_publique.pdf).
- 43 National Agreement to Improve Product Composition, 2014–2020. Dutch Ministry of Health; 2014 (<http://www.akkoordverbeteringproductsamenstelling.nl/en>).
- 44 Ibid.
- 45 Signerte intensjonsavtale for sunnere mat. Norwegian Food Industry Group; 2016 (<https://www.regjeringen.no/no/aktuelt/signerte-intensjonsavtale-for-sunnere-mat/id2522820>).
- 46 Sugar reduction and wider reformulation programme: interim review. Public Health England; 2017 (<https://www.gov.uk/government/publications/sugar-reduction-and-wider-reformulation-interim-review/sugar-reduction-and-wider-reformulation-programme-interim-review>).
- 47 Soft Drinks Industry Levy. Policy paper. HM Revenue and Customs; 2016 (<https://www.gov.uk/government/publications/soft-drinks-industry-levy/soft-drinks-industry-levy>).
- 48 Nutri-Score: un étiquetage nutritionnel pour favoriser une alimentation équilibrée. Ministère des Solidarités et de la Santé; 2017 (<http://solidarites-sante.gouv.fr/prevention-en-sante/preserver-sa-sante/article/nutri-score-un-etiquetage-nutritionnel-pour-favoriser-une-alimentation>).
- 49 Dovrat-Meseritz A, Linder-Ganz R. Israel health ministry claims victory on unhealthy food warning labels. Haaretz. 3 October 2017 (<https://www.haaretz.com/science-and-health/1.815482>).
- 50 Briggs A, Mytton O, Kehlbacher A, Tiffin R, Elhussein A, Rayner M et al. Health impact assessment of the UK soft drinks industry levy: a comparative risk assessment modelling study. *Lancet Public Health* 2016;2(1):e15–e22.
- 51 Curbing global sugar consumption: effective policy actions to help promote healthy diets and tackle obesity. World Cancer Research Fund International; 2015 (<http://www.wcrf.org/sites/default/files/Curbing-Global-Sugar-Consumption.pdf>).
- 52 Oqali. Caractérisation de l'offre alimentaire, par secteur et segment de marché. Étude des produits transformés disponibles sur le marché français entre 2008 et 2011. INRA/ANSES/Oqali; 2015.
- 53 Ibid.
- 54 Author's personal communication with Tesco; 2017.
- 55 Les signataires des chartes d'engagements de progrès nutritionnels. Ministère des Solidarités et de la Santé; 2017 (<http://solidarites-sante.gouv.fr/prevention-en-sante/preserver-sa-sante/le-programme-national-nutrition-sante/article/les-signataires-des-chartes-d-engagements-de-progres-nutritionnels>).
- 56 Ibid.
- 57 National Agreement to Improve Product Composition, 2014–2020. Dutch Ministry of Health; 2014 (<http://www.akkoordverbeteringproductsamenstelling.nl/en>).
- 58 Author's personal communication with Unilever; 2017.
- 59 Charte d'engagements volontaires de progrès nutritionnel. Quick; 2013 (<http://solidarites-sante.gouv.fr/IMG/pdf/Quick.pdf>).
- 60 Author's personal communication with Mars; 2017.
- 61 Davies M. Sugar Puffs are renamed "Honey Monster Puffs" because parents are so paranoid about sugar. Mail Online. 16 October 2014 (<http://www.dailymail.co.uk/health/article-2795964/sugar-puffs-renamed-honey-monster-puffs-parents-paranoid-sugar-critics-say-replacing-sugar-honey-just-marketing-gimmick.html>).
- 62 Tesco. Groceries online (www.tesco.com/groceries/?sc_cmp=ppc*GHS+++Bing+++Grocery*PX+%7C+Bing+%7C+Tesco+Brand+%2B+Service*tesco+groceries%7bproduct_id%7d*e&gclid=CJnzurOr9dYCFcG1GwodalkBTg&gclsrc=ds).
- 63 Passport Packaged Food database. Euromonitor International; 2017 (<http://www.euromonitor.com/package-food-industry>).
- 64 Nutrition and food systems: a report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. HLPE; 2017: 11 (http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-12_EN.pdf).
- 65 European Food and Nutrition Action Plan 2015–2020. Copenhagen: WHO Regional Office for Europe; 2014.
- 66 Nutrition and food systems: a report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. HLPE; 2017 (http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-12_EN.pdf).

- 67 Work programme of the United Nations Decade of Action on Nutrition (2016–2025). 5 May 2017 (<http://www.who.int/nutrition/decade-of-action/workprogramme-2016to2025/en>).
- 68 Food systems and diets: facing the challenges of the 21st century. Global Panel on Agriculture and Food Systems for Nutrition; 2016 (<https://www.glopan.org/foresight>).
- 69 Action Plan on Childhood Obesity 2014–2020. European Commission; 2014 (https://ec.europa.eu/health/sites/health/files/nutrition_physical_activity/docs/childhoodobesity_actionplan_2014_2020_en.pdf).
- 70 Transforming food systems: adding value for better health in Europe. European Health Forum Gastein; 2017 (<https://www.ehfg.org/archive/2017/conference/ehfg2017/f1>).
- 71 Transforming European food and drink policies for cardiovascular health. Brussels: European Heart Network; 2017.
- 72 Nutrition and food systems: a report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. HLPE; 2017 (http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-12_EN.pdf).
- 73 Hawkes C. Identifying innovative interventions to promote healthy eating using consumption-oriented food supply chain analysis. *J Hunger Environ Nutr.* 2009;4(3-4):336–56.
- Gereffi G, Christian M. Trade, transnational corporations and food consumption: a global value chain approach. In: Hawkes C, Blouin C, Henson S, Drager N, Dubé L. Trade, food, diet and health: perspectives and policy options. Oxford: Wiley and Blackwell; 2010: 91–110.
- Hawkes C, Ruel M. Value chains for nutrition. Washington (DC): IFPRI; 2011.
- Anim-Somuah H, Henson S, Humphrey J, Robinson E. Strengthening agri-food value chains for nutrition: mapping value chains for nutrient-dense foods in Ghana. IDS Evidence Report 2: Reducing hunger and undernutrition. Institute of Development Studies; 2013.
- Downs S, Thow M, Ghosh-Jerath S, Leeder S. Aligning food-processing policies to promote healthier fat consumption in India. *Health Promot Int.* 2015;30(3):595–605.
- Gelli A, Hawkes C, Donovan J. Food value chains and nutrition: exploring the opportunities for improving nutrition. In: Pritchard B, Ortiz R, Shekar M. The Routledge handbook of food and nutrition security. Oxford: Taylor & Francis; 2016: 283–98.
- Gelli A, Becquey E, Ganaba R, Headey D, Hidrobo M, Huybregts L et al. Improving diets and nutrition through an integrated poultry value chain and nutrition intervention (SELEVER) in Burkina Faso: study protocol for a randomized trial. *Trials* 2017;18(1):412.
- Maestre M, Poole N, Henson S. Assessing food value chain pathways, linkages and impacts for better nutrition of vulnerable groups. *Food Policy* 2017;68:31–9.
- Waterlander W, Ni Mhurchu C, Eyles H, Vandevijvere, Cleghorn C, Scarborough P et al. Food futures: developing effective food systems interventions to improve public health nutrition. *Agric Syst.* (<https://www.sciencedirect.com/science/article/pii/S0308521X17300409>).
- Fanzo J, Downs S, Marshall Q, Bloem M. Value chain focus on food and nutrition security. In: Pees S, Taren D, Bloem M. Nutrition and health in a developing world. New York (NY): Humana Press: 2017:753–70.
- 74 Aguirre E, Mytton O, Monsivais P. Liberalising agricultural policy for sugar in Europe risks damaging public health. *BMJ.* 2015;351:h5085.
- Schoen V, Lang T. Should the UK be concerned about sugar? Food Research Collaboration; 2015 (<http://foodresearch.org.uk/wp-content/uploads/2015/06/Sugar-policy.pdf><http://foodresearch.org.uk/wp-content/uploads/2015/06/Sugar-policy.pdf>).
- 75 Sugar Yearbook. International Sugar Organization; 2015 (<http://www.isosugar.org/sugarsector/sugar>).
- 76 Ibid.
- 77 Ibid.
- 78 Sugar crash: how EU reform is endangering the livelihoods of small farmers. Fairtrade Foundation; 2015 (<http://fairtrade.org.uk/~media/fairtradeuk/what%20is%20fairtrade/documents/policy%20and%20research%20documents/policy%20reports/fairtrade%20foundation%20sugar%20crash%20report.ashx>).
- 79 The abolition of EU sugar production quotas: Frequently Asked Questions. European Commission; 2016 (https://ec.europa.eu/agriculture/sites/agriculture/files/sugar/doc/sugar-faq_en.pdf).
- 80 Agriculture and rural development: sugar. European Commission; 2017 (http://ec.europa.eu/agriculture/sugar_en).

- 81 Leading sugar beet producers worldwide in 2014, based on production volume (in 1,000 metric tons). Statista; 2014 (<https://www.statista.com/statistics/264670/top-sugar-beet-producers-worldwide-by-volume>).
- 82 Country-by-country sugar subsidy developments. American Sugar Alliance; 2017 (<https://sugaralliance.org/wp-content/uploads/2017/03/Attache-GAIN-Sugar-Reports.pdf>).
Trade facts. American Sugar Alliance; 2017 (<https://sugaralliance.org/foreign-sugar/trade-facts>).
- 83 Russian Federation Sugar Annual 2016. Global Agricultural Information Network; 2016 (https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Sugar%20Annual_Moscow_Russian%20Federation_4-14-2016.pdf).
- 84 Voluntary coupled support: sectors mostly supported. European Commission; 2014 (https://ec.europa.eu/agriculture/sites/agriculture/files/direct-support/direct-payments/docs/voluntary-coupled-support-note_en.pdf).
- 85 Terazono E. Sugar market braced for EU exports. Financial Times. 24 February 2016 (<https://www.ft.com/content/25708056-dac7-11e5-98fd-06d75973fe09>).
- 86 Agricultural Outlook 2016–2025. OECD/FAO; 2016 (https://stats.oecd.org/Index.aspx?DataSetCode=HIGH_AGLINK_2016).
Terazono E. Sugar market braced for EU exports. Financial Times. 24 February 2016 (<https://www.ft.com/content/25708056-dac7-11e5-98fd-06d75973fe09>).
The Cotonou Agreement: from Lomé I to IV bis. European Commission (http://ec.europa.eu/development/body/cotonou/lome_history_en.htm).
The end of EU sugar production quotas: basic figures for the EU sugar sector. European Commission; 2017 (https://ec.europa.eu/agriculture/sugar/doc/factsheet-end-sugar-quota_en.pdf).
- 87 Agricultural Outlook 2016–2025. OECD/FAO; 2016 (https://stats.oecd.org/Index.aspx?DataSetCode=HIGH_AGLINK_2016).
- 88 Bray G, Nielsen J, Popkin B. Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity. *Am J Clin Nutr*. 2004;79:537–43 (<http://ajcn.nutrition.org/content/79/4/537.full.pdf>).
- 89 Agriculture and rural development: sugar. European Commission; 2017 (http://ec.europa.eu/agriculture/sugar_en).
- 90 Ethanol. SugarCane.org; 2017 (<http://sugarcane.org/sugarcane-products/ethanol>).
- 91 Curbing global sugar consumption: effective policy actions to help promote healthy diets and tackle obesity. World Cancer Research Fund International; 2015 (<http://www.wcrf.org/sites/default/files/Curbing-Global-Sugar-Consumption.pdf>).
- 92 ASR Group. Tate & Lyle Sugars (<https://www.tateandlylesugars.com/about-us/asr>).
- 93 AB Sugar (<https://www.absugar.com/about>).
- 94 Curbing global sugar consumption: effective policy actions to help promote healthy diets and tackle obesity. World Cancer Research Fund International; 2015 (<http://www.wcrf.org/sites/default/files/Curbing-Global-Sugar-Consumption.pdf>).
- 95 The European sugar sector. Comité Européen des Fabricants de Sucre; 2017 (<http://www.comitesucre.org/site/cefs/the-european-sugar-sector>).
- 96 Sugar segment. Südzucker; 2017 (<http://www.suedzucker.de/en/Unternehmen/Konzernstruktur/Segment-Zucker>).
- 97 Tereos (<https://tereos.com/en>).
- 98 Louis Dreyfus Company (<http://www.ldcom.com/global/en>).
- 99 Sugar market report and forecast 2017–2020. Expert Market Research; 2017 (<http://www.expertmarketresearch.com/reports/sugar-market>).
- 100 Sugar Yearbook. International Sugar Organization; 2015 (<http://www.isosugar.org/sugarsector/sugar>).
- 101 Ibid.
- 102 Ibid.
- 103 Trading sugar as a commodity. TradeCommodities.co.uk; 2017 (<http://www.tradecommodities.co.uk/commodities/sugar>).
- 104 Sugar market report and forecast 2017–2020. Expert Market Research; 2017 (<http://www.expertmarketresearch.com/reports/sugar-market>).
- 105 Monteiro C, Moubarac J-C, Cannon G, Ng S, Popkin B. Ultra-processed products are becoming dominant in the global food system. *Obesity Reviews* 2013:21–8.
- 106 Data and trends: EU food and drink industry. FoodDrink Europe; 2016 (http://www.fooddrinkeurope.eu/uploads/publications_documents/Data_and_trends_Interactive_PDF_NEW.pdf).

- 107 European grocery retailing: change is the only constant. PlanetRetail; 2014 (<https://www.planetretail.net/presentations/ApexBrasilPresentation.pdf>).
- 108 Frequency of dining at restaurants or other out-of-home dining establishments in Europe as of 3rd quarter 2015. Statista; 2015 (<https://www.statista.com/statistics/683959/eating-out-frequency-europe>).
- 109 Biguzzi C, Schlich P, Lange C. The impact of sugar and fat reduction on perception and liking of biscuits. *Food Qual Prefer.* 2014;35:41–7 (<http://www.sciencedirect.com/science/article/pii/S0950329314000123>).
- Markey O, Lovegrove J, Methven L. Sensory profiles and consumer acceptability of a range of sugar-reduced products on the UK market. *Food Res Int.* 2015;72:133–9 (<http://www.sciencedirect.com/science/article/pii/S0963996915001040>).
- Hoppert K, Zahn S, Janecke L, Mai R, Hoffman S, Rohm H. Consumer acceptance of regular and reduced-sugar yogurt enriched with different types of dietary fiber. *Int Dairy J.* 2013;28:1–7 (<http://www.sciencedirect.com/science/article/pii/S0958694612001665>).
- 110 Chollet M, Gille D, Schmid A, Walther B, Piccinali P. Acceptance of sugar reduction in flavored yogurt. *J Dairy Sci.* 2013;96:5501–11 (<http://www.sciencedirect.com/science/article/pii/S0022030213005122>).
- 111 Passport Packaged Food database. Euromonitor International; 2017 (<http://www.euromonitor.com/packaged-food-industry>).
- 112 Reed D, Knaapila A. Genetics of taste and smell: poisons and pleasures. *Prog Mol Biol Transl Sci.* 2010:213–40.
- Reed D, McDaniel A. The human sweet tooth. *BMC Oral Health* 2006;6(Suppl 1):S17.
- 113 Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics* 1998;101(3 Pt2):539–49.
- 114 Mennella JA, Jagnow CP, Beauchamp GK. Prenatal and postnatal flavor learning by human infants. *Pediatrics* 2001;107(6):E88–E93.
- 115 Scaglioni S, Salvioni M, Galimberti C. Influence of parental attitudes in the development of children eating behaviour. *Br J Nutr.* 2008;99 Suppl 1:S22–5.
- 116 Ventura A, Worobey J. Early Influences on the development of food preferences. *Curr Biol.* 2013;23(9):R401–8.
- 117 Pepino M, Mennella J. Factors contributing to individual differences in sucrose preference. *Chem Senses* 2005;30 Suppl 1:i319–20.
- 118 Mennella J, Bobowski N, Reed D. The development of sweet taste: from biology to hedonics. *Rev Endocr Metab Disord.* 2016;17(2):171–8.
- 119 Sugar reduction and wider reformulation programme: interim review. Public Health England; 2017 (<https://www.gov.uk/government/publications/sugar-reduction-and-wider-reformulation-interim-review/sugar-reduction-and-wider-reformulation-programme-interim-review>).
- 120 Wise P, Nattress L, Flammer L, Beauchamp G. Reduced dietary intake of simple sugars alters perceived sweet taste intensity but not perceived pleasantness. *Am J Clin Nutr.* 2016;103:50–60.
- 121 Kendrick F. Is there a role for regulation to tackle obesity? Nestlé [website]. 17 May 2017 (<http://www.nestle.ie/media/pressreleases/level-playing-field>).
- 122 Dinkovski N. Nestlé and Unilever lead call for EU nutrient profiles. *Food Manufacture.* 7 June 2017 (<https://www.foodmanufacture.co.uk/Article/2017/06/08/Food-giants-call-for-EU-nutrient-profiles>).
- 123 BEUC, CPME, EHN, EPHA, Kellogg Company, Mars, Mondelēz, Nestlé. Open letter to the European Commission: call for a legislative limit for the amount of industrially produced TFAs in foods. 15 October 2015 (http://www.beuc.eu/documents/files/Open%20Letter_industrially_produced%20TFAs_freeEU.pdf).
- 124 Verhoef P, van Doorn J. Segmenting consumers according to their purchase of products with organic, fair-trade, and health labels. *Journal of Marketing Behavior* 2016;2:19–37.
- Vyth E, Steenhuis I, Vlot J, Wulp A, Hogenes MG, Looije D. Actual use of a front-of-pack nutrition logo in the supermarket: consumers motives in food choice. *Public Health Nutr.* 2010;13(11):1882–9.
- 125 Clemens R, Jones J, Kern M, Lee S-Y, Mayhew E, Slavin J et al. Functionality of sugars in food and health. *Compr Rev Food Sci Food Saf.* 2016;15:433–70.
- 126 Ibid.
- 127 Aguirre E, Mytton O, Monsivais P. Liberalising agricultural policy for sugar in Europe risks damaging public health. *BMJ.* 2015;351:h5085.
- 128 Bonnet C, Réquillart V. Sugar policy reform, tax policy and price transmission in the soft drink industry. Working Paper No. 4, Transparency of Food Pricing. TRANSFOP; 2012 (http://www.transfop.eu/media/universityofexeter/businessschool/documents/centres/transfop/wp_transfop_4.pdf).

- 129 Environmental report: beet growing and sugar production in Europe. CIBE/CEFS; 2003 ([http://www.comitesucre.org/userfiles/environ\(5\)\(3\).pdf](http://www.comitesucre.org/userfiles/environ(5)(3).pdf)).
- 130 Hunsigi G. Production of sugarcane: theory and practice. Heidelberg: Springer-Verlag; 1993.
- 131 Learn about vanilla. Rainforest Spices; 2017 (<http://www.rainforestspices.com/about-the-farm/learn-about-vanilla>).
- 132 NFU Sugar. National Farmers Union; 2017 (<https://www.nfuonline.com/sectors/nfu-sugar>).
- 133 Who we are. Royal Cosun; 2017 (<https://www.cosun.com/Over-Cosun/Wie-zijn-wij.aspx>).
- 134 Profile. Cristal Union; 2017 (<https://www.cristal-union.fr/en/group/profile>).
- 135 Russian Federation Sugar Annual 2016. Global Agricultural Information Network; 2016 (https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Sugar%20Annual_Moscow_Russian%20Federation_4-14-2016.pdf).
- 136 The supply and demand of sugar in Swaziland. Global Agricultural Information Network; 2015 (https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Sugar%20Annual_Pretoria_Swaziland_4-20-2015.pdf).
- 137 Goldemberg J, Nogueira H. Sweetening the biofuel sector: the history of sugarcane ethanol in Brazil. Bioenergy Connection; 2014 (<http://bioenergyconnection.org/article/sweetening-biofuel-sector-history-sugarcane-ethanol-brazil>).
- 138 Ethanol. SugarCane.org; 2017 (<http://sugarcane.org/sugarcane-products/ethanol>).
- 139 History of sugar. Sugar History; 2017 (<http://www.sugarhistory.net/who-made-sugar/history-of-sugar>).
- 140 Farah A. Brazilian sugarcane industry. The Brazil Business; 2013 (<http://thebrazilbusiness.com/article/brazilian-sugarcane-industry>).
- 141 The supply and demand of sugar in Swaziland. Global Agricultural Information Network; 2015 (https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Sugar%20Annual_Pretoria_Swaziland_4-20-2015.pdf).
- 142 Sugar crash: how EU reform is endangering the livelihoods of small farmers. Fairtrade Foundation; 2015 (<http://fairtrade.org.uk/~media/fairtradeuk/what%20is%20fairtrade/documents/policy%20and%20research%20documents/policy%20reports/fairtrade%20foundation%20sugar%20crash%20report.ashx>).
- Schoen V, Lang T. Should the UK be concerned about sugar? Food Research Collaboration; 2015 (<http://foodresearch.org.uk/wp-content/uploads/2015/06/Sugar-policy.pdf><http://foodresearch.org.uk/wp-content/uploads/2015/06/Sugar-policy.pdf>).
- 143 The impact of EU sugar reform on developing countries. LMC International/ODI; 2012 (https://assets.publishing.service.gov.uk/media/57a08a8be5274a31e000066a/LMC-ODI_SugarReportPublicVersion_Final_.pdf).
- 144 Commission Regulation (EU) No. 1129/2011 of 11 November 2011 amending Annex II to Regulation (EC) No. 1333/2008 of the European Parliament and of the Council by establishing a Union list of food additives. Official Journal of the European Union; 2011 (<http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32011R1129>).
- 145 Bosley S. Artificial sweeteners raise risk of type 2 diabetes, study suggests. The Guardian. 14 September 2017 (<https://www.theguardian.com/society/2017/sep/14/artificial-sweeteners-raise-risk-of-type-2-diabetes-study-suggests>).
- Lohner S, Toews I, Meerpohl J. Health outcomes of non-nutritive sweeteners: analysis of the research landscape. *Nutr J*. 2017;16(1):55 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5591507/pdf/12937_2017_Article_278.pdf).
- Évaluation des bénéfices et des risques nutritionnels des édulcorants intenses. ANSES;2015 (<https://www.anses.fr/en/system/files/NUT2011sa0161Ra.pdf>).
- 146 Fernan C, Schuldt J, Niederdeppe J. Health halo effects from product titles and nutrient content claims in the context of "protein" bars. *Health Commun*. 2017;9:1–9.
- 147 Évaluation des bénéfices et des risques nutritionnels des édulcorants intenses. ANSES;2015 (<https://www.anses.fr/en/system/files/NUT2011sa0161Ra.pdf>).
- Talati Z, Pettigrew S, Neal B, Dixon H, Hughes C, Kelly B et al. Consumers' responses to health claims in the context of other on-pack nutrition information: a systematic review. *Nutr Rev*. 2017;75(4):260–73.
- 148 Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods. Official Journal of the European Union; 2006 (<http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1924&from=en>).
- 149 REFIT – Evaluation of the Regulation on nutrition and health claims. European Commission; 2017 (https://ec.europa.eu/food/safety/labelling_nutrition/claims/refit_en).
- 150 Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods. Official Journal of the European Union; 2006 (<http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1924&from=en>).

- 151 Keyhole nutrition label. Nordic Co-operation; 2017 (<http://norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-fisheries-and-aquaculture-agriculture-food-and-forestry-mr-fjls/keyhole-nutrition-label>).
- 152 Regulation (EC) No. 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives. Official Journal of the European Union; 2008 (<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R1333>).
- 153 Commission Regulation (EU) No. 1129/2011 of 11 November 2011 amending Annex II to Regulation (EC) No. 1333/2008 of the European Parliament and of the Council by establishing a Union list of food additives. Official Journal of the European Union; 2011 (<http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32011R1129>).
- 154 Commission Regulation (EU) No. 1131/2011 of 11 November 2011 amending Annex II to Regulation (EC) No. 1333/2008 of the European Parliament and of the Council with regard to steviol glycosides. Official Journal of the European Union; 2011 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2011.295.01.0205.01.ENG&toc=OJ:L:2011:295:TOC).
- 155 Regulation (EU) No. 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No. 1924/2006 and (EC) No. 1925/2006 of the European Parliament and of the Council [etc.]. Official Journal of the European Union; 2011 (<http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32011R1169>).
- 156 We are what we eat: healthy eating trends around the world. Nielsen; 2015 (<https://www.nielsen.com/content/dam/niensenglobal/eu/nielseninsights/pdfs/Nielsen%20Global%20Health%20and%20Wellness%20Report%20-%20January%202015.pdf>).
- 157 Arthur R. The reformulation race: driving change in sugar-sweetened beverages. *Beverage Daily*. 21 March 2017 (<https://www.beveragedaily.com/Article/2017/03/21/The-reformulation-race-Driving-change-in-sugar-sweetened-beverages>).
- 158 Vyth EL, Steenhuis IHM, Roodenburg AJ, Brug J, Seidell JC. Front-of-pack nutrition label stimulates healthier product development: a quantitative analysis. *Int J Behav Nutr Phys Act*. 2010;7:65.
- Mhurchu CN, Eyles H, Choi YH. Effects of a voluntary front-of-pack nutrition labelling system on packaged food reformulation: the Health Star Rating system in New Zealand. *Nutrients* 2017; 9(8). pii: E918.
- 159 Irving E, Crossman M. Sugar, obesity and noncommunicable disease: investor expectations. Schroders/ Rathbone Greenbank Investments; 2017 (<http://www.schroders.com/hu/sysglobalassets/digital/insights/2017/pdf/2017-sugar-investor-expectations-consumer.pdf>).
- 160 Popkin BM, Hawkes C. Sweetening of the global diet, particularly beverages: patterns, trends, and policy responses. *Lancet Diabetes Endocrinol*. 2016;4(2):174–86.
- 161 Stevia set to steal intense sweetener market share by 2017, reports Mintel and Leatherhead Food Research. Mintel; 2014 (<http://www.mintel.com/press-centre/food-and-drink/stevia-set-to-steal-intense-sweetener-market-share-by-2017-reports-mintel-and-leatherhead-food-research>).
- 162 Guidance on ending the inappropriate promotion of foods for infants and young children. World Health Organization; 2017 (<http://www.who.int/nutrition/topics/guidance-inappropriate-food-promotion-iyf-backgroundprocess.pdf?ua=1>).
- 163 Public procurement of food for health: technical report on the school setting. European Commission; 2017 (<https://ec.europa.eu/jrc/sites/jrcsh/files/public-procurement-food-health-technical-report.pdf>).
- 164 Gibson S, Ashwell M, Arthur J, Bagley L, Lennox A, Rogers P et al. What can the food and drink industry do to help achieve the 5% free sugars goal? *Perspect Public Health* 2017;137(4):237–47.
- 165 Scrinis G, Monteiro CA. Ultra-processed foods and the limits of product reformulation. *Public Health Nutr*. 2017;13:1–6.
- 166 Duffey K, Popkin B. High-fructose corn syrup: is this what's for dinner? *Am J Clin Nutr*. 2008;88(6):1722S–1732S.
- 167 Fanzo J, Downs S, Marshall Q, Bloem M. Value chain focus on food and nutrition security. In: Pees S, Taren D, Bloem M. *Nutrition and health in a developing world*. New York (NY): Humana Press: 2017:753–70.
- 168 Harvey W. Strategies for conducting elite interviews. *Qualitative Research* 2011:431–41.

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World Health Organization Regional Office for Europe

UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark

Tel.: +45 45 33 70 00 Fax: +45 45 33 70 01

Email: euwhocontact@who.int

Website: www.euro.who.int