Research Paper

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The Need for Legislation on the Nutritional Composition of Infant Cereals: A Review of the Spanish Market

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World Health Organization recommends complementary feeding alongside breastfeeding starting at six months. Infant cereals are among the first complementary foods introduced into children's diets, playing a vital role in their transition from exclusive breastfeeding to diversified feeding. Although labelling is a critical tool for enabling parents to make informed choices, it often lacks clarity and presents vague or misleading information, especially for products targeted to children. Parents are increasingly vigilant to added sugars, refined flours, and processed ingredients, demanding healthier options and greater transparency. This growing concern underscores the gap between marketing claims and actual nutritional value. This study examined labelling of 56 infant cereal brands available in the Spanish market, categorizing them into rice-, corn-, rice/corn- and multigrain-based products. The analysis focused on regulatory compliance and quantity of sugar present. The research revealed that 75% of the analysed cereal brands contained sugar either through direct addition or via dextrinization (starch hydrolysis). Alarmingly, 35.7% of the selected brands exhibited high free sugar content, with some brands reaching up to 35% total sugar. Multigrain cereals exhibited superior nutritional profiles, offering significantly higher levels of protein and fibre compared to rice- or rice/corn-based brands. Notably, the study highlights that current EU regulations permit total sugar contents ranging from 24.5% to 61%, depending on the cereal's energy content. This may pose a risk to infant health. In light of these findings, we advocate for an urgent update of European legislation concerning the nutritional composition of foods for children under 3 years of age.

1. Introduction

The World Health Organization (WHO) recommends exclusive breastfeeding during the first six months of life (WHO, 2023). From six months onward, continued breastfeeding combined with high-quality complementary foods in sufficient quantities is advised for two years or longer (WHO & UNICEF, 2002). Complementary Feeding (CF) is defined as the process by which infants are gradually introduced to solid or liquid foods other than breast milk or infant formula, supporting the transition toward a varied and nutritionally adequate diet (WHO & UNICEF, 2002). This definition has been adopted by major health authorities, including the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (Fewtrell et al., 2017), the UK Scientific Advisory Committee on Nutrition (Public Health England, 2018), the United States Department of Agriculture (USDA, 2019), and the American Academy of Paediatrics (DiMaggio, Cox, & Porto, 2017). CF represents a critical stage in the nutritional development, essential for meeting the increasing energy and micronutrient requirements that appear around six months of age. Within this process, infant cereals, such as porridges or gruels, have traditionally been among the first foods introduced across various cultures (Nicklas, O'Neil, & Fulgoni, 2020). Their popularity is due to their ease of preparation, high energy density, and frequent fortification with essential nutrients, such as iron (Baker, Greer, & Nutrition, 2010). Considering their popularity and widespread consumption, infant cereals have been the topic of numerous studies evaluating their nutritional quality, ingredient composition, and the accuracy of labelling information (Klerks et al., 2019). For this reason, the nutritional role and composition of these products have been intensely debated and scrutinized (Niinikoski & Ruottinen, 2012).

Food labelling refers to the information displayed on food packaging, including details about its contents, ingredients, nutritional value, expiration date, storage instructions, usage guidelines, directions, and relevant warnings (WHO & FAO, 2007). This information is designed to help consumers make informed choices about the products they purchase and consume (Regulation (EU) No 1169/2011). In the case of infant complementary containing cereals, labelling legislation is administered by the European Community (Regulation (EU) 609/2013, enacted by the European Parliament and the Council, on June 12, 2013), and mandatory since July 20, 2016, with modifications introduced in June 2025. Nutritional composition for infant foods, excluding infant formulas, is currently regulated Commission Directive 2006/125/EC, which categorizes these products into two categories: "processed cereal-based foods" and "baby foods."

In response to the growing demand for healthier options, the food industry has begun rethinking formulas and marketing strategies. The shift towards "conscious eating" is reflected in the rise of cereal products promoting benefits such as "low sugar content," "fortified with fibre," or "free from artificial colours and preservatives" (Signes-Pastor, Carey, & Meharg, 2016). Health-conscious parents increasingly seek products that are quick to prepare, palatable, and nutritionally balanced for their children. In response to this demand, the infant cereal industry is encouraged to adapt ingredients and improve production processes. However, substantial efforts remain to ensure that these products meet the health claims they advertise (Wise & Phillips, 2019).

Consumer awareness has largely risen due to readily accessible information about the long-term effects of diets high in sugars, saturated fats, and artificial additives, including colorants and preservatives found in many processed products (Delley & Brunner, 2019). Child health is now seen not only in terms of preventing immediate diseases such as obesity, but also in relation to immune system strengthening, cognitive development, and the prevention of chronic diseases later in life (Wise & Phillips, 2019). Recent studies indicate that nearly 70% of consumers are willing to pay more for products perceived as healthier for their children (Correa et al., 2019). This trend is reshaping the priorities of infant cereal brands, which increasingly highlight features such as "gluten-free," "low in saturated fats," or "fortified with micronutrients" to appeal to health-conscious parents (Potvin Kent, Rudnicki, & Usher, 2017). Despite these efforts, a notable gap remains between marketing

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claims and actual nutritional quality of some products. Some cereal brands modify ingredients to comply with regulations without meaningfully improving nutritional profiles (Moreno Aznar et al., 2021). This article explores how infant cereal brands are responding to parental pressure for healthier alternatives by analysing the nutritional composition indicated in the labelling of different infant cereals available in the Spanish market, with particular attention to sugar content.

2. Methodology

The study analyzed the nutritional composition and ingredients listed on the labels of various infant cereal brands available in the Spanish market, with the aim of comparing their caloric content, macronutrient and micronutrient profile, as well as the presence of specific added ingredients.

2.1. Database of Various Food Products Available in the Spanish Market

Data collection for this study on infant cereals was conducted between February 2023 and May 2024, drawing from a range of various sources. Physical retail locations included Pharmacies in the Spanish cities of Alicante (Pharmacy Luna, Pharmacy Hidalgo, Pharmacy Teatro), San Vicente del Raspeig (Pharmacy Castelar), and Elche (Pharmacy Iborra). In addition, product information was collected from websites of major retail chains, such as Alcampo (www.alcampo.es), Mercadona (www.mercadona.es), and Lidl (www.lidl.com), as well as from online pharmacy platforms such as Cofares (www.cofares.es), Alliance Healthcare (www.alliance-healthcare.es), and BorginoPharma (www.borginofarma.es).

Product selection considered the nutritional information provided on brand's label, enabling a systemic and meaningful classification of infant cereals. Researchers extracted data on nutrient composition and ingredients directly from the labels, excluding products with inconsistent or incomplete information. From each product, the following information was collected: brand name, ingredients and special components (honey, fruit, bacteria, soy, flavourings, minerals, vitamins, oils, fibre, sucrose, fructo-oligosaccharides, maltodextrin, nuts, seeds or cocoa), and energy (Kcal per 100 g of product). Macronutrients (including carbohydrates, starch, fibre, sugars, total fat, saturated fats, monounsaturated fats, polyunsaturated fats, ω-3 fatty acids, and protein) were reported in grams per 100 g of product. Other macronutrients, such as cholesterol, and ω-6 fatty acids, are presented in mg per 100 g of product. Micronutrients (including vitamins, minerals and salt are presented in mg per 100 g of product, except for vitamins D and B9, which were noted in µg per 100 g of product. All indicated values are specified on the product labelling.

2.2. Food Classification into Study Categories

Initially, 70 infant cereal products were collected and independently reviewed by two researchers. 14 cereals lacked data, mainly for two reasons. First, the food product was listed on the website, but the nutritional labelling or ingredient information was not available. These products lacking ingredient list or nutritional composition, as well as duplicates differing only in package size, were discarded. Any discrepancies between reviewers were resolved through assessment by a third author. Finally, 56 products from 19 different brands were selected for the study (see Tables 1a, 1b, and 1c).

Subsequently, the cereals were categorized according to the main cereal ingredient listed. The classification included 4 groups: 1) rice-based cereals, containing rice as the sole cereal (Table 1a); 2) corn-based cereals, containing only corn (Table 1a); 3) rice and corn-based cereals, containing exclusively rice and corn (Table 1b); 4) multigrain cereals, comprising three or more cereal types (Table 1c). This last group included gluten-containing cereals (wheat, oats, barley, rye, triticale), gluten-free cereals (gluten-free wheat or oats), and pseudo-cereals such as quinoa, amaranth, buckwheat, and chia. The group 2 was not considered for statistical analysis (see Results).

Table 1a: List of Infant Cereal-based Preparations Classified by brand and its Main Cereal Components: Rice or Corn.

Brand Code	Type of Cereal	Product Characteristics
1	Rice	Rice-based cream
1	Rice	Rice-based cream
2	Rice	Gluten-free cereals
3	Rice	Instant and dextrinised rice porridge
5	Rice	Rice-based cream
6	Rice	Rice-based cream
6	Corn	Gluten-free biscuits
9	Rice	Bio cereals gluten-free night of calm.
13	Rice	Rice-based cream
13	Rice	Innovate rice cream.
14	Rice	Rice-based cream
14	Rice	Carrot and rice
15	Rice	Rice-based cream
16	Rice	Rice cream
17	Rice	Lactose and gluten-free
18	Rice	Rice-based cream

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Table 1b: List of Infant Cereal-based Preparations Classified by Brand and its main Cereal Components: Rice and Corn.

Brand Code	Type of Cereal	Product Characteristics
1	Rice and Corn	Gluten-free cereals
2	Rice and Corn	Gluten-free cereal porridge
2	Rice and Corn	Gluten-free cereals. First porridge
3	Rice and Corn	Organic gluten-free cereal and sweet corn porridge
4	Rice and Corn	Gluten-free cereals and FOS
6	Rice and Corn	Gluten-free cereals
7	Rice and Corn	Nature selection rice and corn
8	Rice and Corn	Gluten-free cereal porridge
11	Rice and Corn	Gluten-free cereals and FOS
13	Rice and Corn	Fruit starter porridge
14	Rice and Corn	Gluten-free bottle
14	Rice and Corn	Rice and corn
16	Rice and Corn	Organic gluten-free cereals
19	Rice and Corn	Rice and corn
19	Rice and Corn	Gluten-free cereals
Abbreviations: FOS, fructo-oligosaccharides.		

Table 1c: List of Infant Cereal-based Preparations Classified by Brand Along with their main Components in the Multigrain Group.

Brand Code	Type of Cereal	Product Characteristics
1	Multigrain	Gluten-free cereals
1	Multigrain	8 types of cereals biscuits
1	Multigrain	8 types of cereals fruit
1	Multigrain	Buckwheat, rice and corn
1	Multigrain	8 types of cereals with honey
2	Multigrain	8 types of cereals biscuits
2	Multigrain	8 types of cereals with honey
2	Multigrain	8 types of cereals with cacao
5	Multigrain	Porridge 3 types of cereals. Gluten-free.
6	Multigrain	Multigrain
6	Multigrain	Multigrain quinoa
10	Multigrain	Organic cereals
12	Multigrain	Organic gluten-free cereal and sweet corn porridge
13	Multigrain	Cocoa with Maria biscuits
13	Multigrain	5 types of cereals
14	Multigrain	Multigrain with nuts, honey and fruits
14	Multigrain	8 types of cereals and fruits
14	Multigrain	Cola Cao (cacao)
14	Multigrain	Optimum 8 types of cereals with honey
14	Multigrain	5 types of cereals
14	Multigrain	8 types of cereals
14	Multigrain	8 types of cereals in bottle
14	Multigrain	8 organic types of cereals
14	Multigrain	8 types of cereals

2.3. Nutrient Composition Analysis

Statistical analyses were conducted to assess differences in nutrient composition among the three remining infant cereal groups (see section 2.5).

The Pan American Health Organization Nutrient Profile Model (PAHO-NPM) was used to classify foods as either "healthy" or "less healthy", following previous studies (Duran et al., 2019; Leite et al., 2020). Products were considered "less healthy" if they exceeded the thresholds for any of the critical nutrients (sodium, free sugar, total fat, saturated fat, trans-fat), or they contained low- and no-calorie sweeteners (LNCS), as defined by PAHO-NPM. The criterion for trans-fat could not be assessed, as none of the products reported this information. The thresholds applied were: (1) ≥1 mg sodium/Kcal; (2) ≥10% of total energy from free sugars; (3) ≥30% of total energy from total fat; and (4) ≥10% of total energy from saturated fat (PAHO-NPM, 2016). Only products with complete data for all five components (sodium/salt, sugar, total fat, saturated fat, and LNCS) were included in the overall classification of "less healthy" foods.

The free sugar content of cereal-based products was estimated following the methodology described by Beltrá et al. (2020) and Ropero et al. (2023). For all products, a standardized value of 2 g of sugar per100 g was subtracted from the total sugar content to account for the average amount of naturally occurring sugars in the most commonly used grains, as reported in the BEDCA ("Base Española de Datos de Composición de Alimentos"-Spanish Database of Food Composition).

The criterion used to define the excess of free sugars, was based on the definition established by PAHO-NPM (2016). A product was considered to exceed the recommendation level, if the energy (Kcal) derived from free sugars (calculated as g of free sugars x 4 Kcal) accounted for 10% or more of the total energy content. Free sugars were estimated by subtracting 2 g per 100 g (representing the average naturally occurring sugar content in common grains) from the total sugar content. Therefore, the percentage of energy from the sugars was calculated using the following formula: [(Total sugars-2) x 4 x 100] / Total energy (Kcal).

2.4. Requirements for Cereal-based Processed Foods

Requirements for Cereal-based Processed Foods (According to Annex I, Directive 2006/125/EC):

- Cereals: The proportion of cereal and/or starchy root must represent no less than 25% by weight of the final dry mixture.
- Proteins: The protein content must not exceed 1.3 g/100 KJ (5.5 g/100 Kcal). For products with added protein, a minimum of 0.48 g/100 KJ must be incorporated.
- Carbohydrates: The addition of sugars (sucrose, fructose, glucose, glucose syrup honey) is restricted. For example, plain cereals may contain no more than 1.8 g/100 KJ of added sugars. Added fructose must not exceed 0.9 g/100 KJ (3.75 g/100 Kcal).
- Lipids: In most cases, lipid content must not exceed 0.8 g/100 KJ (3.3 g/100 Kcal). The fatty acid profile (lauric, myristic, and linoleic acids) is subjected to regulation.
- Minerals: Sodium content must not exceed 25 mg/100 KJ. Calcium content must be no less than 20 mg/100 KJ (80 mg/100 Kcal).
- Vitamins: Thiamine (Vitamin B1) must not be less than 100 µg/100 Kcal. For products with added vitamins, the following ranges apply per 100 Kcal: 60 to 180 µg RE for vitamin A and 1 to 3 µg for vitamin D. For the remaining vitamins and minerals, the maximum levels were specified in Annex I of Commission Directive 2006/125/EC, when added.

2.5. Statistical Analysis

Nutrient composition data were initially compiled and managed using Microsoft Excel (Office 365) spreadsheets. All statistical analyses were conducted using R software, version 4.4.1 (R Core Team, A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria; http://www.R-project.org). All tests were two-sided, with statistical significance set at $p < 0.05$. Normality of discontinuous variables was assessed using the Kolmogorov–Smirnov test. Do to potential skewness, nutrient composition was primarily summarized using the median and interquartile range (IQR). Differences in nutrient composition across the three study categories were examined using the Mann–Whitney U test for continuous variables.

3. Results

3.1. Sample Description

A total of 70 infant cereal products were initially compiled. Of these, 14 were excluded due to missing ingredient or nutritional labelling, erroneous labelling, or duplication (i.e. identical products differing in package size).

Thus, 56 infant cereal products from 19 different brands were included in the analysis. The most common pattern observed was a limited product range: ten brands (4,7,8,9,10,11,12,15,17 and 18) marketed only a single product. The remaining 9 brands offered multiple products, ranging from 2 (brands 3, 5, 16 and 19) to 13 (brand 14). Specifically, brands 6 and 13 offered 5 products each; brand 2 offered 7; and brand 1 offered 8 (see Tables 1a,1b and 1c).

After reviewing the 56 infant cereal products, 4 distinct groups were identified based on the predominant cereal listed on the label: rice (Table 1a), corn (Table 1a), rice and corn (Table 1b), and multigrain (Table 1c). The product made exclusively from corn was excluded because a single food item cannot be representative of the entire group.

The classification by cereal type was as follows (N=56):

- Rice-based (N=16): These products were exclusively formulated with rice. One product in this group also contained carob flour (Table 1a).
- Corn-based (N=1): A single corn-based product was identified as a gluten-free biscuit suitable for use both as a biscuit and as porridge (Table 1a). Due to its singularity, this product was excluded from statistical analyses.

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- Rice and Corn (N=15): These formulations combined rice and corn. Four products in this group also included tapioca (Table 1b).
- Multigrain (N=24): This was the largest group. These products contained a mixture of 3 or more carbohydrate-rich ingredients, including gluten-containing cereals (e.g. wheat, oats) and pseudo-cereals such as quinoa (Table 1c).

3.2. Gluten Content Analysis

Of the 56 products analysed, 36 (64%) were gluten-free. These formulations consisted exclusively of natural gluten-free ingredients, including rice, corn, millet, quinoa, tapioca, buckwheat, and carob, making them suitable for children with gluten intolerance. The remaining 20 products (35.7%) contained gluten, with wheat, oats, barley, rye, and spelt being the most common used cereals. A comparative analysis revealed that gluten-free products tended to be simpler in composition, featuring fewer ingredients. In contrast, gluten-containing products exhibited greater ingredient diversity and generally higher levels of fibre and protein (see Table 2).

Table 2: Energy and Nutrient Density in Studied Cereal Brands. Values in 100 g of Product.

Nutrients	Rice			Rice and Corn			Multigrain			Corn	p-value
	Median(n)	25%	75%	Median(n)	25%	75%	Median(n)	25%	75%	Value (n)	
Energy (Kcal)	382(16)a	377.75	388.25	378(15)a,c	373	391.5	379(24)a,c	376	385.25	438(1)	0.769
Carbohydrates (g)	83.5(16)a	81.33	85.53	83(15)a,c	80.45	83.6	75.55(24)b,d	74.38	79.14	75.4(1)	<0.001*
Sugar (g)	3.1(16)a	0.88	6.83	4.5(15)a,c	4	16.5	7(24)a,c	2.35	25.18	25.3(1)	0.0999
Total Fat (g)	1.35(16)a	0.93	2.35	1.7(15)a,c	1.05	3	2.1(24)b,c	1.78	2.85	12.2(1)	0.074
Saturated Fat (g)	0.2(16)a	0.18	0.25	0.4 (15)a,c	0.3	0.45	0.4(24)b,c	0.2	0.4	6(1)	0.132
Proteins (g)	7.4(16)a	7.23	7.55	7(15)b,c	6.1	7.2	9.6(24)b,d	8.93	12	5.6(1)	<0.001*
Fibre (g)	1.5(15)a	1	3.95	3.7(15)a,c	1.75	4.7	6.0(23)b,d	4.45	6.45	2.3(1)	<0.001*
Salt (g)	0.04(16)a	0.03	0.1	0.05(15)a,c	0.05	0.09	0.06(23)a,c	0.03	0.09	0.06(1)	0.922
Vit A (μg)	420(10)a	375	445	375(13)a,c	300	420	397.5(17)a,d	375	450	ND	0.606
Vit B1 (mg)	0.7(14)a	0.5	0.85	0.68(14)a,c	0.53	0.98	0.5(24)a,c	0.5	0.64	0.5(1)	0.184
Vit B2 (mg)	0.6(3)a	0.6	0.7	0.6(4)a,c	0.47	0.6	0.6(8)a,c	0.6	0.6	0.3(1)	0.13
Vit B3 (mg)	6.5(7)a	4.5	8.5	6.5(10)a,c	6.4	8.5	6(17)a,c	6	8.5	5.5(1)	0.357
Vit B5 (mg)	2.8(3)a	1.8	3.05	2.65(6)a,c	2.5	2.8	2.8(10)a,c	2.8	2.8	ND	0.789
Vit B6 (mg)	0.33(10)a	0.3	0.69	0.32(13)a,c	0.3	06	0.36(17)a,c	0.3	0.8	0.6(1)	0.731
Vit B8 (mg)	0.02(1)	ND	ND	0.01(1)	ND	ND	ND	ND	ND	ND	ND
Vit B9 (mg)	40(8)a	4.89	46.25	0.07(13)a,c	0.07	50	40(15)a,d	40	70	ND	0.057
Vit B12(μg)	1(3)a	0.5	1.65	1(5)a,c	0	1	1(7)a,c,	1	1	ND	0.106
Vit C (mg)	50(7)a	30	60	52.5(3)a,c	25	70	50(7)a,c	30	50	35(1)	0.702
Vit D (μg)	10(10)a	7.5	10	7.5(13)a,c	7.5	8.5	7.5(20)a,c	7.5	10	ND	0.15
Vit E (mg)	5 (9)a	4.4	5.5	5.2 (13)a,c	4.4	5.48	4.4(17)a,c	2.8	4.4	3(1)	0.537
Vit K(μg)	40(5)a	25	40	32.5(4)a,c	18.75	40	40(11)a,c	32.5	40	ND	0.218
Calcium (mg)	170(10)a	148.75	307.5	159(13)a,c	145	196	245(17)a,d	160	400	310(1)	0.161
Sodium (mg)	10(5)a	8	12	30.5(6)a,c	21.25	40	20(8)a,c	12.63	23	240(1)	0.911
Iron (mg)	7.5(10)a	7	7.5	7.5(13)a,c	7.5	8	7.5(16)a,c	7.0	7.85	5(1)	0.464
Phosphorus (mg)	255.5(4)a	180.25	388.75	156(3)a,c	89.4	212.65	180(3)a,c	90.3	186.5	ND	0.328
Potassium (mg)	ND	ND	ND	381.8(1)	ND	ND	ND	ND	ND	ND	ND
Magnesium (mg)	24.55(2)	12.83	36.28	127.8(1)	ND	ND	ND	ND	ND	ND	ND
Iodine (mg)	60(2)a	60	60	60(6)a,c	30.4	76	66(3)a,c	60	72	ND	0.444
Zinc (mg)	2.8(4)a	1.2	5.68	1.2(6)a,c	1.05	1.2	2.35(4)a,c	1.53	3.83	ND	0.124

n: The amount of products analysed. 25% and 75% represent the interquartile range; *Statistically significant differences according to p< 0.05. ND: Statistically not determined. Identical letters in the same row indicate no significant difference.

3.3. Nutritional Composition and Quality

The nutrient composition of the infant cereals is detailed in Table 2, with the key findings highlighted below. As expected, all product types exhibited a high carbohydrate content. However, the presence of free sugars was also significant. These sugars are introduced via two primary mechanisms, the second of which is generally discouraged:

1. Starch Hydrolysis/Dextrinization: Starch naturally present in cereals is enzymatically or thermally transformed into free sugars.
2. Direct Addition: Free sugars are added via ingredients such as cocoa, cookies, honey, sucrose, dextrose, fructose, fruit juices, and fruit pulp.

Among the 56 infant cereal products analysed, only 14 products (25%) contained only naturally occurring sugars. The remaining 42 products (75%) included sugars derived from a combination of naturally occurring sources, starch hydrolysis, and/or direct addition. Therefore, three-quarters of the cereals studied contained either added or hydrolysed sugars. The distribution of total sugar content was concerning: 14 products contained between 0 g and 2 g of sugar per 100 g; 16 products contained between >2 g and 5 g of sugar per 100 g; 4 products contained between >5 g and 10 g of sugar per 100 g; 22 products contained >10 g, of which 16 exceeded 20 g per 100 g of product (see table 3). Alarmingly, the 5 products with the highest sugar content reached 28%, 29%, 34%, and 35%, all originating from the same brand (Brand 14). A detailed analysis of these 5 products revealed the following compositions (see table 4):

Table 3: Number of Cereals According to Sugar Content.

Sugar Content*/100g	N Cereals
<0 and ≤2g	14
>2g and ≤ 5g	16
>5g and <10g	4
>10g	22
*The 2g maximum limit, the highest amount in any cereal, is subtracted from the total sugar content	

Table 4: Comparison of Cereals with Excessive Sugar Content.

Product	Cereal (%)	Other Ingredients	Total Sugar (g/100g)	Exceeds Paho (≥28 g/100 g)	Contains Added Hydrolyzed Sugars
35 g Sugar (6 cereals)	79%	10% fruit, 6% honey, <2% dextrinomaltose	35	Yes	Yes (fruit, honey and dextrinomaltose))
34 g Sugar (5 cereals)	75%	19% Cola Cao, <2% dextrinomaltose, malt extract	34	Yes	Yes (Cola Cao and dextrinomaltose malt extract)
29 g Sugar (8 cereals)	88.3%)	25% fruit, <2% dextrinomaltose	29	Yes	Yes (dextrinomaltose)
28 g Sugar (8 cereals)	95% hydrolysed wheat, wheat, whole-wheat, rice, corn, rye, whole oats, buckwheat, spelt, barley)	25% fruit, <2% dextrinomaltose	28	Yes	Yes (fruit and hydrolysed sugars in cereals)
28 g Sugar (5 cereals) 87% (wheat, rice, barley, rye, oats)		5%quinoa,<2%fructooligosaccharides, malt extract	28	Yes	Yes (malt extract)

- 35 g Sugar Cereal: This product contained 79% dextrinized flour from six cereals, supplemented with 10% fruit pulp (apple, pear, grape, and raisins), 6% honey, and less than 2% dextrinomaltose.
- 34 g Sugar Cereal: This product included 75% dextrinized flour from 5 cereals and a significant 19% of Cola Cao, along with less than 2% dextrinomaltose and malt extract.
- 29 g Sugar Cereal: Composed primarily of 88.3% dextrinized flour from 8 cereals, with 25% fruit pulp (orange, apple, banana, pineapple, pear, and kiwi), and less than 2% dextrinomaltose.
- 28 g of Sugar Cereals-Variant A (8 cereals): Contained 95% of cereal flours (hydrolysed wheat, wheat, whole-wheat, rice, corn, rye, whole oats, buckwheat, spelt, barley) and 3% fructooligosaccharides.
- 28 g of Sugar Cereals-Variant B (5 cereals): Included 87% dextrinized cereal flour (wheat, rice, barley, rye, oats), 5% quinoa, and less than 2% fructooligosaccharides and malt extract.

These findings underscore the importance of quantifying the proportion of dextrinized flours in infant cereal formulations. Regarding their direct contribution to free sugar content (through hydrolysis or as carriers of added sweet ingredients) accurate disclosure and regulation of dextrinised flour content are essential for assessing the nutritional quality of these products, particularly in the context of early childhood dietary recommendations.

Based on the PAHO-NPM criteria, which classifies processed foods as high in free sugars when more than 10% of their total energy comes from such sugars (see section 2.3), 20 infant cereals (35.7%) meet this criterion. Regarding other nutritional factors, such as fat, salt, and the presence of sweeteners, the 56 products were considered acceptable. Only 2 cereal products were classified as less healthy due to their saturated fat content. In total, 22 products (39,29%) would be considered less healthy under PAHO-NPN criteria, meaning they would not be eligible for advertising to children in Europe if this model was applied. However, under current European legislation, all 56 products comply with existing regulatory standards. The digitalization of food labeling, including e-labeling, QR codes, and blockchain traceability, is increasingly important. QR codes providing detailed information on product origin, production processes, and nutritional quality offer an innovative means to enhance transparency and consumer trust, particularly for infant products. Establishing consensus on regulatory standards for these innovations is essential.

Table 2 presents the energy and nutrient density of the different cereal product groups, expressed per 100 g of product. Four cereal groups were analysed: rice, rice and corn, multigrain, and corn (represented by a single product and therefore excluded from statistical analysis). No significant differences in energy content were observed between groups (p= 0.7688). Carbohydrate content was significantly lower in the multigrain group (75.55 g) compared to the rice (83.5 g) and rice-corn (83 g) groups (p< 0.0005). Regarding sugar, total fat, and saturated fat content, no statistically significant differences were found (p= 0.09989, p= 0.07431, and p= 0.1317, respectively). However, the multigrain group exhibited a higher total fat content (2.1 g) compared to the other groups. Protein content was significantly higher in the multigrain group (9.6 g) compared to the rice and rice-corn groups (p< 0.0001). Similarly, fibre content was significantly higher in the multigrain group (6.0 g) compared to the other groups (p< 0.0001). No statistically significant differences were found in the content of vitamin A, B-complex vitamins (B1, B2, B3, B5, B6, B9, and B12), vitamin C, vitamin D, vitamin E, and vitamin K. Likewise, calcium, sodium, iron, phosphorus, potassium, magnesium, iodine, and zinc content did not differ significantly among groups (p> 0.05). Nevertheless, a trend toward higher calcium concentration was observed in the multigrain group (245 mg) compared to the other groups. Micronutrients According to European regulations, specifying the naturally present vitamins and minerals in infant cereals is not mandatory. However, if they are added for fortification, it is mandatory to declare the amounts of these added vitamins and minerals. Therefore, their presence on labels depends on whether fortification has occurred, which explains why the sample size (n) varies depending on the product and the nutrients.

Table 3 The comparison reveals that, although the products differ in the amount and type of cereals and other ingredients, all of them have sugar levels above the limit recommended by PAHO and contain added or hydrolyzed sugars, suggesting that frequent consumption could contribute to excessive sugar intake in the diet.

In summary, the nutrient composition of the 3 studied cereal groups revealed notable differences. Carbohydrate content was lower in multigrain infant cereals compared to rice and rice-corn cereals. In contrast, multigrain cereals exhibited higher fibre content than the other two groups. Protein, the second most abundant macronutrient, also varied significantly: the rice-corn group had the lowest protein content (7.0 g), followed by the rice group (7.4 g), while multigrain group contained the highest amount (9.6 g). Although approximately 75% of infant cereals contained added or naturally occurring sugars, this does not result in statistically significant differences in sugar content among the 3 groups. The remaining macronutrients, minerals and vitamins studied did not show statistical differences. Overall, the multigrain group presented a more balanced nutritional profile, characterized by higher protein and fibre content, which may confer additional health benefits compared to the other groups.

Sugar Alert in infant Cereals!

- 35.7% of the products exceed the free sugar thresholds set by PAHO.
- 75% of cereals contain sugars derived from a combination of naturally occurring sources, starch hydrolysis, and/or direct addition.
- 5 products have a sugar content greater than or equal to 28g/100g, positioning them as potentially high-risk foods for daily consumption for children under 3 years old.

These findings highlight the need to review product formulations and labelling to protect consumer health, especially in children.

3.4. Adherence to current legislation

European legislation governing carbohydrate content in infant cereals is highly permissive, restricting only the inclusion of added sugars (sucrose, fructose, glucose, glucose syrup, and honey) to a maximum of 7.5 g/100 Kcal. Based on this threshold and the energy content of the products analysed, the legislation effectively allows for a wide and concerning range of sugar content. Specifically, it allows up to 24.5% added sugars and a potential total sugar content of up to 61%, depending on the specific caloric density of the cereal.

The presence of vitamins and minerals on nutritional labels is highly variable; with values ranging from the complete absence of potassium declaration to the inclusion of vitamin B1 (thiamine) in 53 products. According to Annex I of European Directive 2006/125/EC, manufacturers are not required to declare the quantities of vitamins and minerals unless these nutrients have been added to the product. The directive also establishes maximum permissible levels for added nutrients, with the exception of thiamine, which must be present at a minimum of 100 µg per 100 Kcal. Therefore, all infant cereals that report vitamin and mineral quantities (which is not the case for all products) are in compliance with current legislation.

Therefore, we argue that legislative reform is warranted to mandate the declaration of vitamin and mineral content, regardless of whether these nutrients are added or naturally present. Such transparency would enhance consumer awareness and support informed nutritional choices.

4. Discussion

This study examines current industry trends in the label information of infant cereals and their ingredients, progress toward improved nutritional quality, and the potential future implications for products targeting children. As parents increasingly demand greater transparency and accountability in food products, the infant cereal industry faces a critical juncture in meeting the expectations of a market centered on children's well-being.

Recommendations regarding cereal intake in infants and young children vary across countries and often remain vague. One point of consensus is that the intake of cereals is not recommended before six months of age. However, many gluten-free cereal packages indicate they are suitable for consumption from 4 months of age. Why does this discrepancy exists? We assume this reflects an industry-driven effort to expand sales among uninformed consumers, facilitated by the absence of regulatory legislation.

Fifty-six infant cereal products from nineteen different brands were analysed in this study, whereas Grammatikaki, Wollgast, & Caldeira (2019) identified 58 infant cereals (launched or relaunched) included in the Mintel Global New Product Database (GNPD) for the period of January 2012-March 2017. The analysis of the infant cereals included in the present study indicates that, overall these products provide an adequate energy content, with average values ranging from 380 Kcal (multi-cereals) to 408 Kcal (rice and corn cereals), consistent with the 382 Kcal reported by Grammatikaki et al. (2019). However, it is important to note that the average for rice and corn cereals is skewed by an outlier: one product with an energy content of 812 Kcal, which markedly exceeds the values observed in the remaining 55 cereals.

Regarding carbohydrates, multigrain cereals contain less than rice or corn-based cereals, with 74.39 g, 82.19 g and 80.99 g respectively. This is consistent with the 80.9 g reported by Grammatikaki et al. (2019), which could be beneficial as long as it does not compromise the energy intake required for children's growth and development (Motuhifonua et al., 2023). However, excessive carbohydrate reduction could negatively impact cognitive and physical performance in children. The high sugar content in infant cereals is concerning, as excessive consumption in childhood has been linked to an increased risk of obesity, type 2 diabetes, and dental cavities (WHO, 2015). Significant harmful associations have been found between dietary sugar intake and various health issues, including endocrine/metabolic disorders (obesity, type 2 diabetes), cardiovascular conditions (dyslipidemia, hypertension) (DiNicolantonio & Lucan, 2014), cancer, neuropsychiatric disorders (depression and attention deficit/hyperactivity disorder), hyperuricemia, gout, ectopic fat accumulation, allergies, and dental, liver, bone and respiratory (asthma) problems in children. These risks contribute to a 21% increase in overall mortality (Huang et al., 2023). Therefore, exploring healthier alternatives, such as reducing added sugars or limiting sugars from dextrinization, is recommended to improve the nutritional profile of these products.

Despite being in 2025, the high sugar content in infant cereals remains a significant concern. Although there has been a reduction since 2017, when Grammatikaki et al. (2019) reported only an average of 22 g of sugar, the current study shows that sugar content has decreased to 13.27g in multi-cereals, 9.69g in rice and corn, and 5.81g in rice. Nevertheless, these levels remain elevated. This study reveals that 35.71% of products are classified as high in free sugars according to the PAHO-NPM, with all of these exceeding 12 g of sugar per 100 g. Notably, 5 products surpass 28 g of sugar per 100 g. High-sugar cereals are distributed across all 4 product categories: 4 rice-only, 5 rice and corn, 1 corn-only, and 10 multigrain. Importantly, this last category (multi-cereals) includes the 5 products with the highest sugar content. These cereals contain ingredients such as Maria biscuits, honey, Colacao, and/or dextrinized flours. Furthermore, if the WHO recommendation, limiting free sugars to a maximum of 5% of total energy intake, was applied, 24 products (43%) would fail to meet this global standard. Reducing in sugar content and increasing whole grain content in infant cereals could benefit infant health and support the achievement of sustainable healthy diet recommendations (WHO & FAO, 2019; Willett et al., 2019). Some commercial brands in Spain have already pioneered sugar reduction strategies, achieving up to a 90% decrease in total sugar content. This was accomplished by eliminating added free sugars and removing the hydrolysis process, resulting in non-hydrolysed cereals in which total sugar derives exclusively from naturally occurring sources. Furthermore, these products also incorporate 50% whole grains and have shown good acceptance among children aged 4 to 24 months (Sanchez-Siles et al., 2020). Our study identified 15 infant cereals (representing only 26.79% of the total sample) with a favourable nutritional profile. These products contain between 75 g and 85.6 g of carbohydrates and less than 2 g of sugar. Their distribution across categories is as follows: 6 are rice-only, 2 are rice and corn, and 6 are multigrain.

Fats are not only a crucial source of energy but also essential for brain development and the absorption of fat-soluble vitamins (Campbell, 2019). Infant cereals generally contain moderate fat levels of 1.8 g (Grammatikaki et al., 2019). In our study, this level was slightly higher, with average fat contents of 2.77 g in rice and corn cereals, 2.58 g in multigrain cereals, and 2.33 g in rice cereals. Regarding saturated fat, we found values of 0.87 g in the rice and corn group, 0.42 g for multigrain cereals, and 0.32 g for rice cereals, compared to the 0.4 g mean reported by Grammatikaki et al. (2019), which is not significantly different. Only two cereals are classified as unhealthy based on the saturated fat criterion (exceeding 10% of energy value, according PAHO-NPM): the single corn-only cereal (12.33%) and the rice cereal with carob (12.56%). One contains palm oil, while the other includes unspecified vegetable oils. Using healthier vegetable oils, such as olive oil or high-oleic sunflower oil, can reduce the risk of cardiovascular diseases and support healthy development in children (Zalewski et al., 2025).

Another important aspect is protein content. Multigrain cereals contain higher levels of proteins (9.4 g), which support muscle and tissue development in children. However, rice-based cereals, which lower protein levels (7.4g), could improve their nutritional profile by incorporating high-quality plant or dairy proteins, such as whey protein, which provide essential amino acids for growth. These findings are consistent with the 8.2 g reported by Grammatikaki et al. (2019).

Regarding fibre, multigrain cereals display the highest values (6 g), which support gut health and blood glucose regulation (Ahnen, Jonnalagadda, & Slavin, 2019). Rice-based cereals, which are lower in fibre (1.5g), could benefit from soluble fiber inclusion, such as inulin, known to aid digestion and promote gut health (Zalewski et al., 2025). These findings are consistent with the 4.4 g reported by Grammatikaki et al. (2019).

Regarding the declaration of vitamins and minerals, their inclusion on nutritional labels is only mandatory when they have been added to the product. Consequently, it is not possible to determine how closely the total micronutrient content of these cereals aligns with the Dietary Reference Intake (DRI). What can be affirmed is that the added quantities of these micronutrients consistently fall below the maximum legislative limits, specifically ranging from two to three times lower than the permitted maximums. This finding underscore one of the key reasons why breastfeeding or the use of substitute milk formulas must not be discontinued after the introduction of complementary feeding. Cereals, particularly rice and corn-based products, exhibited deficiencies in vitamins B9 and B12, as well as minerals such as calcium and iron. Fortifying these cereals with such nutrients could improve brain and bone development in children (Diego Quintaes, Barberá, & Cilla, 2017). Additionally, vitamin D plays critical role in bone health and immune function, and its inclusion in cereals could help prevent common childhood deficiencies (Bischoff-Ferrari, 2011). While Grammatikaki et al. (2019) reported and average sodium content of 25.2 mg, the present study found levels below 10 mg.

Despite an overall reduction in the sugar content of infant cereals over the past eight years, the majority of products (73.21%) still contain added sugars, contrasting with the 26.79% that do not.

Improving front-of-pack labelling for infant cereals is essential to meet consumer expectations and support healthier choices. Labels should provide clear information not only on core nutritional data but also on sustainability, traceability, natural ingredients, and corporate responsibility. These non-nutritional factors are increasingly relevant for health-conscious consumers (Fretes et al., 2021). Furthermore, detailed information on fatty acid profiles, protein quality, vitamin and mineral content, and potential additives such as refined oils should be included, as these elements significantly influence consumer perception (Adhikari et al., 2022). Incorporating nutritional quality symbols, such as the Nutri-Score, could further aid consumers in making informed dietary choices (Debras et al., 2020). Several recent studies (Zalewski et al., 2025) emphasize that inadequate intake of essential fatty acids, iron, and zinc during the first two years of life can affect neuronal myelination and cognitive functions. Therefore, the reformulation of infant cereals should prioritize not only sugar reduction but also a balanced supply of these essential micronutrients. This highlights the importance of nutrition in early neurodevelopment, a topic of significant scientific and social interest.

While some brands already include claims such as "gluten-free", "0% added sugar", or "0% dextrinization/hydrolyzed sugars", not all of these claims are verified by regulatory authorities such as EFSA, which could lead to consumer confusion (Dang, 2023). Ultimately, the impact of special ingredients depends on cereal quality, fortification levels, and overall dietary context. Therefore, labelling must comply with international regulations to ensure accuracy and support informed consumer choices. Improving the nutritional profile of infant cereals, by reducing sugar

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content, fortifying with key nutrients, and incorporating healthy fats, is fundamental for promoting a balanced diet for children. This analysis of infant cereal labelling reveals significant variability in the nutritional quality of products available in the market, particularly in terms of sugar, fat, and fibre content. While some products are enriched with beneficial micronutrients, many contain elevated levels of added sugars and saturated fats. Strengthening labelling regulations would improve transparency and clarity, enabling parents and caregivers to make healthier decisions for their children. This study underscores the importance of improving the nutritional profile of infant cereals through sugar reduction, nutrient fortification, and the use of healthier fats, essential steps toward fostering balanced diets in children.

Scientific evidence indicates that nutrients naturally present in foods are better absorbed than those added through industrial fortification. Natural food matrices promote interactions between micronutrients and other bioactive compounds, optimizing their absorption and utilization by the body. For these reasons, although commercial baby foods may offer convenience, they do not replace the benefits of a varied diet based on natural foods, particularly in supporting the development of chewing skills, flavour perception, adaptation to the family diet, and optimal nutrient absorption. The findings of this study highlight significant challenges in the nutritional composition and labelling of commercial complementary cereals in Europe. Although these products are frequently recommended as the first complementary food for infants, a considerable proportion exhibits notable nutritional inadequacies and a high prevalence of added sugars. This is particularly concerning given that habitual consumption of foods high in free sugars during early childhood has been associated with the development of unhealthy dietary preferences, increased risk of childhood obesity, and dental caries.

A central issue concerns the limitations of current European Union food labelling regulations, which do not clearly distinguish between naturally occurring sugars (such as lactose and fructose) and added sugars. In this context, it is not possible to accurately estimate the contribution of added sugars to total caloric intake. This lack of differentiation complicates product comparisons, hinders researchers' ability to assess nutritional quality, and limits caregivers' capacity to make informed decisions. Within this context, it is essential to explicitly include ingredients such as dextrin's in product labelling. Dextrins are commonly added to complementary foods as thickeners, stabilizers, or to modify texture and solubility. Although technically derived from starch, dextrins are carbohydrates that can significantly contribute to the available sugar content of the final product, especially when used in substantial quantities. Without clear labelling of their presence and function, products may be perceived as "free from added sugars," despite containing simple carbohydrates that influence glycaemic load and overall energy content. From a regulatory and public health perspective, the inclusion of dextrins in detailed labelling practices would help align standards with the 2019 recommendations of WHO Europe, which called for a complete ban on added sugars and sweeteners in commercial complementary foods. Considering dextrins as part of the carbohydrate components relevant for calculating total and added sugars would enhance transparency and enable a more accurate assessment of the nutritional profile of these products. Finally, given the dynamic nature of the commercial food market, stricter and more harmonized labelling criteria are urgently needed. These should encompass not only total and added sugar content but also functional ingredients such as dextrins. Such measures would facilitate the monitoring of temporal trends, improve regulation of marketing practices directed at infants and young children, and ultimately contribute to improving the nutritional quality of complementary foods available on the market. Confusing health and nutrition claims in food advertising targeting infants can distort caregivers' perceptions of product quality and safety. This misinformation can influence food choices, promoting inappropriate options that increase the risk of early metabolic dysfunction and perpetuate unhealthy eating patterns. European legislation concerning infant cereals (specifically Regulation (EU) 609/2013 and Commission Directive 2006/125/EC) only addresses added sugar, not the total free or dextrinised sugar present in the final product. We identified 5 products with sugar content exceeding 28%. Grammatikaki et al. (2019) reported that average sugar levels were even higher in some countries: 37 g in Croatia, 31.6 g in Portugal. On the other side, Italy and Greece were below 6.9 g of sugars in 2017. Crucially, since the added sugar content complies with current law, these products remain legally marketable. Consequently, in 2025, 35.7% of infant cereals sold in Spain are classified as high in free sugar (according to the PAHO-NPM criteria). This elevated sugar content is primarily attributed not to excess added sugar, but to the dextrinization of the flours used in these products. Therefore, it is essential to update European legislation to regulate the total sugar content of infant cereals. Furthermore, legislation should explicitly prohibit the inclusion of added sugars, dextrinised flours, or the subsequent dextrinization of the product. In addition to nutritional quality, the environmental sustainability of infant cereals is an emerging and highly relevant aspect.

Recent European initiatives promote the use of local ingredients, reduction of environmental impact in cereal production, and recyclable or biodegradable packaging factors that are still minimally reflected in current labeling. Incorporating these considerations adds an ecological dimension and aligns the work with the United Nations Sustainable Development Goals (SDGs 12 and 13).

Price strongly influences purchasing decisions for infant foods, especially among lower-income families. Options with better nutritional profiles often come at higher prices, which may limit accessibility. Promoting public policies that encourage reformulation and subsidize healthier products could facilitate more equitable infant nutrition.

This work presents notable strengths, particularly in terms of its scope and regulatory relevance:

- Pioneering Report: It constitutes the first comprehensive analysis of the nutrient composition of infant feeding cereals available in Spain.
- Broad Market Overview: The study offers a concise and exhaustive overview of the Spanish infant cereal market, enabling the identification of common formulation patterns and emerging trends.
- Regulatory Monitoring: The dataset provides a valuable resource for evaluating compliance with labelling regulations and verifying that products meet stipulated nutrient thresholds (e.g., for sodium or fat) in relation to health claims.

The study has several limitations, primarily concerning the reliability and accuracy of the data collected:

- Non-Representative Brand Selection: The products analyzed were not selected based on customer purchasing patterns or product popularity in the Spanish market.
- Reliance on Manufacturer Information: The dataset relies entirely on the accuracy of product labels provided by manufacturers, distributors, and websites (pharmacy and supermarket).
- Absence of Laboratory Verification: No laboratory analysis were conducted to validate the reported food composition. Therefore, the accuracy of declared nutritional values (such as fats, carbohydrates, and vitamins) is assumed, although the actual composition may vary due to natural raw material variability and manufacturing processes.
- Inaccuracy due to Regulatory Rounding: Nutritional values are subject to regulatory rounding, which introduces slight but systematic inaccuracies into the final dataset.

Limitations in Nutrient Information

- Non-Mandatory Nutrients: Current labelling regulations require declaration of only a basic set of nutrients (energy value, fat, saturated fat, carbohydrates, sugars, protein, and salt/sodium). Many micronutrients (such as zinc, magnesium, and certain vitamins) are not mandatory and were therefore analysed in less detail in the study.
- Lack Nutrient Breakdown: Labels frequently report nutrients in aggregated categories (e.g., "Fats" or "Carbohydrates"), preventing the differentiation between monounsaturated and polyunsaturated fats, soluble *vs* insoluble fibre, starch *vs* other carbohydrates.
- Ambiguity in Ingredient Labelling: A major challenge in accurately assessing the nutritional content of processed foods, particularly with respect of added sugars, stem from the lack of clarity in ingredient labelling.
- Quantification of Added Sugars: Labels report only total sugars (natural + added), making it necessary to rely on assumptions or ad hoc calculations to estimate the amount of added sugars.
- Absence of Specific Quantities: While ingredients are listed in descending order of quantity, exact proportions are usually not provided. This prevents precise calculation of an ingredient's nutritional contribution (e.g., the amount of cocoa).
- Compound Ingredients: The inclusion of compound ingredients (e.g., a prepared mix) further complicates analysis, as their internal components are often not detailed on the label.

5. Conclusions

These findings emphasize the urgent need for more rigorous labelling regulations to ensure that nutritional information for infant foods is both clear and accurate. Transparent labelling is essential to enable consumers to make truly informed decisions about the products they purchase for their children. In the main time, it is critical that caregivers carefully examine ingredient lists and avoid products containing dextrinised or hydrolysed cereals. Sugar in any form (including glucose, fructose, galactose, sucrose, lactose, maltose, and trehalose), as well as chocolate (e.g., Cola Cao), honey, syrups, or fruit juices, should be excluded. In conclusion, infant cereals should contain 0% added sugars and 0% processed sugar. Ideally, these products should contain less than 2% of naturally occurring sugars from the base cereal. If fruit is included, the total sugar content should not exceed 5%.

Crucially, the consumption of these specialised infant food products is neither essential nor necessary for adequate infant nutrition. Infants can thrive on natural foods such as brown rice or pasta. Therefore, it is essential to update European legislation to regulate both the total sugar content and the proportion of saturated fats. Furthermore, legislation should explicitly prohibit the inclusion of added sugars, dextrinised flours, or the subsequent dextrinization of the product, and ensure that saturated fats contribute less than 10% of the total caloric value of the product.

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8. Declarations of Interest:

None.

9. Author Contributions

Conceptualization: E.G.-G.; Data curation: E.G.-G. and M.B.; Formal analysis: M.B.; Funding: A.C.-B.; Investigation: J.R., E.G.-G. and R.B.; Methodology: M.B.; Resources: A.C.-B.; Software: M.B. and R.B.; Supervision: E.G.-G.; Validation: J.M.Z. and J. A.; Writing -original draft: E.G.-G. and M.B.; Writing-review and editing: E.R.

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