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Research

Decadal transition in food labelling compliance with the Food Safety and Standards Authority of India regulations and the nutritional composition of processed packaged foods: Implications for public health

Bhavya Pande[1,*], Suneeta Chandorkar[1], Meenu Singh[2]

[1] Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, 390002, India; 2Department of Business Management, University of Europe for Applied Sciences, Hamburg, 22765, Germany

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Background

India is at the epicenter of the non-communicable disease epidemic, partly fuelled by the rising sales of highly processed packaged foods. In response, the FSSAI has implemented more stringent labelling regulations to promote healthier food processing and empower consumers to make informed dietary choices.

Objective

To study the shifts in labelling compliance with FSSAI regulations and the nutritional composition of highly processed packaged foods in the years 2013 and 2024.

Methods

In 2013, a cross-sectional survey of processed packaged foods (N=1020) was conducted in supermarkets of Vadodara city to examine various components of food labelling (ingredients list, Nutrition Facts Panel (NFP), nutrition and health claims, warnings and declarations, and allergen information). After a decade, the same products (N=200) were re-examined in 2024 to understand the changes in labelling.

Results

Over the decade, the following notable changes were observed in labelling: improved compliance in reporting of allergen information from 21% to 75% ($p < 0.001$) including the product claims, warnings, and declarations; an increase in the number of products reporting food additives; and significant improvement in the reporting of sodium and trans-fat on NFP ($p < 0.001$). The most unreported mandatory nutrient was "sugar" (2013) and "added sugar" (2024), with no significant changes observed in the reporting of energy, fat, sugar, and sodium content. Cocoa butter in chocolates has been partially replaced with hydrogenated vegetable oil, while palm oil has substituted other vegetable oils. These changes are primarily intended to reduce production costs but may compromise the product's nutrient profile. Non-nutritive sweeteners have been partially substituted for sugar in beverages.

Conclusions

The current labels show improved compliance; however, this has not led to a significant shift toward healthier ingredients. Such a shift can be achieved only through mandatory reformulation policies.

INTRODUCTION

India is undergoing a nutrition transition, which is characterised by dietary shifts, namely reduced consumption of fruits and vegetables, limited access to nutrient-dense foods, and an excess of low-cost, energy-dense, processed foods high in fat, sugar, and sodium that are potential contributors to obesity, hypertension, heart-related diseases, and depressive symptoms (Shim et al. 2021; Magalhaes et al. 2022; Mendonça et al. 2017; Srour and Kesse 2019; Rodriguez et al. 2023).

To address the issue of oblivious use of processed packaged food choices and their increased consumption, the Food Safety and Standards Authority (FSSAI) has

*Corresponding author: bhavyapande@ymail.com

progressively strengthened labelling regulations for consumer awareness and encouraged healthier choices. In 2011, Food Safety and Standards (Packaging and labelling) Regulations came into force and mandated reporting of the basic five nutrients [energy (kcal), protein (g), total fat (g), carbohydrates (including sugar) (g) and sugar (g)] on Nutrition Facts Panel (NFP); reporting of ingredients in the ingredient list in descending order by weight; claims regarding fatty acids or cholesterol must report saturated fatty acids (SFA) (g), monounsaturated fatty acids (g), and polyunsaturated fatty acids (g), cholesterol content (g) and trans fatty acids (TFA) (g); warning and declaration of certain additives such as monosodium glutamate (MSG), caffeine, polyols, or non-nutritive sweeteners (e.g., acesulfame potassium and sucralose), and allergens. However, reporting on labels of health claims such as "trans-fat free" (if products contain <0.2 g of TFA per serving) and "saturated fat free" (<0.1 g per 100 g/ml) was not mandatory.

Subsequently, in 2018, the Food Safety and Standards (Advertising and Claims) Regulations were enforced, stipulating that all claims must use the exact prescribed wording and may only be made if the product meets the specified conditions. For instance, a "low sugar" claim is permitted only if sugar is ⩽ 5 g per 100 g of solids or ⩽ 2.5 g per 100 ml of liquids; a "very low sodium" claim only if sodium is ⩽ 0.04 g per 100 g (or per 100 ml); and a "rich in fibre" claim only if fibre is ⩾ 6 g per 100 g or ⩾ 3 g per 100 kcal.

In 2019, the Food Safety and Standards (Labelling and Display) Regulations proposed a colour-coded Guideline Daily Amount (GDA) scheme for the front-of-pack label (FoPL); however, it was never enforced.

Furthermore, in 2020, the Food Safety and Standards (Packaging and labelling) Regulations were updated to Food Safety and Standards (Labelling and Display) Regulations and mandated the reporting of additional nutrients, namely added sugars, SFA, TFA, cholesterol (with specific conditions), and sodium, along with the basic five nutrients mentioned above. The regulations also strengthened requirements for reporting polyols. Manufacturers were previously required to include a statement, "Polyols may have a laxative effect," if polyols were present in a product. Under the updated rules, this declaration is now mandatory only when polyol is added at ⩾10% in a product.

In the same year, the FSSAI banned the sale of food products high in SFA, TFA, added sugars, and sodium within school canteens, hostels, or within 50 meters of school premises. Schools were encouraged to become "Eat Right Campuses" for promoting safe and healthy foods under the Food Safety and Standards (Safe Food and Healthy Diets for School Children) Regulations, 2020.

In parallel, reformulation efforts were made under the Food Safety and Standards (Prohibition and Restrictions on Sales) Second Amendment Regulations, 2021, to eliminate industrial trans-fat. Food products containing edible oils and fats must not contain industrial TFA ⩾2% by mass of the total oils/fats present in the product from 1st January 2022 (ahead of the global 2023 target), with a voluntary 'trans-fat free' logo.

In 2022, a draft of the Food Safety and Standards (Labelling & Display) Amendment Regulations proposed the Indian Nutrition Rating (INR), a modified version of the Health Star Rating system, as a FoPL. However, it is not yet enforced. Simulation-based modelling studies have estimated that the implementation of such FoPL systems is likely to reduce mortality rates linked to Non-Communicable Diseases (NCDs) by shifting consumer behaviour toward healthier choices (Lopez-Sanchez et al. 2023; Egnell et al. 2019).

While regulatory compliance in food labelling is important, prioritising a shift towards healthier ingredients is even more critical for addressing nutrition and public health concerns. Processed packaged foods often report multiple names and forms of fats (e.g., palm oil, hydrogenated fats), sugars (e.g., glucose syrup, high-fructose corn syrup, maltodextrin), and sodium (e.g., monosodium glutamate, disodium ribonucleotides) in their ingredient list, making comparisons over time complicated. Examining these changes in the ingredient list over time is nevertheless essential, as it provides reformulation insights. Therefore, this paper highlights the shifts in food labelling compliance of processed packaged food and changes in their composition in India over the past decade.

METHODS

In 2013, a cross-sectional market survey of processed packaged foods was conducted in supermarkets (n=4) and grocery stores (n=4) in Vadodara, Gujarat. Various components of food labels were examined, namely the ingredients list, NFP, health and nutrition claims, and warnings and declarations. Label information was collected by taking photographs of the products in the supermarkets. The same processed packaged foods were further studied in 2024 to check the shift in labelling.

About 1,020 products were examined in 2013 and again in 2024. At baseline, 206 products had insufficient labelling information, and 316 were discontinued and could not be traced in supermarkets or online platforms. Some 298 products had changed their names by 2024, and their composition could not be ascertained. To avoid confusion and misinterpretation of data, many of these products were excluded. This left 200 products for comparison (Figure 1).

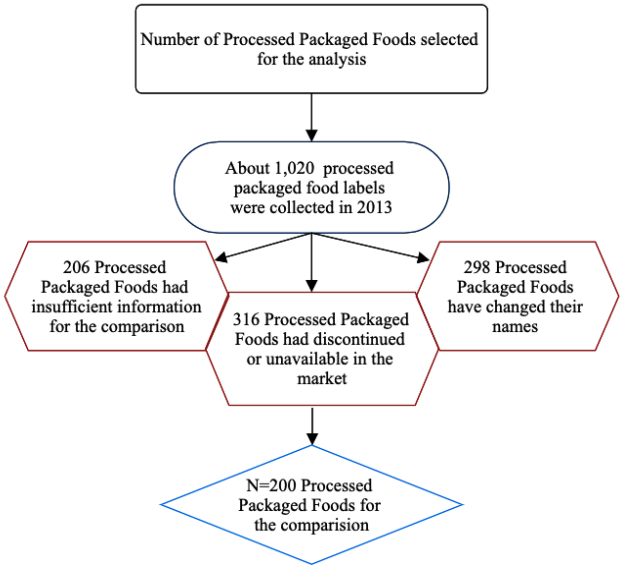

Figure 1. Selection of processed package foods

The sample foods were classified into South East Asia food categories, as follows: confectionary (e.g., chocolates, Indian sweets), bakery wares (the South Asian designation for "bakery goods", e.g., cakes, sweet biscuits, cream wafers), processed fruits and vegetables (e.g., jams, pickles and canned fruits), cereal (e.g., sweet and savoury breakfast cereal), beverages (e.g., malted drinks, carbonated drinks, fruit juices and squashes), cheese and analogues, composite foods (e.g., noodles, ready-to-eat (RTE) gravies, ready-to-cook mixes, and instant soups), fats and oil emulsions (e.g., butter and margarine), sauces, dips, and dressings (ketchups, sauces, and dressing), and RTE savouries (e.g., extruded snacks, chips and popcorn).

Products examined in 2013 and 2024 were assessed according to the regulations in effect at the respective time periods (Table 1). The objective was to explore whether the same products demonstrated any change in compliance over time in response to evolving labelling regulations and whether compliance improved, declined, or there was no change. Furthermore, the shift in composition of processed packaged foods was also studied; however, there were no FSSAI regulations to assess compliance with food composition. Compliance was assessed based on the information provided on the food label and whether products reported the information in accordance with labelling and claims regulations.

Table 1. Labelling compliance of processed packaged foods using the FSSAI regulations in 2013 and 2024

Year of Product Evaluation	Regulations Applied	Enforcement Year	Compliance Assessment	Composition Assessment
2013	Food Safety and Standards (Packaging and Labelling) Regulations, 2011	Published: 1 Aug, 2011 Enforced: 5 Aug, 2011	• Reporting of mandatory nutrients on the NFP • Nutrition and health claims, warnings, declarations, and allergen information	• Reporting of nutritional values on the NFP • Ingredient list (number of ingredients, presence of multiple forms and names of fat, sugar, sodium, presence of food additives)
2024	1. Food Safety and Standards (Labelling and Display) Regulations, 2020	Published: 17 Nov, 2020 Enforced: 1 Jan, 2022	• Reporting of mandatory nutrients on the NFP • Declaration of warnings, declarations, and allergen information	• Reporting of nutritional values on the NFP • Ingredient list (number of ingredients, presence of multiple forms and names of fat, sugar, sodium, presence of food additives)
	2. Food Safety and Standards (Advertising and Claims) Regulations, 2018	Published: 2018 Enforced: 1 Jul, 2019	• Compliance with wording/language • Substantiation of claims using NFP and ingredient list	–

Note: There were no specific FSSAI regulations for food composition assessment. FSSAI: Food Safety and Standards Authority of India; NFP: Nutrition Facts Panel

Potential shifts in compliance with the FSSAI regulations were assessed by examining (1) reporting of mandatory nutrients on the NFP and (2) reporting of nutrition and health claims, warnings, and declarations, and allergen information on the food label. Compliance with nutrition and health claims and regulations was evaluated by (1) checking adherence to the FSSAI guidelines on appropriate wording and language, and (2) assessing whether the claim is substantiated by examining the information on the NFP or ingredient list. Shifts in composition were assessed by (1) changes in reporting of the nutritional values by evaluating the NFP, and (2) changes in reporting of ingredients, total number of ingredients, and multiple sources of fat, sugar, and sodium added/reduced/replaced by evaluating the ingredient list.

STATISTICAL ANALYSIS

Descriptive and inferential statistics were performed using Jamovi version 2.6.22 current software. To compare the compliance over the decade, McNemar's test and the paired t-test were used for categorical data and continuous data, respectively. For each food category, the mean, standard deviation (SD), median, and IQR (interquartile range) were calculated for the energy (kcal/100g), total sugar (g/100g), total fat (g/100g), and sodium (mg/100g) content of processed packaged foods for the year 2013 and 2024 and compared using the paired t-test and Wilcoxon test

RESULTS

CHANGES OBSERVED OVER THE DECADE

REPORTING OF MANDATORY NUTRIENTS ON NFP

Table 2 shows that the reporting of all mandatory nutrients on the NFP increased by 2.5% by 2024, indicating no significant shift towards improved compliance. However, the percentage of products reporting sodium on NFP

significantly increased by 51% ($p < .001$), while that of trans-fat rose by 41.5% ($p < .001$), reflecting the mandatory declaration requirements introduced in 2020. The FSSAI regulations (2011) required reporting of carbohydrates, including how much of this was "sugars," and the update in 2020 further strengthened this requirement by making it mandatory to specifically report "added sugar" on the NFP, thereby enhancing transparency for consumers. However, this nutrient remained the most frequently unreported across all food categories in both years, indicating persistent non-compliance.

REPORTING OF ALLERGEN INFORMATION

The 2011 regulations only required the mention of allergenic ingredients within the ingredient list. By 2020, regulations mandated a standardised declaration using the wording "CONTAINS...," and allergens can be declared in two distinct ways. Foods and ingredients known to cause allergies must be reported with "Contains (Name of allergy-causing ingredients)," and ingredients that may be present due to cross-contamination or are known to cause allergies should be declared as "May Contain (Name of allergy-causing ingredients)." Over the decade, there has been a significant improvement in the compliance with the reporting of allergen information from 20.5% to 75% ($p < 0.001$) (Table 2). In 2013, several food categories that were likely to have one or more allergens and yet had very low or zero reporting of allergen information (Figure 2). This was the case for cereals, sauces, dips, dressings, fats and emulsions, cheese and analogues, processed fruits and vegetables, and bakery wares. By 2024, these categories saw substantial increases in reporting, with bakery wares and cereals reaching 100%. The declaration of 'Contains allergy-causing ingredients' and 'May contain allergy-causing ingredients' increased from 11.3% to 63.5% and from 8.5% to 11.50%, respectively. This indicates enhanced compliance with allergen labelling requirements. In 2013, the most commonly reported allergens were mustard, sesame, wheat, soy, milk, peanuts, and tree nuts. By 2024, allergen reporting had become more detailed, covering additional allergens such as barley, oats, eggs, and sulphites.

Table 2. Shift in food labelling information over a decade

Reporting of information	Year 2013 (%)	Year 2024 (%)	*P* value (McNemar's)	Remarks
Mandatory nutrients on NFP	83.5	86	*0.466*	Most unreported nutrient: "Sugars" in 2013 and "Added sugar" in 2024
Sodium on NFP	45.5	96.5	*<0.001*	Increased reporting due to the Food Safety and Standards (Labelling and Display) Regulations, 2020
Trans-fat on NFP	48.5	90	*<0.001*	Increased reporting due to the Food Safety and Standards (Labelling and Display) Regulations, 2020
Allergen information	20.5	75		Allergens reported in 2013: Mustard, sesame, wheat, soy, milk, peanuts, and tree nuts
Contains allergy-causing ingredients	11.3	63.5	*<0.001*	Allergens reported in 2024: Wheat, milk, soy, barley, oats, eggs, peanuts, tree nuts, sulphites, sesame seeds, and mustard
May contain allergy-causing ingredients	8.5	11.5		
Ingredient percentage on the ingredient list	7.5	5.5	*0.285*	-

NFP: Nutrition Facts Panel; a total of 200 processed packaged foods were assessed for each of the two years (2013 and 2024); $p<0.001$: statistically significant

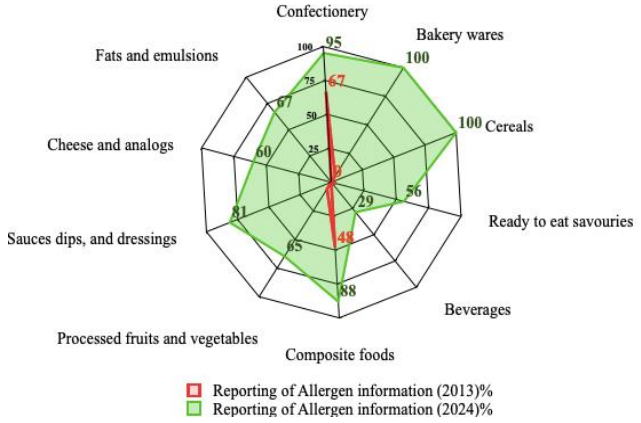

Figure 2. Comparison of allergen information across food categories (2013 vs 2024)

REPORTING OF CLAIMS, WARNINGS, AND DECLARATIONS

Table 3 compares the claims, declarations, and warnings on processed packaged foods in 2013 and 2024. In categories such as confectionery and bakery wares, the FSSAI regulations of eliminating trans fats in India by 2022 led to the removal of the earlier claim, i.e., "Hydrogenated fat used-contains trans-fat," in 2024. While most claims across categories were substantiated, some exceptions were observed. For instance, the claim "Least oil for a healthy heart" on RTE savouries in 2013 was considered arbitrary due to its inappropriate language and difficulty in comprehension for consumers. Similarly, the claim "Cooked in healthy oil" was not substantiated, as the specific type of oil used was not mentioned in the ingredient list.

By 2024, better compliance in reporting declarations and warnings across various food categories was observed. For instance, in 2013, chocolate-coated cakes (bakery wares) containing sorbitol and instant soups (composite foods) with MSG lacked mandatory warnings, indicating non-compliance with FSSAI guidelines. By 2024, compliance improved, with the warnings "Polyols may have a laxative effect" and "Contains MSG (not recommended for infants below 12 months and pregnant women)," respectively. The composite food category had more claims, declarations, and warnings reported than all other food categories.

Table 3. Claims, warnings, and declarations across food categories over a decade

Food category	Type of Food	Claim/warning/declaration reported (2013)	Claim/warning/declaration reported (2024)	Compliance/Non-compliance with the FSSAI regulations
Confectionary	Chocolates	Declaration: Hydrogenated vegetable fat used-contains trans-fat	Declaration: No	FSSAI trans-fat regulation eliminated trans-fat in 2022
		Claim: No trans-fat, Zero cholesterol	Claim: No	FSSAI trans fat regulation eliminated trans fat in 2022

Table 3. continue

Bakery wares	Sweet biscuits, tea cake, cream wafers	Declaration: Hydrogenated vegetable fat used-contains trans-fat	Declaration: No	
	Chocolate-coated cake	Warning: No warning for polyols	Warning: Polyols may have a laxative effect	Non-compliance in 2013 with FSSAI regulations
Cereal	Breakfast cereals	Claim: High in dietary fibre, calcium, iron, folate, B vitamins	Claim: High in fibre, calcium, iron, and vitamins C, B, folate	Compliance in 2013 and in 2024, as the nutrition claims were substantiated
Composite foods	Instant Noodles/Pasta	Claim: Source of protein, 100% real vegetables, Zero trans-fat, Goodness of calcium	Claim: Source of calcium, protein, iron, vitamin C, folic acid, fibre	Compliance in 2013 and 2024 as a nutrition claims were substantiated
		Warning: Added MSG (Not recommended for infants)	Warning: Contains MSG (not recommended for infants below 12 months and pregnant women)	Non-compliance in 2013 with FSSAI regulations 2011, as "below 12 months" was not mentioned. However, mentioning pregnant women was not mandatory.
	RTE mixes	Claim: No	Claim: High protein, dietary fibre source, trans fat-free	Nutrition claims were substantiated for products examined in 2024
		Claim: Least oil for a healthy heart	No claims were reported	An arbitrary claim made in 2013
	Instant soups	Warning: No warning/declaration for added MSG	Warning: No	Non-Compliance in 2013 with the FSSAI regulations MSG was not reported in the ingredient list in 2024
Beverages	Fruit juices	Declaration: No	Declaration: Contains non-caloric sweetener. This contains sterol glycosides	Compliance with the FSSAI regulations in 2024 No added non-caloric sweetener reported in 2013.
RTE-savouries	Rice- and legume-based finger snack	Claim: Zero trans-fat, No added MSG, cholesterol-free	No claims were reported	Compliance in 2013 with the FSSAI regulations
		Claim: Cooked in healthier oil	No claims were reported	The nutrition claim was not substantiated, as the type of cooking oil was not mentioned in 2013
Sauces, dips, and dressings	Dips	Warning: Contains MSG. Not Recommended For Infants Below 12 Months	Warning: No	Compliance in 2013 with the FSSAI regulations MSG was replaced with INS 635 in 2024

FSSAI: Food Safety and Standards Authority of India; RTE: Ready-to-eat; INS: International Numbering System

FOOD COMPOSITION

In both years, no specific FSSAI regulations were in place to assess the compliance of processed packaged food composition. Therefore, only shifts in composition were examined.

Table 4 reveals the mean ± SD/median (IQR) of energy (kcal/100g), total fat (g/100g), total sugar (g/100g), and sodium (mg/100g) content of processed packaged food across all food categories. Bakery wares reported a significant increase in the energy value (464±36.3 kcal/100 g to 477±29.4 kcal/100 g), and composite foods reported a significant rise in total sugar (2 g/100 g to 2.6 g/100 g) and a decline in total fat content (6.90 g/100 g to 6 g/100 g). No other food categories showed a significant change in the nutrient content.

REPORTING OF THE NUMBER OF INGREDIENTS IN THE INGREDIENT LIST

Table 5 highlights the changes in the ingredient list of processed packaged foods in our sample. Over the past decade, the category with the greatest increase in reporting of the number of ingredients was RTE savouries (12 to 16), with increased reporting of food additives, including flavour enhancers and preservatives. In contrast, a decline was seen in composite foods (19 to 17). No change was observed in the beverages and cereal category. In some cases (bakery wares and composite foods), labelling information has been updated for greater transparency, such as specifying refined wheat flour and the type of oils used. Refined palm oil was frequently used in 2024. Additionally, in 2024, hydrogenated vegetable oil were used as a cocoa butter substitute. Non-nutritive sweeteners (NNS) like stevia and sucralose in beverages such as fruit juices and powdered, and carbonated drinks were used as sugar alternatives in 2024. Across both years, multiple sources of "nutrients/ingredients of concern" in ingredient lists, reported using their alternative names and forms, were identified. For sugars, dextrose, high fructose corn syrup, maltodextrin, sorbitol, and liquid glucose were noted. In the case of sodium, MSG (International Numbering System (INS) 621), INS 635, and INS 627 have been reported. Whereas for fats, sources such as hydrogenated or partially hydrogenated fats, palm oil, and shortening were identified. Overall, the table reflects extended ingredient lists due to the reporting of food additives without any reduction in alternative sources or names of "nutrients/ingredients of concern" nor their replacement with healthier ingredients.

Table 4. Shift in the energy, total fat, total sugar, and sodium content over a decade

Food categories	Mean ± SD/Median (IQR) of nutrient content											
	Energy (Kcal/100g)			Total Fat (g/100g)			Total Sugar (g/100g)			Sodium (mg/100g)		
	2013	2024	P-value	2013	2024	P-value	2013	2024	P-value	2013	2024	P-value
Confectionery	467 ±83.74	474 ±71.9	.43	22.3 ±9.10	23.3 ±9.67	.21	46.5 ±9.23	49.5 ±11.7	.37	82.5 (41, 115)	72 (14, 229)	1.00
Range (Min and Max)	277-561	281-597		1.20-35.1	1.20-47.6		24.7-60.2	24.4-73.4		-	-	
Bakery wares	464±36.3	477±29.4	.004*	19±3.35	19.7±3.47	.2	28.6±9.92	28.6±10.2	.89	471	420	-
Range (Min and Max)	372-505	417-525		12.5-26	13-26.5		7.30-45.6	8.40-41.9		-	-	
Cereals	381±16.7	379±10.6	.56	3.65 (1.15, 6.38)	3.88 (1.32, 5.63)	.55	11.1 (5.17, 30.2)	11.2 (7.10, 27.4)	.17	600 (400, 700)	490 (400, 733)	.67
Range (Min and Max)	354-405	360-397		-	-		-	-		-	-	
RTE savouries	543±29.9	543±37.4	.95	33.7±4.55	32.5±5.62	0.42	2.80 (0.45, 3.39)	2.90 (1.70, 4.27)	.8	791 (661, 982)	656 (474, 876)	.45
Range (Min and Max)	449-602	449-640		21.9-42	19-47.4		-	-		-	-	
Beverages	55 (43,374)	56 (44.8, 376)	.37	0 (0, 0.1)	0 (0,0)	1	13.1 (11, 39.8)	13.1(10.6, 47)	.82	25.5 (17.7, 207)	34.5 (21.8, 363)	.27
Range (Min and Max)	24-419	24-419		.0-11.3	0-12		1.70-94.0	1.70-92.9		5.0-556	1.2-556	
Composite foods	345 (280,412)	343 (210, 402)	.2	6.90 (2.27, 14.6)	6.00 (1.96, 14)	*.04**	2 (.05, 4.70)	2.6 (1.00, 8.12)	*.002**	801 (548, 1364)	819 (306, 1703)	.92
Processed fruits and vegetables	280 (198, 320)	281 (157, 290)	.84	.10 (.00, 15.7)	.45 (.10, 14.8)	.62	53.6 (12, 65.8)	50.6 (17.4, 67.8)	.12	351 (259, 1425)	255 (107, 1476)	.88
Sauces, dips, and dressings	142 (108, 412)	141 (112,471)	.37	.95 (0.00, 40.2)	2.25 (0.20, 39.8)	.55	12.3 (7.28, 21.3)	13.1 (7.75, 22.7)	.16	1508 (1090, 2091)	1454 (1062, 1927)	.20
Cheese and analogues	300±28.7	297±21.9	.43	24.2±1.48	24.0 ± 0.67	.75	0	2.5 (0.75, 4.08)	.18	1270±178	1278±240	.98
Range (Min and Max)	252-326	258-310		22-26	23.1-26		-	-		1000-1439	1000-1600	
Fats and emulsions	631±94.5	658±58.2	.42	69.7±10.5	71.7±7.64	.42	.0±.0	0.0±0.0	-	828±202	856±167	.42
Range (Min and Max)	535-724	615-724		59-80	65-80		0-0	0-.3		650-1048	739-1048	

A paired t-test was performed, where Mean±SD was calculated; a Wilcoxon test was performed, where the median was calculated; the range was calculated for the mean values and IQR (interquartile range) for the median values; *p < 0.05: statistically significant; N=200

REPORTING OF "NUTRIENTS/INGREDIENTS OF CONCERN" IN THE TOP THREE POSITIONS IN THE INGREDIENT LIST

The nutrients of concern, namely fat, were in the form of palm oil and hydrogenated vegetable oil; sugar was in the form of dextrose, high-fructose corn syrup, maltodextrin, sorbitol, and liquid glucose, while sodium was often in the form of flavour enhancers such as MSG (INS 621), disodium 5′-ribonucleotides (INS 635), and disodium 5′-guanylate (INS 627). Their presence among the first three ingredients indicates that they constitute a significant portion of the product's composition.

Table 5 shows the percentage of processed packaged foods having "nutrients/ingredients of concern" in the top three of the ingredient lists. In both years, it was observed that the first three ingredients of processed packaged foods were dominated by fat, sugar, and sodium, and their multiple sources. There was an increase in the percentage of products containing fat as the top three ingredients, primarily in processed fruits and vegetables (17.6%). Whereas the prominence of sugar in the top three has declined in the cereal food category (25%). In cheese and analogues, the position of sodium in the top three has dropped in 60% of products (2024). Overall, fat is increasingly present in the top three, while sodium and sugar sources showed some reductions in selected categories over the decade. Therefore, fat, sugar, and sodium sources continue to occupy the top three positions in the ingredients list of processed packaged foods.

REPORTING OF FOOD ADDITIVES IN THE INGREDIENT LIST

Figure 3 shows the shifts in the number of processed packaged foods containing specific additives in 2013 and 2024. While there were small changes for some of them, overall, there was not much change in the proportion of foods containing these additives during the decade.

Table 5. Shift in the ingredient list over a decade (2013 and 2024)

Food categories	N	"Nutrients/ingredients of concern" in the top three of the ingredient lists (%)									Ingredients reported (No.)		Observations
		Fat-based (2013)	Fat-based (2024)	% Change	Sugar-based (2013)	Sugar-based (2024)	% Change	Sodium-based (2013)	Sodium-based (2024)	% Change	2013	2024	
Confectionery	21	76.2	81	↑ 4.8	100	100	NC	NP	NP	NP	10	11↑	Cocoa butter in chocolates was partially replaced by hydrogenated vegetable oil by 2024. Increased presence of soy lecithin by 2024. Use of hydrolysed vegetable protein and fractionated vegetable fat by 2024. In both years, the presence of multiple sources of sugar was reported: Dextrose, high fructose corn syrup, maltodextrin, sorbitol, and liquid glucose.
Bakery wares	19	73.7	84.2	↑ 10.5	89.5	89.5	NC	NP	NP	NP	15	17 ↑	The type of edible vegetable oil used was not mentioned in 2013 Refined palmolein was frequently used in the 2024 sample. Wheat flour is revised to refined wheat flour for more transparency by 2024. Increased presence of emulsifiers by 2024: INS 471, INS 481, INS 412, and INS 415.
Cereals	16	0	0	NC	100	75	↓ 25.0	25	12.5	↓ 12.5	15	15	No change in the number of ingredients by 2024. In both years the presence of multiple sources of MSG was reported: hydrolysed vegetable protein and hydrolysed groundnut protein
RTE savouries	25	92	100	↑ 8.0	16	16	NC	24	24	NC	12	16↑	Additives such as flavour enhancers, anti-caking agents, acidity regulators, and preservatives were not reported in 2013, but their presence was observed in 2024 MSG (INS 621) was replaced with Disodium 5' ribonucleotides (INS 635) and Disodium 5'Guanylate (INS 627) Vegetable oil moved to the top 3 ingredients by 2024 (previously reported in the last position (2013).
Beverages	28	3.6	3.6	NC	89.3	89.3	NC	NP	NP	NP	10	10	Reporting of stevia, sucralose, and maltodextrin in mango, pineapple, and orange juices and powder, and carbonated drinks in 2024
Composite foods	50	42	38	↓ 4.0	12	12	NC	52	46	↓ 6.0	19	17 ↓	Wheat flour revised to refined wheat flour by 2024 Increased reporting of additives in noodles (thickeners, humectants, acidity regulators) by 2024 Reduced use of additives (flavour enhancers, raising agents, synthetic colours and flavours) in 2024 In both years, the presence of multiple sources of MSG was reported: yeast extract, hydrolysed vegetable protein, and hydrolysed groundnut protein

NC: No change; NP: Not present in top three ingredients

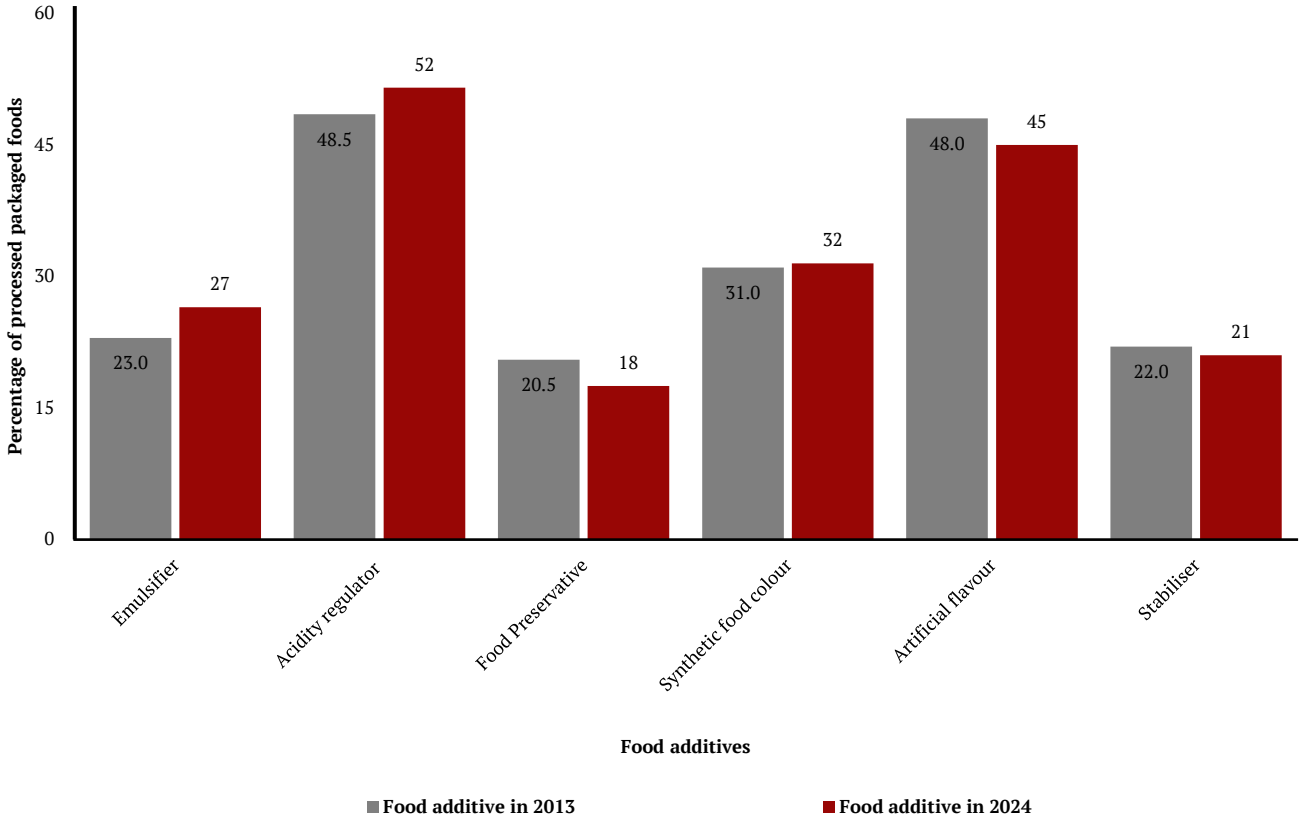

Figure 3. Reporting of food additives in processed packaged foods (2013 vs 2014) (N=200)

DISCUSSION

Processed packaged foods have become an essential part of our everyday diet. During the processing of these foods, the natural food matrix is broken down, and ingredients are isolated and stabilized using additives such as emulsifiers and preservatives, as well as "nutrients of concern" like sugar, fat, and salt. These foods are usually RTE (savoury snacks, sugary breakfast cereals, and fast-food items) and ready-to-heat (instant noodles, instant soup, and RTE gravies). The FSSAI has various food labelling guidelines and advisories on processed packaged foods, and manufacturers must comply with these guidelines.

By 2024, 86% of products were showing compliance in reporting all mandatory nutrients on the NFP. "Sugar" and "added sugar" remained the most frequently unreported nutrients across all food categories in 2013 and 2024, respectively, indicating non-compliance. Singh et al. (2013) also found that the least reported nutrient in processed packaged foods was 'sugar'. Reporting of added sugar is crucial in addressing public health challenges such as obesity and diabetes. A recent study reported a decline in consumption intentions when the added sugar was reported in the NFP compared with when it was not mentioned, indicating an increase in consumer demand for packaged food with no added sugar (Zapata 2019; Ma et al. 2024). Frequent reading of food labels also resulted in lower sodium and trans-fat intake (Zhang et al. 2017; Shangguan et al. 2020).

Health and nutrition claims, warnings and declarations, and allergen information are also important components of food labelling. Over the past decade, reporting claims have shown increased compliance in accordance with the Food Safety and Standards (Advertising and Claims) Regulations, 2018. Several studies have shown that nutrition and health-related claims are extrinsic product characteristics that can have a major impact on purchasing decisions of processed packaged foods (Ballco and Gracia et al. 2022; Kaur et al. 2017).

In India, a high level of food sensitisation in adults (26.5%) has been observed (Mahesh et al. 2016). Failing to disclose allergen information can lead to food-induced anaphylaxis (Parrish and Kim, 2018). The risk becomes even greater when allergens that may be present due to cross-contamination are not reported, posing a potential threat to individuals with food allergies (Pele et al. 2007). Research has found that patients reported accidental allergic reactions to processed foods containing non-ingredient allergens, with milk being a major culprit (Blom et al. 2018). Although the declaration of allergen information on food labels was mandatory in 2013, most food categories failed to comply; however, our data show that by 2024, compliance had improved significantly.

Over the last decade, the energy content of bakery wares has shown a significant rise, mainly due to the increasing number of products listing fat as one of the top three ingredients. Similarly, composite foods have seen a notable rise in total sugar content and a decline in total fat content, as the number of products with fat among their top three ingredients has decreased with no significant change in overall energy content. No noticeable shift was seen in other food categories. In contrast, a study conducted in Spain

found a decrease in the median levels of added sugar, salt, saturated fat, and total fat across all food categories between 2016 and 2021. This improvement was attributed to Spain's national reformulation plan (Yusta-Boyo et al. 2024). Similarly, countries such as Italy, Luxembourg, and Norway have reformation plans for foods high in sugar, fat, and sodium (Kleis et al. 2020). Currently, India does not have a similar plan of action.

FoPL has also been successfully adopted in several countries, where it has demonstrated effectiveness in guiding consumers toward healthier choices and leading to food reformulation (Van der Bend et al. 2020; Quintiliano et al. 2020; Bablani et al. 2020). In 2022, FSSAI proposed the Indian Nutrition Rating (INR) as a FoPL system, but it has yet to be implemented. This is primarily attributed to strong resistance from the food industry, including undue influence on the development and enforcement of nutrition policies. Prior research indicates that alternative FoPL systems may be more effective in the Indian context and that the nutrient thresholds of the proposed INR warrant reconsideration and may mislead consumers into perceiving unhealthy foods as healthy (Pettigrew et al. 2022; Iyer, 2022).

However, with rising consumer awareness, the influence of social media platforms, and pressure from food activists, food manufacturers have begun the trials to reformulate their products with reduced added sugar in products like fruit juices, malted drinks, and ketchups, as well as the replacement of palm oil with oils such as rice bran and sunflower in products like chips (Sen 2024; Dutta 2024; Singh 2024).

The comparison of processed packaged food ingredient lists of 2013 and 2024 has shown notable changes, with RTE savouries exhibiting the greatest increase in all categories, possibly due to increased reporting of food additives. In contrast, a decline in the number of ingredients is observed in composite foods, possibly due to reformulation. With the implementation of stringent FSSAI regulations mandating disclosure of the type of oil used, greater transparency was achieved in 2024. This revealed that palm oil was the most commonly reported edible vegetable oil across several product categories.

Statista (2023) indicates that palm oil is the largest edible oil imported in India and is widely used in processed foods. By 2024, palm oil had partially replaced cocoa butter in chocolates (confectionery), possibly due to its lower cost, higher melting point, creamy texture, odourless and colourless properties (Alhaji et al. 2024). However, nearly 50% of its total fat content consists of saturated fats (USDA 2019), raising concerns about its potential health risks, particularly related to CVD.

Additionally, NNSs such as steviol glycosides (INS 960) and sucralose (INS 950) were reported as partial sugar substitutes in beverages (fruit juices and carbonated drinks) in 2024. Globally, the use of these and other sweeteners, such as cyclamate, sucralose, and steviol glycosides, in fruit juices has increased over the last decade (Silva et al. 2021). However, their effects on health are debatable. Some studies have reported positive health outcomes, while others suggest that they can alter eating behaviours, leading to increased energy intake, obesity, and a higher risk of diabetes (Peter et al. 2014; Cabral et al. 2018; Hirahatake et al. 2019). There is growing evidence that they are implicated in the development of metabolic abnormalities (Yin et al. 2025).

By 2024, only 5.5% of products in our sample mentioned the weight percentage of ingredients in their ingredient lists. Reporting the weight of ingredients can prevent deceptive practices, such as highlighting a minor ingredient as a key feature without disclosing its actual contribution. Furthermore, consumers can determine whether they are getting the appropriate quantity of key ingredients relative to the product's price.

One consistent observation in both years was the presence of "nutrients/ingredients of concern" (sugar, fat, and sodium) among the top three listed ingredients in categories like confectionery, bakery wares, sauces, dips, dressings, cheese and analogues, and fats and emulsions. This consistency underscores the critical role these ingredients play in the organoleptic properties—taste, texture, and overall sensory profile—of these food categories. An Indian study found that added sugar was among the top three ingredients in instant soup (11%) and beverage mixes (23%) (Shobana et al. 2024).

According to the FSSAI regulations (2020), a food additive must be clearly listed in the ingredient list of packaged foods. By 2024, the reporting of food additives across all food categories had increased, especially in the case of acidity regulators, emulsifiers, and synthetic food colour. A decline was observed in the number of products reporting artificial flavours. Acidity regulators are added to extend shelf life by acting as a buffer to control pH levels and enhance the activity of antioxidants (EUFIC 2021). Soy lecithin (INS 322), an emulsifier, is frequently reported in chocolates (confectionery). This is added to achieve a smooth, velvety consistency (Böhme et al. 2016). In cakes, bread, and biscuits (bakery wares), the reporting of emulsifiers such as mono- and di-glycerides of fatty acids (INS 471), sodium lactylates (INS 481), xanthan gum (INS 415), and guar gum (INS 412) has increased. These are typically added to stabilise batter, enhance batter aeration, and extend shelf life by reducing the rate of starch retrogradation (Orthoefer and Kim 2019). A decline was observed in the number of products reporting artificial flavours. Recent studies have shown that increased consumption of processed packaged food led to an increased intake of food additives such as emulsifiers, which are associated with a higher risk of breast and prostate cancer, as well as type 2 diabetes (Sellem et al. 2024; Salame et al. 2024).

Substantial improvements in the FSSAI regulations over the past decade, including mandatory reporting of sodium and trans-fats on NFP, a zero trans-fat initiative, the declaration of allergen information, and the prohibition of misleading health and nutrition claims, have significant public health implications. By 2024, these measures have led to improved compliance with the reporting of sodium and trans-fat on NFP. The substantiation of health and nutrition claims will guide consumers toward healthier products, such as "low in sodium" claims for individuals with hypertension. Additionally, greater compliance with reporting warnings and declarations will promote transparency and increase consumer awareness of health risks.

Despite the positive shift towards improved reporting and compliance with the FSSAI regulations, certain gaps

were evident that need to be addressed:

1. As per the FSSAI guidelines, food manufacturers need to declare the statement 'Polyols may have a laxative effect' if a given polyol is added at more than ten percent in a food product. However, there are no guidelines addressing the cumulative effect of multiple polyols added at different percentages that collectively exceed ten percent.
2. Under FSSAI regulations, the disclosure of ingredient weight percentages is not mandatory, except in cases where a key ingredient is prominently featured in the product name or label. This can be misleading, as consumers may not be able to assess the product's value accurately.
3. The nutrient content of processed packaged foods is not generally chemically analysed and reported on labels, even though these products often contain multiple hidden sources of fat, sugar, and sodium listed under alternative names and forms.
4. Although compliance showed substantial improvement, it did not reach 100%. This suggests that the presence of regulations alone is insufficient without effective enforcement and monitoring, which can be strengthened through active enforcement by the FSSAI (including inspections, surveillance, and penalties) combined with independent verification by accredited laboratories.

STUDY CONSIDERATIONS

1. Since the discontinued processed packaged foods were excluded, the sample primarily reflects products that remained available throughout the study period, i.e., in the years 2013 and 2024.
2. Verification of nutrient values through chemical analysis is essential to assess the compliance of declared information with FSSAI regulations; however, this aspect was beyond the scope of the study.

CONCLUSION

Substantial improvements in compliance with labelling regulations have been observed over the past decade, with better adherence to the reporting of mandatory nutrients and the declaration of claims, warnings, and allergen information. There has also been an increase in the reporting of food additives in processed packaged foods. However, despite these changes, there has been no notable shift towards improving nutritional content or promoting healthier and more natural ingredients. Instead, multiple sources and names for "nutrients of concern" are listed on the food label. Addressing these gaps is crucial for supporting public health and promoting healthier processed packaged foods. If India wishes to achieve a shift toward healthier ingredients, then labelling regulations alone may not suffice; stronger policy tools are needed, including the implementation of FoPL, mandatory reduction targets for fat, sugar, and salt, and compulsory disclosure of ingredient percentages. Such measures would enhance transparency and drive reformulation towards healthier products.

AUTHOR CONTRIBUTIONS

BP and SC contributed to the conceptualization and methodology of the study. BP and MS were responsible for data curation. BP carried out the formal analysis and prepared the original draft under the supervision of SC. All authors contributed to reviewing and editing the manuscript, and all authors have read and approved the final version.

STATEMENTS AND DECLARATIONS

Ethical approval: The study was approved by the Institutional Ethics Committee for Human Research (IECHR) of the Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, with the ethical approval number IECHR/FCSc/PhD/10/2023/07.

CONFLICT OF INTEREST

The authors declare that they have no other potential conflicts of interest.

CONSENT TO PARTICIPATE

Not applicable. This study did not involve participants.

CONSENT FOR PUBLICATION

Not applicable

DATA AVAILABILITY

The data used in the study may be shared upon reasonable request to the corresponding author.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN SCIENTIFIC WRITING

Nothing to disclose.

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REFERENCES

Alhaji, A. M., Almeida, E. S., Carneiro, C. R., da Silva, C. A. S., Monteiro, S. and Coimbra, J. S. d. R. 2024. "Palm Oil (Elaeis guineensis): A Journey through Sustainability, Processing, and Utilization." *Foods*, 13(17): 2814. https://doi.org/10.3390/foods13172814

Bablani, L., Ni Mhurchu, C., Neal, B., Skeels, C. L., Staub, K. E. and Blakely, T. 2020. "The impact of voluntary front-of-pack nutrition labelling on packaged food reformulation: A difference-in-differences analysis of the Australasian Health Star scheme." *PLoS Medicine*, 17(11):1003427. **Full text here**

Ballco, P. and Gracia A. 2022. "Tackling nutritional and health claims to disentangle their effects on consumer food choices and behaviour: A systematic review." *Food Quality and Preference,* 101:104634. https://doi.org/10.1016/j.foodqual.2022.104634

Blom, W. M., Michelsen-Huisman, A. D., van Os-Medendorp, H., van Duijn G, de Zeeuw-Brouwer, M. L., Versluis, A., Castenmiller, J. J. M., Noteborn, H. P. J. M., Kruizinga, A. G., Knulst, A. C. and Houben, G. F. 2018. "Accidental food allergy reactions: Products and undeclared ingredients." *The Journal of Allergy and Clinical Immunology,* 142(3):865–875. https://doi.org/10.1016/j.jaci.2018.04.041

Böhme, B., Symmank, C. and Rohm, H. 2016. "Physical and sensory properties of chocolate made with lecithin of different origin." *European Journal of Lipid Science and Technology*, 118(12):1839–1845. https://doi.org/10.1002/ejlt.201600201

Cabral, T. M., Pereira, M. G. B., Falchione, A. E. Z., de Sá, D. A. R., Correa, L., da Maia Fernandes, D., de Sá, L. B. P. C. and Arbex, A. K. 2018. "Artificial sweeteners as a cause of obesity: Weight gain mechanisms and current evidence." *Health,* 10(5):700. https://doi.org/10.4236/Health.2018.105054

Dutta, S. S. 2024. "After Maggi ketchup, sugar cut by 14% in Bournvita: Outcry over 'unhealthy 'packaged food bears fruit." *The Print*. **Full text here**

Egnell, M., Crosetto, P., d'Almeida, T., Kesse-Guyot, E., Touvier, M., Ruffieux, B., Hercberg, S., Muller, and L., Julia, C. 2019. "Modelling the impact of different front-of-package nutrition labels on mortality from non-communicable chronic disease." *The International Journal of Behavioural Nutrition and Physical Activity,* 16(1):56. https://doi.org/10.1186/s12966-019-0817-2

Food Safety and Standards Authority of India (FSSAI). 2011. "Food Safety and Standards (Packaging and Labelling) Regulations, 2011." **Full text here**

Food Safety and Standard Authority of India (FSSAI). 2018. "The Food Safety and Standards (Advertising and Claims) Regulations, 2018." **Full text here**

Food Safety and Standards Authority of India. 2019. "Food Safety and Standards (Labelling and Display) Regulation, 2019 [Draft notification]." **Full text here**

Food Safety and Standards Authority of India (FSSAI). 2020. "Food Safety and Standards (Packaging and Labelling) Regulations." **Full text here**

Food Safety and Standards Authority of India (FSSAI). 2020. "Food safety and standards (Safe food and balanced diets for school children) Regulations, 2020." **Full text here**

Food Safety and Standards Authority of India (FSSAI). 2021. "The Food Safety and Standards (Prohibition and Restrictions on Sales) Regulations, 2011, Amendment 12." **Full text here**

Food Safety and Standards Authority of India (FSSAI). 2022. "Food safety and standards (Labelling & Display) amendment regulations, 2022." **Full text here**

Hirahatake, K. M., Jacobs, D. R. Jr., Shikany, J. M., Jiang, L., Wong, N. D., Steffen, L. M. and Odegaard, A, O. 2019. "Cumulative intake of artificially sweetened and sugar-sweetened beverages and risk of incident type 2 diabetes in young adults: The Coronary Artery risk development in young adults Study." *The American Journal of Clinical Nutrition,* 110(3):733–741. **Full text here**

Iyer, A. 2022. "Front of package labelling: Why is the 'health-star rating 'bad for food safety in India? Down to earth." **Full text here**

Kaur, A., Scarborough, P. and Rayner M. 2017. "A systematic review and meta-analyses of the impact of health-related claims on dietary choices." *International Journal of Behavioural Nutrition and Physical Activity,* 14(1):93. https://doi.org/10.1186/s12966-017-0548-1

Kleis, L. D., Schulte, E. A. and Buyken, A. E. 2020. "Reformulation across Europe: An overview on planned and implemented strategies in European countries other than Germany – part 1." *Ernahrungs Umschau,* 67:190–199. https://doi.org/10.4455/eu.2020.052

Lopez-Sanchez, M., Moreno-Salazar, Y., Cuenca, J., Ortega, J. and Román-Aguirre R. 2024. "Incidence of traffic light labelling on noncommunicable diseases: A roadmap for achieving sustainable development." *International Journal of Food Sciences and Nutrition,* 75(2):185–196. https://doi.org/10.1080/09637486.2023.2280503

Ma, X., Gallardo, R. K., Canales, E., Atucha, A., Zalapa, J. and Iorizzo, M. 2024. "Effects of the added sugar labelling on consumers' willingness to pay: The case of cranberry products under different nutrition-related information treatments." *Journal of the Agricultural and Applied Economics Association,* 3(2):424–444. https://doi.org/10.1002/jaa2.121

Magalhaes, E. I.D. S., de Oliveira, B. R., Rudakoff, L. C. S., de Carvalho, V. A., Viola, P. C.A. F., Arruda, S. P. M. and da Silva, A. A. M. 2022. "Sex-dependent effects of the intake of NOVA classified ultra-processed foods on syndrome metabolic components in Brazilian adults." *Nutrients,* 14(15):3126. https://doi.org/10.3390/nu14153126

Mahesh, P. A., Wong, G. W., Ogorodova, L., Potts, J., Leung, T. F., Fedorova, O., Holla, A. D., Fernandez-Rivas, M., Clare Mills, E. N., Kummeling, I., Versteeg, S. A., van Ree, R., Yazdanbakhsh, M. and Burney, P. 2016. "Prevalence of food sensitization and probable food allergy among adults in India: The EuroPrevall INCO study." *Allergy*, 71(7):1010–1019. https://doi.org/10.1111/all.12868

Mendonca, R. D., Lopes, A. C., Pimenta, A. M., Gea, A., Martinez-Gonzalez, M. A. and Bes-Rastrollo, M. 2017. "Ultra-processed food consumption and the incidence of hypertension in a Mediterranean cohort: The Seguimiento Universidad de Navarra project." *American Journal of Hypertension,* 30(4):358–366. https://doi.org/10.1093/ajh/hpw137

Orthoefer, F. and Kim, D. 2019. "Applications of emulsifiers in baked foods." *Food Emulsifiers and Their Applications,* 299–321. https://doi.org/10.1007/978-3-030-29187-7_10

Parrish, C. P. and Kim, H. 2018. "Food-induced anaphylaxis: An update." *Current Allergy and Asthma Reports,* 18:41. https://doi.org/10.1007/s11882-018-0795-5

Pele, M., Brohée, M., Anklam, E. and Van Hengel, A.J. 2007. "Peanut and hazelnut traces in cookies and chocolates: Relationship between analytical results and declaration of food allergens on product labels." *Food Additives and Contaminants,* 24(12):1334–1344. **Full text here**

Peters, J. C., Wyatt, H. R., Foster, G.D., Pan, Z., Wojtanowski, A. C., Vander Veur, S. S., Herring, S. J., Brill, C. and Hill, J.O. 2014. "The effects of water and non-nutritive sweetened beverages on weight loss during a 12-week weight loss treatment program." *Obesity*, 22(6):1415–1421. https://doi.org/10.1002/oby.20737

Pettigrew, S., Coyle, D., McKenzie, B., Vu, D., Lim, S. C., Berasi, K. and Kowal, P. 2022. "A review of front-of-pack nutrition labelling in Southeast Asia: industry interference, lessons learned, and future directions." *The Lancet Regional Health-Southeast Asia*, 3:100017. https://doi.org/10.1016/j.lansea.2022.05.006

Quintiliano Scarpelli, D., Pinheiro Fernandes, A. C., Rodriguez Osiac, L. and Pizarro Quevedo, T. 2020. "Changes in nutrient declaration after the food labeling and Advertising Law in Chile: A longitudinal approach." *Nutrients,* 12(8):2371. **Full text here**

Rodriguez, O. C., Moreno, M. R., Fernández-Barrès, S., Cimpean, A., Arnoriaga-Rodríguez, M., Puig, J., Biarnés, C., Motger-Albertí, A., Cano, M. and Fernández-Real, J. M. 2023. "Consumption of ultra-processed foods is associated with depression, mesocorticolimbic volume, and inflammation." *Journal of Affective Disorders,* 340:340–348. https://doi.org/10.1016/j.jad.2023.05.009

Salame, C., Javaux, G., Sellem, L., Viennois, E., de Edelenyi, F. S, Agaësse, C., De Sa, A., Huybrechts, I., Pierre, F., Coumoul, X., Julia, C., Kesse-Guyot, E., Allès, B., Fezeu, L. K., Hercberg, S., Deschasaux-Tanguy, M., Cosson, E., Tatulashvili, S., Chassaing, B., Srour, B., and Touvier, M. 2024. "Food additive emulsifiers and the risk of type 2 diabetes: Analysis of data from the NutriNet-Santé prospective cohort study." *The Lancet. Diabetes & Endocrinology,* 12(5):339–349. **Full text here**

Sellem, L, Srour, B., Javaux, G., Chazelas, E., Chassaing, B., Viennois, E., Debras, C., Druesne-Pecollo, N., Esseddik, Y., Szabo de Edelenyi, F., Arnault, N., Agaësse, C., De Sa, A., Lutchia, R., Huybrechts, I., Scalbert, A., Pierre, F., Coumoul, X., Julia, C., Kesse-Guyot, E. and Touvier, M. 2024. "Food additive emulsifiers and cancer risk: Results from the French prospective NutriNet-Santé cohort." *PLoS Medicine,* 21(2):1004338. **Full text here**

Sen, S. 2024. "Dabur India cuts added sugar in juices by 21%, aims for further 3%". *NDTV*. **Full text here**

Shangguan, S., Afshin, A., Shulkin, M., Ma, W., Marsden, D., Smith, J., Saheb-Kashaf, M., Shi, P., Micha, R., Imamura, F., Mozaffarian, D. and Food PRICE (Policy Review and Intervention Cost-Effectiveness) Project. 2019. "A meta-analysis of food labelling effects on consumer diet behaviours and Industry Practices." *American Journal of Preventive Medicine*, 56(2):300–314. **Full text here**

Shim, J. S., Shim, S. Y., Cha, H. J., Kim, J. and Kim, H. C. 2021. "Association between ultra-processed food consumption and dietary intake and diet quality in Korean adults." *Journal of the Academy of Nutrition and Dietetics,* 122(3):583–594. https://doi.org/10.1016/j.jand.2021.07.012

Shobana, S., Sangavi, G., Wuni, R., Priyanka, B., Leelavady, A., Kayalvizhi, D., Anjana, R. M., Krishnaswamy, K., Vimaleswaran, K. S. and Mohan, V. 2024. "Assessment of front and back of pack nutrition labels of selected convenience food products and snacks available in the Indian market." *PLoS One,* 19(12):0314819. https://doi.org/10.1371/journal.pone.0314819

Silva, P. D., Cruz, R. and Casal, S. 2021. "Sugars and artificial sweeteners in soft drinks: A decade of evolution in Portugal." *Food Control,* 120:107481. https://doi.org/10.1016/j.foodcont.2020.107481

Singh, M, Iyer, U. and Chandorkar, S. 2013. "Nutrition labelling compliance of branded processed packaged foods with Indian food laws (FSSAI, 2011 regulations)." *International Journal of Food and Nutritional Sciences,* 2(4):14–19.

Singh, R. 2024. "Pepsico India starts trials to replace palm oil in Lay's: Here's why." *Business Standard.* **Full text here**

Srour, B., Fezeu, L. K. and Kesse-Guyot, E. 2019. "Ultra-processed food intake and risk of cardiovascular disease: Prospective cohort study." *BMJ,* 365:1451. https://doi.org/10.1136/bmj.l1451

Statista. 2023. "Leading importers of palm oil worldwide in 2023." **Full text here**

The European Food Information Council (EUFIC). 2021. "What are acidity regulators and why are they added to food." **Full text here**

US Department of Agriculture (USDA). 2019. Food Data Central- Palm oil. **Full text here**

Van der Bend, D. L., Jansen, L., van der Velde, G. and Blok, V. 2020. "The influence of a front-of-pack nutrition label on product reformulation: A ten-year evaluation of the Dutch Choices programme." *Food chemistry* 6:100086. https://doi.org/10.1016/j.fochx.2020.100086

Yin, X., Shi,Y., Sheng, T. and Ji, C. 2025. "Early-Life Gut Microbiota: A possible link between maternal exposure to non-nutritive sweeteners and metabolic syndrome in offspring." *Nutrition Reviews,* 83(7):1954–1969. https://doi.org/10.1093/nutrit/nuae140

Yusta-Boyo, M. J., González, E. G., García-Solano, M., Rollán Gordo, A., Peña-Rey, I. and Rodríguez-Artalejo, F. 2024. "Reduction of sugar, salt and fat content in foods over the period 2016–2021 in Spain: The National Food Reformulation Plan." *European Journal of Clinical Nutrition,* 78(2):149–154. https://doi.org/10.1038/s41430-023-01357-w

Zapata, P. 2019. "Is the nutrition facts panel with added sugar content effective at reducing intention to consume added sugar in college students?" (Order No. 27997730). Publicly available content database. (2414422620). **Full text here**

Zhang, D., Li, Y., Wang, G., Moran, A. E. and Pagán, J. A. 2017. "Nutrition label use and sodium intake in the U.S." *American Journal of Preventive Medicine,* 53:S220–S227. https://doi.org/10.1016/j.amepre.2017.06.007