



Food hypersensitivity communication across physical and online foodservice menus in Brazil: fragmented regulation and consumer experiences in a mixed-methods study

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ABSTRACT

Inadequate communication of food hypersensitivity in foodservice settings is a recognised risk to consumer safety, yet in Brazil no national regulation governs disclosure in non-prepackaged foods. This study characterises how food hypersensitivity is communicated through physical and online foodservice menus across Brazilian cities, and whether communication differs by the presence of local legislation. A convergent mixed-methods study assessed food hypersensitivity communication in 1034 menus (323 physical; 711 online) from 18 Brazilian cities (seven with specific legislation, 11 comparators). Menus were classified by format: no information; ingredient-only; emphasised (typographic highlighting); or symbol/code-based (icons, codes or matrices). Four focus groups with 18 participants explored experiences of adults with food allergy, intolerance or coeliac disease, and parents of children with food allergy or coeliac disease. Most menus provided some information, predominantly ingredient-only (physical: 76.2%; online: 88.0%); few provided none (6.5%; 1.0%). Warning messages were uncommon (physical: 11.1%; online: 0.1%). Explicit food hypersensitivity information was more frequent in regulated than unregulated physical menus (regulated: 24.5%; unregulated: 12.7%; $p < 0.001$). Higher average customer expenditure predicted explicit information (OR = 3.46), and the effect of local regulation depended on establishment type (interaction $p < 0.001$). Regulation was associated with explicit information among independent establishments (OR = 8.29) but not among chains (OR = 0.55), which provided it at comparable levels regardless of regulatory context. No regulatory effect was observed online, where local laws rarely apply. Consumers valued clear, visually salient formats — icons and complete ingredient descriptions — and identified hidden hypersensitivity-relevant ingredients in composite dishes and inconsistent staff guidance as key barriers, particularly on delivery platforms. This is the first assessment of food hypersensitivity communication in Brazilian foodservice, showing that subnational regulation is associated with more explicit physical-menu communication among independent establishments. Establishments require structured communication and staff training; delivery platforms need mandatory disclosure fields and standardised warnings; policymakers

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should prioritise structured allergen fields on delivery platforms, with a national framework as a longer-term objective.

1. Introduction

Food hypersensitivity is an umbrella term for any objectively reproducible adverse reaction to food, broadly classified by underlying mechanism into immune-mediated food allergy and non-immune-mediated food intolerance (Johansson et al., 2004; Jutel et al., 2023). Food allergy affects an estimated 220 to 520 million people worldwide, and inadvertent exposure to a culprit allergen can trigger reactions ranging from urticaria (hives) to life-threatening anaphylaxis (Begen et al., 2018; Boyd & Santos, 2025). Coeliac disease, an immune-mediated hypersensitivity to gluten, affects approximately 1% of the global population (Caio et al., 2019), while non-immune-mediated conditions include lactose intolerance. Although these conditions differ in pathophysiology and severity, their management depends on the ability of affected individuals to identify and avoid the foods that trigger adverse reactions.

Brazilian prevalence data are limited and vary by condition. The most recent nationally representative estimate places medically diagnosed food allergy among children under five at 4.6% (95% CI 4.0–5.3) (Freitas-Costa et al., 2026). No comparable estimates exist for coeliac disease or lactose intolerance. Brazilian studies summarised in the 2025 national clinical guideline report coeliac disease prevalence between 1 in 214 and 1 in 681 across regions and populations, with substantial underdiagnosis recognised (Ministry of Health, 2025). The burden is therefore substantial but incompletely characterised.

Strict dietary avoidance remains the only effective prevention strategy for all forms of food hypersensitivity, making access to clear and reliable food hypersensitivity information a matter of food safety rather than mere consumer preference (Begen et al., 2018). Fatal reactions have been linked internationally to absent, incomplete or inaccurate allergen information. In Brazil, a recent media-reported case involved a 17-year-old girl who died after an allergic reaction following the consumption of a sweet purchased in a shopping centre (Record, 2025). In the United Kingdom (UK), Owen Carey died after consuming buttermilk-marinated chicken at a restaurant, despite having informed staff of his dairy allergy. The case prompted the Owen's Law campaign for mandatory written allergen disclosure in foodservice settings in the UK (Food Standards Agency - FSA, 2022). Eating outside the home is a high-risk setting, accounting for a substantial proportion of adverse allergic reactions, most often through failures in communication between consumers and food business operators (Barnett et al., 2020).

Written disclosure is the modality consumers with food allergies most consistently prefer (Begen et al., 2018). Verbal communication is valued when perceived as trustworthy, but it is routinely underused: many consumers avoid disclosing their condition to staff for fear of causing inconvenience or being seen as demanding, which leaves safe decision-making resting on whatever written information the menu provides (Barnett et al., 2020; Begen et al., 2016). Allergen communication in foodservice settings nonetheless remains insufficient across multiple countries, with information frequently absent, incomplete, or presented in formats that do not support informed food choices (Leftwich et al., 2011; Wen & Kwon, 2019). This discrepancy between the information consumers requires and the information food establishments provide is a documented risk factor for adverse allergic reactions in out-of-home eating contexts (Barnett et al., 2020).

These failures are experienced as more than an informational deficit. Eating out requires continuous vigilance, and consumers describe anxiety, reluctance to question staff, and avoidance of unfamiliar establishments, alongside resentment at the time and effort required to eat safely and a sense of exclusion from social occasions (Antich Ferrer et al., 2025; Barnett et al., 2018; Leftwich et al., 2011). This reluctance has an empirical basis. In one study, only 22% of restaurant staff answered

basic food allergy questions correctly despite reporting high confidence in serving customers safely (Abuja & Sicherer, 2007).

Communication failures also reflect an unequal global regulatory landscape. High-income countries, particularly in Europe and Oceania, have developed structured frameworks for allergen disclosure in foodservice settings (Dominguez et al., 2024). By contrast, most low- and middle-income countries (LMICs) lack any binding legislation addressing non-prepackaged foods (Vicentini et al., 2026b). In upper-middle-income countries (UMICs), regulation tends to be fragmented across subnational jurisdictions, including states, provinces and municipalities, each with different requirements for scope, allergen lists and prescribed communication formats. Income level alone does not explain this fragmentation. In the United States, a high-income country, the absence of a binding federal requirement for written allergen disclosure in non-prepackaged foods has left regulation to individual states, producing the largest body of subnational allergen legislation worldwide (Vicentini et al., 2026b). Brazil, a UMIC, exemplifies this pattern. In the absence of a federal framework, a patchwork of state and municipal laws has emerged, resulting in inconsistent consumer protection across the country (Vicentini et al., 2026a, 2026b). The two countries therefore converge on fragmented subnational regulation despite differing markedly in income level and in the resources available for enforcement.

This fragmentation is further compounded by the growth of digital food delivery platforms, which increasingly mediate how consumers access food hypersensitivity information. Yet online menus remain largely ungoverned — excluded from the scope of most existing local regulations, even in cities where physical menus are subject to specific requirements (Nahle et al., 2025). Taken together, regulatory inequity across income groups, subnational fragmentation in Brazil and the limited coverage of digital ordering environments indicate important limitations in current food hypersensitivity communication frameworks and establish the rationale for the present study.

The central question guiding this study was: how is information about food hypersensitivity currently communicated to consumers through physical and online foodservice menus across Brazilian cities, and does this vary according to the presence of local legislation? Rather than inferring causality, the study sought to describe and compare communication practices across regulated and unregulated contexts, examining format, completeness, and the use of warning messages. A second objective was to explore how consumers living with food allergies, intolerances, or coeliac disease perceive, seek, and respond to this information in real-world foodservice settings — including the barriers they encounter and the formats they value. Menu analysis establishes what information is displayed, but not whether consumers find it useable, trust it, or act on it, and the two objectives are therefore complementary. By integrating large-scale menu analysis with consumer focus groups, this study offers the first mixed-methods, nationwide assessment of food hypersensitivity communication in a UMIC with a fragmented regulatory landscape, generating evidence directly applicable to policy development, foodservice practice, and consumer protection.

2. Methods

This study examined food hypersensitivity communication practices in Brazilian foodservice through a convergent mixed-methods design (Creswell & Plano Clark, 2018). The quantitative and qualitative components were collected in parallel and integrated during interpretation. Stage 1 was a systematic evaluation of physical and online menus from foodservice establishments across Brazil's five macroregions. Stage 2 comprised focus groups with adult consumers with food hypersensitivity and parents of children with food allergies. The menu evaluation (Stage 1) provided a

large-scale characterisation of whether food hypersensitivity information was available and, when present, how it was presented across foodservice establishments, distinguishing between ingredient-only, emphasised-information and symbol/code-based menu formats. The focus groups (Stage 2) provided complementary insight into the lived experiences of those directly affected, exploring how consumers perceive, seek, and act upon food hypersensitivity information provided by foodservice establishments — including the barriers they encounter, the communication formats they value, and the expectations they hold towards both physical and digital service contexts. Integration of the two components allowed the observed menu communication practices to be interpreted in relation to consumers' reported experiences and needs, thereby informing the practical and policy implications of the study.

All participants were aged 18 years or older and provided written informed consent prior to enrolment, in accordance with the ethical approval granted by the Research Ethics Committee of the University of Campinas on 22 November 2024 (CAAE 83116524.6.0000.5404). All data were collected from April 2025 to February 2026.

2.1. Stage 1 - evaluation of physical and online menus from foodservice establishments

2.1.1. Sample

The minimum sample size was calculated for the estimation of the prevalence of food hypersensitivity-related information in menus, and applies to the combined physical and online samples rather than to either component separately. Assuming an expected prevalence of 50%, the most conservative assumption when the true prevalence is unknown, a 95% confidence level, and an absolute precision of 10 percentage points, a minimum of 97 menus was required per Brazilian macroregion. To ensure representation across the five macroregions, this value was multiplied by five, resulting in a minimum target sample of 485 menus. The final sample comprised 1034 menus (323 physical and 711 online), exceeding this minimum.

Cities were selected using two complementary criteria. The first was urban centrality, defined using the Brazilian Institute of Geography and Statistics classification of the Brazilian urban network (Regiões de Influência das Cidades, REGIC), which ranks urban centres by the reach of the goods, services and employment they provide to surrounding municipalities. Cities classified as metropolises or regional capitals, the two highest tiers, were eligible: Palmas, Natal, Brasília, Cuiabá, Campinas, Limeira, Piracicaba, Ribeirão Preto, Santos, Curitiba and Porto Alegre. The second criterion was the presence of specific food hypersensitivity legislation, either municipal (Belo Horizonte, Rio de Janeiro, Serra Negra, Rio Grande) or state-level, in which case the state capital was sampled: Belém (State of Pará), Fortaleza (State of Ceará) and Salvador (State of Bahia).

The subnational laws underpinning this classification share a common requirement — that foodservice establishments disclose, on their menus, the presence of selected hypersensitivity-relevant substances — but diverge markedly in the substances covered, the establishments included, and the communication format prescribed (Vicentini et al., 2026a). Coverage ranges from a single substance to broad multi-allergen lists. In the city of Rio de Janeiro, only gluten and its derivatives must be disclosed, and only in buffet or self-service establishments (Rio de Janeiro, 2017). In the state of Bahia, the list covers wheat, rye, barley, oats, crustaceans, eggs, fish, peanuts, soy, milk, several tree nuts and natural latex (Bahia, 2025). Across jurisdictions, gluten and lactose are the most consistently mandated substances (e.g., Serra Negra, 2025; Belo Horizonte, 2018; Pará, 2024), reflecting the prominence of coeliac disease and lactose intolerance in this regulatory landscape. The laws also differ in the establishments they reach and in whether they prescribe how information must be presented: most specify what to disclose but not how, whereas only the state of Ceará mandates a standardised visual format through obligatory icons (Ceará, 2022). This heterogeneity — in substances, settings, and communication format — produces inconsistent consumer protection across the country,

and a fuller inventory of these instruments is provided elsewhere (Vicentini et al., 2026b). For each law, we extracted the number of substances required to be disclosed, whether a display format was prescribed, the types of menus covered and the categories of establishment covered. These attributes are summarised in Table 3.

For physical menus, data were collected in situ around each city's main gastronomic reference point — identified through preliminary online searches and validated using Google Maps as the area with the highest concentration of foodservice establishments. Collection began within a 1 km radius of this reference point, consistent with buffer sizes commonly adopted in urban food-environment research (Charreire et al., 2010). Where this radius did not yield the pre-established minimum number of eligible establishments, the search area was progressively expanded outwards, up to a maximum radius of 5 km, to obtain comparable sample sizes across cities of differing establishment density. The collection radius was thus determined by local outlet density rather than fixed a priori, consistent with the recommendation that buffer size in food-environment research be scaled to density rather than applied uniformly (Charreire et al., 2010). Only establishments classified as restaurants, snack bars, and bars were eligible; those catering exclusively to restricted diets (e.g. allergen-free, gluten-free or lactose-free) and those without any menu were excluded. Menus (physical or accessed via QR code) in use on the day of the visit were photographed, and a brief questionnaire was completed with a manager or member of staff on duty. The questionnaire characterised the establishment on five items: ownership structure (chain or franchise versus independent), type of service, production volume, number of employees, and average customer expenditure. Ownership structure and average customer expenditure were used as predictors in the analyses reported below. The remaining items were used to describe the sample. For online menus, 40 foodservice establishments per city were selected in order of appearance on iFood — 20 for lunch (between 11am and 2pm) and 20 for dinner (between 6pm and 10pm) — using an automated extraction procedure in Python (Scrapy library, version 2.15.0).

2.1.2. Measures

For physical menus, the content and presentation of food hypersensitivity information were characterised using a decision flow chart that guided the sequential assessment of warning messages, the presence of relevant information, and communication format (Fig. 1). For each menu, the presence or absence of a warning message related to food allergy or intolerance, including precautionary statements such as “may contain”, was recorded (Q1). They were then assessed for the presence of food hypersensitivity information (Q2). Menus were classified as providing no food hypersensitivity information when they did not include ingredient details, hypersensitivity-relevant substances references, warning messages or any other information that could help consumers identify potential hypersensitivity-relevant substances; these menus often relied on vague or non-descriptive item names, such as “house fish”. Menus providing at least minimal ingredient or food hypersensitivity information were further classified according to communication format (Q3). The ingredient-only information category included menus that provided brief ingredient descriptions or general explanations of dishes, without any food hypersensitivity-specific visual emphasis. The omission of ingredients commonly used in foodservice, such as salt, oil and standard seasonings, did not preclude classification in this category. The emphasised ingredient/substance information category included menus that highlighted relevant ingredients or hypersensitivity-relevant substances within dish descriptions through typographic features, such as differences in colour, bold type, italics, uppercase letters, underlining, font size or text boxes. For these menus, font type, size, colour and emphasis were systematically recorded. The symbol- or code-based hypersensitivity information category included menus that indicated hypersensitivity-relevant substances using distinct visual or coded elements, such as icons, logos, colour-coded dots, initials, abbreviations, food hypersensitivity information matrices, legends or similar symbols. These menus were also assessed in relation to differences in colour, size and other forms of visual emphasis.

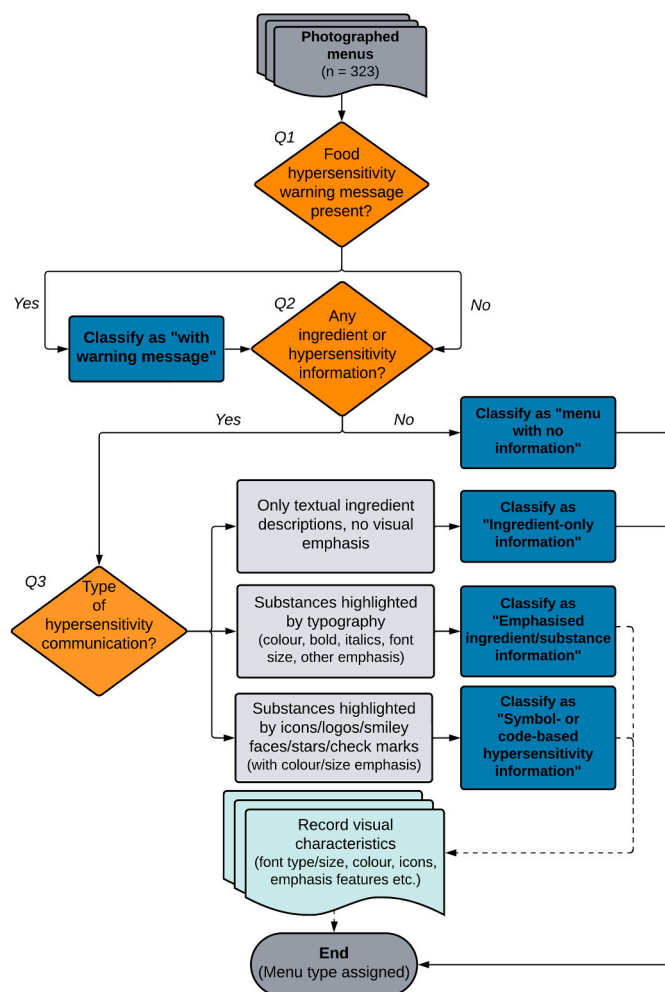


Fig. 1. Decision flow chart for classification of physical foodservice menus according to food hypersensitivity communication. Notes: Q = question.

The placement of information on hypersensitivity-relevant substances was also recorded, distinguishing whether it appeared directly on the menu or in a separate document readily accessible to consumers at the establishment. For menus containing ingredient or food hypersensitivity information, a further distinction was made according to whether this information was present across all menu sections. Menus were classified as having full section coverage when descriptions were provided consistently across every section (e.g., starters, mains and desserts), and as partial coverage when one or more sections lacked any such information. This measure refers only to the *presence* of descriptions across menu sections; it does not capture the accuracy or exhaustiveness of the ingredient information provided within each dish.

For online menus, automated and manual validation were used to classify units of analysis (Fig. 2). Each item description was treated as the unit of analysis. Three main variables were derived from item descriptions: the presence of ingredient information ("with information" or "without information"), the presence of a warning message related to food allergy or intolerance, and the mention of specific allergen groups. To apply these three variables to the online item descriptions, we built three term dictionaries — predefined lists of words used for automated text matching. The dictionaries were seeded with the ingredient and allergen vocabulary observed in the physical menus and then refined iteratively as they were tested against the online descriptions, until matching performance stabilised. The first comprised allergen groups aligned with Brazilian food labelling regulations and *Codex Alimentarius* (e.g. eggs; milk and milk derivatives; wheat and other gluten-containing

cereals; soya; peanuts; tree nuts; fish; crustaceans; molluscs; sesame; sulphites), further expanded to include commonly used ingredient terms. The second included expressions referring to allergy or intolerance warnings, such as "allergens", "food allergy", "may contain", "cross-contamination", "food restriction" and "traces". The third comprised ingredients frequently used in dish descriptions, compiled from physical menus collected in three restaurants per city. Examples of terms included in each dictionary are provided as Supplementary File S1. The automated procedure captured all textual content displayed on each establishment's page on the platform — including the establishment header, description and policy fields — and not only the individual item descriptions used as the unit of analysis for ingredient and format classification. The warning-message dictionary was therefore applied to the full text retrieved for each establishment, so that precautionary or food hypersensitivity-related statements presented at page or establishment level, rather than within a specific dish description, would also have been detected.

2.1.3. Analysis

All physical menus were independently evaluated by two researchers using the decision flowchart to classify each menu according to the proposed criteria. Discrepancies were discussed and resolved with the involvement of a third researcher, resulting in 100% consensus for the final classifications. Inter-rater agreement prior to consensus was quantified using Cohen's kappa (κ) for Q1 and Q2, and linearly weighted Cohen's kappa (κ_w) for the three-level Q3 classification.

Item descriptions from online menus were exported to a spreadsheet and subjected to an automated cleaning and classification procedure in Python. Pre-processing removed duplicate entries, industrially manufactured products (such as soft drinks, packaged chocolates, industrial sauces, beers, sweets and confectionery), non-food items (e.g. handicrafts, knives, pet products, toys, thermal bags), and combo offers that paired beverages with dishes without providing an independent dish description, in order to avoid false negatives resulting from incomplete information. Following this step, the number of entries was reduced from 40,335 to 27,108. Text was then standardised by removing diacritics, hyphens, commas and other punctuation to enable consistent automated dictionary matching.

Using the three dictionaries described above, an algorithm classified each item as "with information" or "without information" regarding ingredient content, identified the presence of warning expressions related to food allergy or intolerance, and flagged the mention of each allergen group. An item was considered "with information" when its description contained at least two terms from the ingredient dictionary; all others were classified as "without information". A minimum threshold of two matching terms was adopted to reduce the misclassification of items with uninformative single-word descriptions (e.g., "salad", "soup", "juice"), which would not provide consumers with meaningful ingredient information, while avoiding the exclusion of minimally but adequately described dishes. To prevent misclassification of single-ingredient dishes whose names imply their composition — such as "pastel", "feijoada" and "coxinha" — a predefined list of such dishes was systematically classified as "with information" regardless of description length.

The reliability of the automated classification was evaluated through a validation step. A simple random sample of approximately 10% of the dataset ($n \approx 2711$ items) was manually reviewed by a researcher, who verified the "with/without information" classification and the identification of hypersensitivity-relevant substances and ingredients. All items flagged by the algorithm as containing a warning message were also examined in full ($n = 5995$). Items flagged as containing symbol- or code-based hypersensitivity information were individually verified on the platform's website.

Categorical associations were tested using Pearson's chi-square (Yates-corrected for 2×2 tables), or Fisher's exact test when expected counts were below five. Explicit food hypersensitivity information was

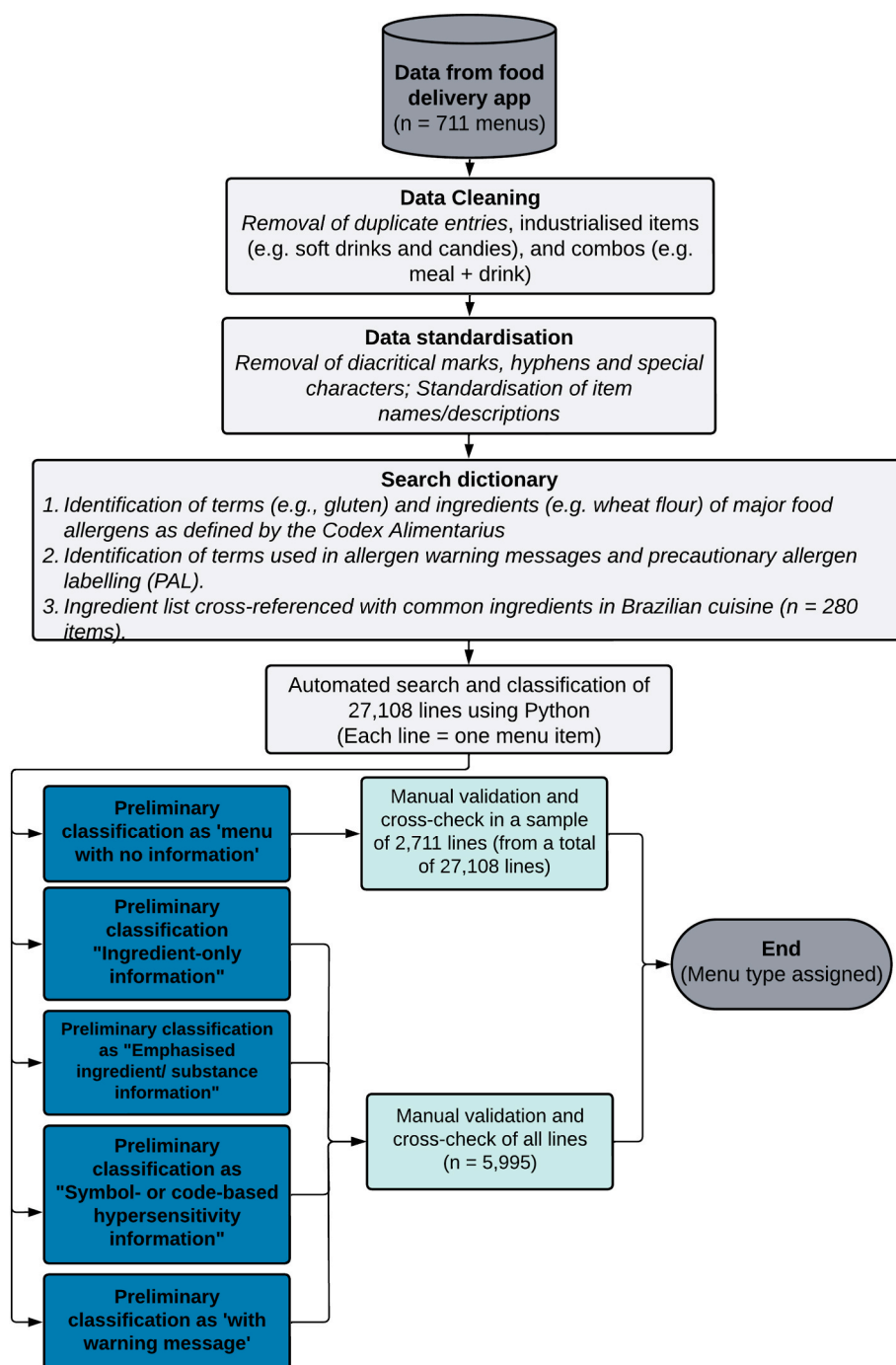


Fig. 2. – Flow chart with automated and manual steps to classify online menus.

defined as menus that signalled relevant substances (e.g. gluten, lactose, milk, eggs) through typographic emphasis, symbols, codes or matrices. To identify its predictors, a binary logistic regression was fitted with the presence of explicit information in physical menus as the dependent variable, and ingredient-only descriptions or menus without information as the reference category. Predictors were local food hypersensitivity legislation, establishment type and average customer expenditure; results are reported as odds ratios (OR) with 95% CIs, with coefficient robustness checked by bias-corrected and accelerated (BCa) bootstrap (5000 replications) and model fit by the likelihood-ratio test and Nagelkerke's R^2 .

To test robustness to the clustering of menus within cities, generalised linear mixed models (Bernoulli family, logit link) with a random

intercept for city (18 cities; 323 menus) were fitted, with fixed effects tested by likelihood-ratio tests. Three specifications were compared. The first retained the binary legislation indicator. The second replaced it with a three-level measure of regulatory scope, obtained by counting the substances each law requires to be disclosed. Cities were classified as having no legislation (11 cities, 213 menus), narrow-scope legislation covering one to three substances (4 cities, 73 menus), or broad-scope legislation covering four or more (3 cities, 37 menus). Absence of legislation was the reference category. The third added municipal gross domestic product per capita for 2023 (IBGE), expressed in units of BRL 10,000 and grand-mean centred, as a city-level socioeconomic covariate. Prescriptiveness of display format was not entered as a fixed effect, since only one jurisdiction mandates a standardised visual format and

the corresponding parameter would not be separable from that city's random intercept; it is reported descriptively in Table 3. Population density was examined at city level but not entered into the models, as municipal density does not describe the central commercial districts from which menus were sampled. An interaction between regulatory status and establishment type was also tested, since the effect of legislation may plausibly differ between establishments operating under corporate standards and those without them. A sensitivity analysis excluding Serra Negra, the regulated city with the smallest number of assessed menus, was conducted to verify that the interaction was not attributable to a single city. Analyses used JASP (v0.19).

2.2. Stage 2 - assessment of the perceptions of consumers with food allergies, intolerances and coeliac disease

Focus groups were selected as the qualitative method because they enable participants to build on each other's contributions, generating collective meaning that may not emerge in individual interviews (Kitzinger, 1995; Morgan, 1997; Ochieng et al., 2018). This dynamic suit the exploration of lived experiences of managing food hypersensitivity in everyday out-of-home eating contexts. Design and reporting followed Ochieng et al. (2018), which addresses recurrent gaps in the reporting of sampling, group size and session conduct.

Participants were recruited via social media using purposive snowball sampling. Of the 60 interested volunteers, 44 completed a questionnaire collecting detailed information on their type of food hypersensitivity, diagnostic status, and availability to participate in the focus groups. Of these, 18 individuals were selected based on overlapping availability to ensure heterogeneity in food hypersensitivity profile, age, and sex. All participants were aged 18 years or older and voluntarily participated in the sessions without financial compensation. The focus groups were conducted remotely via videoconference and fully recorded. Individuals without a medical diagnosis of food hypersensitivity were excluded. Geographic location and the presence of local food hypersensitivity legislation were not used as selection criteria. Nevertheless, participants were recruited from different regions of Brazil, including municipalities and states with and without local food hypersensitivity legislation. Four online focus groups were conducted: two with adults with coeliac disease ($n = 3$ and $n = 5$), one mixed-allergy group ($n = 8$), and one comprising parents of children with food allergy or coeliac disease ($n = 2$). The focus groups were guided by an overarching question: what difficulties do people with food hypersensitivity encounter when eating outside the home, and what positive and negative experiences do they report in physical establishments and in delivery settings? Six topics operationalised this question: (1) barriers and risk-mitigation strategies when eating out or ordering delivery; (2) impact of food hypersensitivity on social eating; (3) experiences of frustration with food hypersensitivity communication and suggestions for improvement; (4) ideal menu formats and digital tools; (5) positive reference experiences in domestic or international foodservice settings. A sixth, closing open question invited each participant to make one recommendation to foodservice establishments and delivery services, and to raise any further issue not covered in the discussion. The discussions were conducted in Portuguese and guided by a designated moderator until data saturation was reached, defined as the point at which no new issues related to the proposed topics emerged. Each session lasted approximately 60 min. The full moderator guide, including the opening instructions and the wording of each question, is provided in Supplementary File S2.

All sessions were audiovisually recorded, fully transcribed verbatim, and subjected to thematic content analysis following the framework proposed by Bardin (2013). The analytic process comprised three stages: (1) pre-analysis, involving repeated readings of the transcripts to develop an overall understanding and identify initial meaning units related to food hypersensitivity communication, information-seeking behaviour, and risk management in foodservice contexts; (2) material

exploration, with systematic coding of meaning units and meaning cores (e.g. absence of ingredient descriptions, hidden allergens in sauces and seasonings, inadequate staff knowledge, valued communication formats, digital platform limitations, regulatory expectations); and (3) treatment and interpretation of results, in which subcategories were grouped into broader thematic categories capturing the main dimensions of participants' experiences with food hypersensitivity communication. Coding was conducted independently by two researchers, and discrepancies in codes, subcategories, or categories were resolved through consensus meetings involving a third researcher. All coding and category management were performed using MAXQDA 24 software (VERBI Software, Berlin, Germany). Data saturation was assessed iteratively throughout the analytical process. No new categories or subcategories emerged after the third focus group session, suggesting that the data reached thematic saturation with the sample obtained. The fourth group included parents, and therefore, complemented the analysis. The topics above structured the moderator guide and were defined a priori. The categories reported in the Results emerged inductively from the coding of meaning units and therefore do not map one-to-one onto the guide: material from several topics converged into single categories, and one category, regulatory and policy expectations, drew substantially on the closing open question.

3. Results

3.1. Food hypersensitivity communication in physical and online menus

In total, 1034 menus were included, comprising 323 physical menus collected in situ and 711 menus obtained from the iFood platform — the most widely used food delivery application in Brazil (Ma, 2025). Of the 323 physical foodservice establishments evaluated, 35.6% were franchises and 64.4% were independent. In terms of service type, 47.1% of establishments were classified as restaurants, 39.9% as snack bars, and 13.0% as bars. Average customer expenditure per person was reported as below R\$50 (22.6%), R\$50–R\$100 (53.9%) and above R\$100 (23.5%). Among the 711 online establishments retrieved from the iFood platform, 54.4% of establishments were classified as restaurants, 42.3% as snack bars, and 3.2% as bars. The mean customer rating was 4.8, based on a 1-to-5 scale.

Inter-rater agreement on the physical menus was high: $\kappa = 1.00$ for warning messages, $\kappa = 0.78$ for the presence of hypersensitivity information, and $\kappa_w = 0.97$ for the three-level format classification (Table 1). Manual review of a random 10% sample of online items ($n \approx 2711$) confirmed the automated classification, which correctly identified the presence or absence of ingredient information in 96.7% of cases.

Most menus provided some information, predominantly ingredient-only (physical: 76.2%; online: 88.0%); few provided none (physical: 6.5%; online: 1.0%). When comparing regulated and unregulated cities within each menu type (Table 1), distinct patterns emerged. For physical menus, regulation was associated not with whether information was present, but with its format. The overall proportion of menus carrying any food hypersensitivity information (95% vs. 93%, $p = 0.58$) and warning messages (9.6% vs. 12%, $p = 0.40$) was similar across regulated and unregulated cities; among menus that did provide information, however, those in regulated cities relied less on ingredient-only descriptions (72% vs. 86%, $p = 0.002$) and more on symbol- or code-based formats (24% vs. 10%, $p < 0.001$). Among the 302 establishments that provided some type of information, 291 used the menu itself, 10 used a separate document, and one used signage on the buffet to describe hypersensitivity-relevant substances. All establishments that presented food hypersensitivity information outside the main menu used either emphasised ingredient/substance information or symbol- or code-based hypersensitivity information formats. For online menus, no statistically significant differences were found for any variable between regulated and unregulated cities ($p > 0.05$ for all comparisons), indicating that the presence of local food hypersensitivity legislation had no measurable

Table 1

Food hypersensitivity communication practices in physical and online menus according to the presence of local legislation.

Variables	Physical menus		p	Online menus		p
	With regulation	Without regulation		With regulation	Without regulation	
	(n = 110)	(n = 213)		(n = 271)	(n = 440)	
Any food hypersensitivity information*	104 (95%)	198 (93%)	0.58	269 (99%)	435 (99%)	0.60
Warning message*	10 (9.1%)	26 (12.2%)	0.40	1 (0.4%)	0 (0%)	0.20
Ingredient-only information**	75 (72%)	171 (86%)	0.002	240 (89%)	386 (89%)	0.84
Ingredient-only information with coverage across all menu sections§	47 (63%)	97 (57%)	0.38	77 (32%)	129 (33%)	0.73
Emphasised ingredient/substance information**	4 (4%)	8 (4%)	0.93	7 (3%)	21 (5%)	0.14
Symbol- or code-based hypersensitivity information**	25 (24%)	19 (10%)	<0.001	22 (8%)	28 (6%)	0.37

Percentage of total menus; ** percentage of menus with any food hypersensitivity information; § percentage of menus classified as ingredient-only information; p-values for Chi-square test; Inter-rater agreement prior to consensus, assessed on all 323 physical menus independently coded by two raters: Cohen's κ for the dichotomous classifications (warning messages, presence of hypersensitivity information) and linearly weighted Cohen's κ for the three-level format classification.



Fig. 3. Examples of food hypersensitivity communication identified in Brazilian foodservice menus. Panels A–B illustrate emphasised ingredient/substance information, and panels C–G illustrate symbol- or code-based formats; the key communication element in each panel is highlighted in green. (A) menu item with "contains lactose" and "contains gluten" tags placed below the dish description; (B) declaration embedded at the end of an ingredient list, stating the presence of gluten, lactose, milk derivatives and soy; (C) row of standardised icons assigning multiple hypersensitivity-relevant substances to each dish; (D) coloured dots used as a code — here blue for crustacean (shrimp) and yellow for milk — whose meaning depends on a separate legend; (E) matrix cross-referencing menu items against a fixed set of substances (lactose, gluten, wheat, rye, barley, oat, crustaceans, egg, fish); (F) pictographic icons accompanied by text declaring "contains lactose", "contains milk protein" and "contains gluten and derivatives"; (G) compact two-letter code ("GL", for gluten and lactose) placed beside the dish name. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

influence on the food hypersensitivity communication practices observed in online menus.

Comparisons between physical and online menus differed by regulatory context (Table 1). In regulated cities, online menus more often carried plain ingredient-only information, whereas physical menus more

often used warning messages and the more complete and visually structured formats (all $p < 0.001$). In unregulated cities these differences were attenuated, although physical menus still provided ingredient-only information with coverage across all menu sections more frequently than online menus ($p < 0.001$).

Among the 323 physical menus, 36 (11.1%) contained at least one warning message, compared with only 1 (0.1%) of the 711 online menus. These varied in specificity: brief prompts to disclose restrictions or ask staff ($n = 4$); cross-contamination alerts noting that descriptions may be incomplete ($n = 22$), e.g. 'traces of gluten, lactose, tree nuts and seafood may be present ... menu descriptions may not list all ingredients'; combined statements disclosing hypersensitivity-relevant substances and directing customers to staff ($n = 9$); references to a dedicated allergen list ($n = 2$); and offers to adapt preparations, sometimes with dedicated equipment ($n = 4$).

Menus using emphasised ingredient/substance information or symbol- or code-based hypersensitivity information were further analysed according to their visual features. Among menus with emphasised ingredient/substance information, hypersensitivity-relevant substances were indicated through colour differences, font changes, bold type, italics, font size variation, text boxes and uppercase letters. Examples of these typographic highlighting strategies are presented in Fig. 3A and B. Among menus with symbol- or code-based hypersensitivity information, 40 establishments used icons to indicate relevant substances (Fig. 3C), one used coloured dot (Fig. 3D), two used information matrices (Fig. 3E), and one used a letter code for the substance (Fig. 3G). Some menus combined multiple visual elements, including variations in colour and size, circles and icons (Fig. 3F).

Across menus with emphasised or symbol/code-based information, 274 ingredient mentions were recorded in physical menus (154 regulated, 120 unregulated) and 145 in online menus (46 vs 99). The most frequently mentioned hypersensitivity-relevant substances were lactose, gluten, milk and eggs (Table 2) whereas molluscs, sesame, rye and barley were the least frequently mentioned (data not shown).

A binary logistic regression examined factors associated with explicit food hypersensitivity information in physical menus. The full model (M_1 : local legislation, establishment type, average customer expenditure; each coded 1 = yes/franchise/above R\$100) improved significantly on the null model ($\Delta X^2 = 23.07$, $df = 3$, $p < .001$; Nagelkerke $R^2 = 0.116$). All three predictors were independently associated with a higher probability of explicit information. Establishments in regulated cities showed about twice the odds of those in unregulated ones (OR = 2.14, 95% CI [1.16, 3.96], $p = .016$); franchises about 2.7 times the odds of independents (OR = 2.67 [1.43, 4.98], $p = .002$); and establishments with expenditure above R\$100 comparable odds relative to lower-expenditure ones (OR = 2.66 [1.38, 5.13], $p = .004$) — all confirmed by BCa bootstrap.

Between-city heterogeneity was substantial. In a mixed-effects model accounting for the clustering of menus within cities, establishment type ($\chi^2(1) = 10.74$, $p = .001$) and expenditure ($\chi^2(1) = 6.47$, $p = .011$) remained associated with explicit information, whereas local legislation

did not ($\chi^2(1) = 1.55$, $p = .213$). The intraclass correlation was 0.31, indicating that approximately one third of the variability in explicit information was located between cities. Disaggregating legislation by regulatory scope did not recover the association: neither narrow-scope (adjusted Odds Ratio (aOR) 1.45, 95% CI 0.22–9.83, $p = .701$) nor broad-scope legislation (aOR 2.58, 95% CI 0.26–25.85, $p = .435$) was associated with explicit information, and municipal Gross Domestic Product (GDP) per capita showed no association (aOR 0.89 per BRL 10,000, 95% CI 0.64–1.25, $p = .497$). The full model sequence is reported in [Supplementary Tables S1 and S2](#) (Supplementary file S3).

The association between regulation and explicit information depended on establishment type. The interaction between regulatory status and establishment type was significant ($\chi^2(1) = 11.95$, $p < .001$) and improved model fit substantially (Akaike Information Criterion = 245.6 against 255.5 for the model without it). In unregulated cities, explicit information was present in 26.9% of chain menus and 4.4% of independent menus (OR 10.00, 95% CI 3.47–28.81). In regulated cities this difference was absent, with 18.9% of chain menus and 27.4% of independent menus carrying explicit information. Regulation was associated with explicit information among independent establishments (OR 8.29, 95% CI 1.77–38.89) but not among chains (OR 0.55), and the ratio of these two odds ratios was 0.07 (95% CI 0.01–0.33). Higher average customer expenditure remained associated with explicit information in both contexts (OR 3.46, 95% CI 1.54–7.79). Excluding Serra Negra, the regulated city with the fewest assessed menus ($n = 8$), the interaction was retained ($\chi^2(1) = 10.63$, $p = .001$; $n = 315$, 17 cities), with the effect of regulation among independent establishments attenuated (OR 4.34, 95% CI 1.13–16.62) and the chain advantage in unregulated cities unchanged (OR 10.62, 95% CI 3.75–30.09).

This heterogeneity is evident at the city level (Table 3). Explicit hypersensitivity information was more frequent in regulated (24.5%) than unregulated (12.7%) physical menus, but unevenly so. Among regulated cities, adoption was concentrated in Fortaleza (56.0%, $n = 25$) and Serra Negra, whereas Belo Horizonte and Rio de Janeiro fell below 5%; conversely, several unregulated cities, e.g. Cuiabá (27.8%) and Natal (23.8%), matched or exceeded most regulated ones.

Legislation: Salvador, State Law 14863/2025 (Bahia, 2025); Fortaleza, State Law 17899/2022 (Ceará, 2022); Rio Grande, Municipal Law 8067/2017 (Rio Grande, 2017); Belém, State Law 10654/2024 (Pará, 2024); Belo Horizonte, Municipal Law 11,116/2018 (Belo Horizonte, 2018); Serra Negra, Municipal Law 4775/2025 (Serra Negra, 2025); Rio de Janeiro, Municipal Law 6159/2017 (Rio de Janeiro, 2017).

Substances were taken from the text of each law; overlapping categories (e.g. almonds within tree nuts) are reproduced as listed. Sugar

Table 2
Hypersensitivity-relevant substances identified in physical and online menus according to local regulatory status.

Hypersensitivity-relevant substances	Type	Physical menus		Online menus		Menus citing substance ($n = 1034$)
		With regulation ($n = 110$)	Without regulation ($n = 213$)	With regulation ($n = 271$)	Without regulation ($n = 440$)	
Milk	Allergen	18 (16.4%)	11 (5.2%)	4 (1.5%)	11 (2.5%)	44 (4.3%)
Eggs	Allergen	18 (16.4%)	12 (5.6%)	1 (0.4%)	10 (2.3%)	41 (4.0%)
Fish	Allergen	16 (14.5%)	5 (2.3%)	1 (0.4%)	3 (0.7%)	25 (2.4%)
Crustacean shellfish ¹	Allergen	16 (14.5%)	7 (3.3%)	3 (1.1%)	6 (1.4%)	32 (3.1%)
Tree nuts ²	Allergen	14 (12.7%)	12 (5.6%)	1 (0.4%)	9 (2.0%)	36 (3.5%)
Peanuts	Allergen	2 (1.8%)	6 (2.8%)	0 (0%)	1 (0.2%)	9 (0.9%)
Wheat	Allergen	0 (0%)	5 (2.3%)	1 (0.4%)	3 (0.7%)	9 (0.9%)
Soybean	Allergen	15 (13.6%)	11 (5.2%)	1 (0.4%)	6 (1.4%)	33 (3.2%)
Lactose	Intolerance-related	27 (24.5%)	25 (11.7%)	29 (10.7%)	36 (8.2%)	117 (11.3%)
Gluten	Coeliac disease-related	28 (25.5%)	26 (12.2%)	5 (1.8%)	14 (3.2%)	73 (7.1%)

¹Includes prawns; ²Includes walnuts, almonds, hazelnuts, cashew nuts, Brazil nuts, macadamia nuts, pistachios, and other tree nuts. Percentages are calculated within each column, using the number of menus in the corresponding group as the denominator ($n = 110$, 213, 271, and 440, respectively); they indicate the proportion of menus in that group citing each substance. As a single menu may cite more than one substance, these categories are not mutually exclusive and column percentages may sum to more than 100%.

(Belo Horizonte, Rio Grande) and colourants (Ceará) are not food allergens and appear here as they do in the laws. Ceará is the only jurisdiction prescribing a standardised visual format, and Pará the only one whose law explicitly covers digital menus.

GDP per capita calculated from municipal GDP at current prices for 2023 (IBGE, PIB dos Municípios) divided by the resident population of the 2022 Demographic Census; figures may differ by 1–2% from the official IBGE per capita, which uses the 2023 population.

In online menus, the presence of a lactose-free icon was the only hypersensitivity-related icon identified among the analysed establishments (Fig. 4). Accordingly, the establishments classified as providing symbol- or code-based hypersensitivity information in the online environment ($n = 50$; Table 1) were those displaying this lactose-free icon; no other icons, codes or matrices were detected online. The symbol- or code-based category is therefore considerably narrower for online than for physical menus, and direct comparisons of this format between the two settings should be interpreted with caution. Other hypersensitivity-relevant substances were highlighted within the item descriptions and were therefore classified as emphasised ingredient/substance information.

3.2. Consumer perceptions of hypersensitivity communication

The 18 participants comprised 14 women (77.8%) and four men (22.2%), with a mean age of 37.2 years. The groups comprised one mixed food-allergy group ($n = 8$), two groups of adults with coeliac disease ($n = 3$ and $n = 5$), and one parent or caregiver group ($n = 2$). Content analysis identified five categories: (1) information gaps in menus, (2) preferred communication formats, (3) digital communication and delivery limitations, (4) regulatory and policy expectations, and (5) impact on social participation (Table 4).

Within information gaps in menus, the absence of complete ingredient descriptions was a recurring source of frustration, with particular difficulty in identifying hypersensitivity-relevant ingredients in sauces, seasonings and composite preparations, the items most likely to be omitted from ingredient-only menus: "on the menu it does not describe which allergens are in it, and sometimes I have to talk to the chef or the cook himself" (FG1). Inconsistent information from staff was the most frequently coded meaning core in Stage 2 (Table 4), yet the effect of training on communication quality was not measured here and remains a priority for evaluation. Inconsistent information from staff was the most frequently coded meaning core, with participants describing staff unable to confirm the composition of dishes ("usually the staff cannot say it exactly", FG1) and a parent asking "how am I supposed to guess that a hamburger bun contains milk?" (FG2).

Clear and objective communication, whether verbal or written, was the most frequently cited preference ($n = 45$), followed by well-organised visual menus with complete descriptions ($n = 26$). Ingredient-only information without explicit declarations or visual emphasis was still recognised as helpful, indicating that consumers value completeness regardless of format. The value attributed to visual formats was expressed in immediate terms: "if you make it visual, you glance at it and you already

know" (FG3). Icons and symbols ($n = 14$), separate menus for hypersensitivity information ($n = 5$), identification on the dish ($n = 3$) and communication through social media ($n = 5$) were also valued.

Participants reported that online menus provided less ingredient detail than physical menus, consistent with the Stage 1 finding of complete ingredient coverage in approximately 33% of ingredient-only online menus against 60% of physical menus. They called for more detailed ingredient information on delivery platforms ($n = 5$), dedicated hypersensitivity fields in ordering systems, allergen labelling on packaging ($n = 1$) and separate digital menus ($n = 1$). Even partial solutions were valued: "at least separate the foods into different categories, that alone would already help a lot" (FG1). Certification seals were also mentioned as a potential trust-building mechanism ($n = 3$), particularly among participants with coeliac disease. Participants referred to certification in general terms and did not identify a specific certifying body or define the standards such a certification should represent.

Participants identified a need for greater governmental action ($n = 8$), encompassing specific legislation, enforcement mechanisms and broader public policy. They framed this as a matter of both rule-setting and oversight, stating that "there should be some stricter legislation (...) and some kind of inspection" (FG1), and proposed fiscal incentives so that "inputs for people with dietary restrictions had a tax exemption, because that would encourage restaurants to make options for us" (FG1).

Participants reported avoiding outings and events when no safe option was anticipated ($n = 13$; "my social life is practically zero", FG3), and taking part only by bringing their own food, in some cases including cookware ($n = 10$; "we even have to bring our own pans", FG2). Embarrassment was compounded by the trivialisation of food hypersensitivity by staff and other diners ($n = 9$; "many people think it is fussiness", FG1), and exclusion was most acute on celebratory occasions, where desserts rarely had safe equivalents ($n = 6$; "everyone will be eating cake and I will be eating an apple", FG1).

4. Discussion

The two stages are discussed together under each theme, since the menu analysis documents what is disclosed and the focus groups explain how that disclosure is used, misread, or found insufficient by the consumers it is meant to protect.

4.1. What menus disclose and what consumers cannot find

This study provides the first nationwide characterisation of food hypersensitivity communication in Brazilian foodservice menus. Ingredient-only information dominated both menu types (physical 76%; online 88%), with most establishments providing general food descriptions and no specific emphasis on hypersensitivity-relevant substances. Warning messages were particularly scarce in physical menus and virtually absent from online menus — a finding of concern, given that such messages are a minimal and inexpensive form of allergen disclosure. This pattern is consistent with international evidence documenting the persistent insufficiency of allergen communication in foodservice settings (Leftwich et al., 2011; Nahle et al., 2025; Radke et al., 2016; Wen & Kwon, 2019).

Stage 2 accounts locate the same gap at the point of service (Section 3.2). Participants described sauces, seasonings and desserts as the items whose composition is hardest to establish from menu descriptions, which is consistent with evidence that these items most often omit information on hypersensitivity-relevant ingredients. In the absence of reliable written disclosure, consumers are compelled to seek verbal clarification from staff, an interaction constrained by social embarrassment, concern about causing inconvenience, and uncertainty about

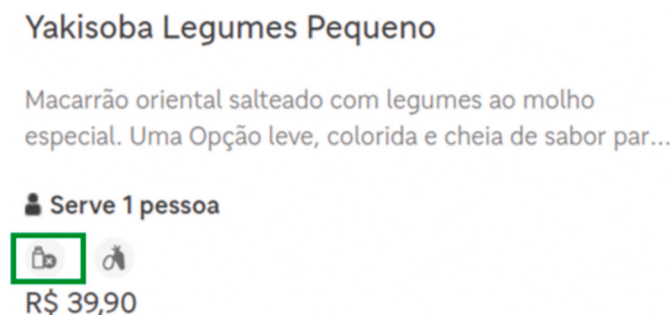


Fig. 4. Use of a "lactose-free" icon in the analysed online menus. The adjacent icon indicates a vegetarian option and is unrelated to allergen information.

Table 3

Characteristics of the 18 sampled cities: food hypersensitivity legislation, socioeconomic context and provision of explicit hypersensitivity information in physical menus.

Municipality (State)	Substances required to be disclosed	Disclosure requirements: format and scope	GDP per capita (BRL)	Menus (n)	Explicit information, n (%)
Cities with specific food hypersensitivity legislation (n = 7)					
Salvador (BA)	Wheat, rye, barley, oats, crustaceans, eggs, fish, peanuts, soya, milk, almonds, hazelnuts, cashew nuts, Brazil nuts, macadamia, walnuts, pecans, pistachios, pine nuts, chestnuts, natural latex	Format not prescribed; menus or buffet displays, all establishments	31,720	10	2 (20.0)
Fortaleza (CE)	Gluten, lactose, milk, fish, almonds, colourants, tree nuts, soya, eggs, crustaceans	Standardised icons; menus, all establishments	35,797	25	14 (56.0)
Rio Grande (RS)	Gluten, sugars, shellfish, oilseeds (peanuts, nuts, walnuts, almonds, hazelnuts), eggs	Format not prescribed; product composition, all establishments	73,511	2	0 (0.0)
Belém (PA)	Lactose, gluten, seafood	Format not prescribed; physical and digital menus, all establishments	31,100	23	2 (8.7)
Belo Horizonte (MG)	Gluten, lactose, sugar (plus dietetic or light classification)	Format not prescribed; menus, all establishments	56,227	21	1 (4.8)
Serra Negra (SP)	Lactose, milk protein, gluten and derivatives	Format not prescribed; foods prepared or served in restaurants, bars, snack bars, hotels and self-service or buffet-by-weight establishments	34,616	8	7 (87.5)
Rio de Janeiro (RJ)	Gluten and derivatives	Format not prescribed; menus, buffet-style and self-service establishments only	67,372	21	1 (4.8)
Cities without specific food hypersensitivity legislation (n = 11)					
Brasília (DF)	–	–	129,790	20	4 (20.0)
Campinas (SP)	–	–	80,794	19	0 (0.0)
Cuiabá (MT)	–	–	59,994	18	5 (27.8)
Curitiba (PR)	–	–	67,691	20	4 (20.0)
Limeira (SP)	–	–	71,528	38	3 (7.9)
Natal (RN)	–	–	41,477	21	5 (23.8)
Palmas (TO)	–	–	46,808	20	0 (0.0)
Piracicaba (SP)	–	–	104,770	3	0 (0.0)
Porto Alegre (RS)	–	–	78,586	13	3 (23.1)
Ribeirão Preto (SP)	–	–	74,869	21	1 (4.8)
Santos (SP)	–	–	73,964	20	2 (10.0)
Total	–	–	–	323	54 (16.7)

Note. – = no specific food hypersensitivity legislation in force. Explicit information refers to menus signalling hypersensitivity-relevant substances through typographic emphasis, symbols, codes or matrices, as opposed to ingredient-only descriptions or menus with no information.

staff competence (Barnett et al., 2020; Begen et al., 2016; Leftwich et al., 2011). When written menu information and verbal guidance do not align, the resulting inconsistency erodes consumer trust in both staff and the establishment as a whole. Safer outcomes are more likely when allergy disclosure is prompted early, involves fewer intermediaries, and is supported by checking procedures integrated throughout the service interaction (Wingate et al., 2021). When these conditions are absent, inconsistent communication becomes a structural barrier to safe dining and reinforces the case for mandatory and standardised communication requirements in foodservice settings (Dominguez et al., 2024; Wingate et al., 2021).

Poor food hypersensitivity communication also carries a psychosocial cost. Unreliable information sustains vigilance and anticipatory anxiety that erode participation in social eating (Knibb et al., 2024; Roleston et al., 2025). The avoidance behaviours reported by participants in the present study, described in Section 3.2, are consistent with this literature and indicate that incomplete menu information restricts social participation rather than food choice alone.

4.2. Format, not only content

Symbol- or code-based hypersensitivity information and emphasised ingredient/substance information remained uncommon across both menu types, despite evidence that these formats are more readily detected by consumers with food hypersensitivity (Lee & Wei, 2024). Menu space has long been regarded primarily as a marketing resource — a tool for influencing consumer purchasing behaviour and directing

attention toward high-margin items, rather than for conveying safety-relevant information (Reynolds et al., 2005).

The preference ranking observed in Stage 2 is consistent with the evidence on visual salience. Consumers tend to prefer visually salient formats because they reduce search effort and facilitate faster identification of risk-relevant information during food choice (Fogolari et al., 2023; Proi et al., 2025). Eye-tracking evidence confirms that menus using symbol- or code-based food hypersensitivity information allowed consumers with food hypersensitivity to identify allergen information significantly faster than menus using emphasised ingredient/allergen information or ingredient-only information, with icons functioning as effective visual anchors during menu scanning (Lee & Wei, 2024). Pictograms accompanied by explicit textual labels were better understood than symbols alone, and symbol-based communication is more likely to be preferred when it reduces rather than replaces information processing demands (Marra et al., 2017; Medeiros et al., 2021). Informational depth and format are therefore complementary rather than competing priorities, and improving the completeness of ingredient descriptions in such menus may represent a meaningful and more immediately achievable advance for many establishments.

4.3. The digital environment

Online menus presented a markedly different profile. Local regulation had no measurable association with food hypersensitivity communication in the digital context, consistent with Canada, where local rules similarly failed to improve disclosure on delivery platforms (16% of non-chain online menus included allergen statements and 10% used

Table 4

Categories, meaning cores, and examples of quotes identified in the focus groups conducted with adults experiencing food hypersensitivity and parents/caregivers of children with food allergy or coeliac disease.

Categories	Meaning cores ^a	Quotes
1. Information gaps in menus	1.1. Lack of ingredients and allergen information (6) 1.2. Inconsistent or conflicting information (55)	"My biggest difficulty when eating outside the home is that some restaurants do not describe what is in the dish." "What bothers almost everyone here in the group is the lack of information, from the staff to the managers and even the chefs."
2. Preferred communication formats	2.1. Use of allergen icons and symbols (14) 2.2. Well-organized visual menus with complete descriptions (26) 2.3. Separate menu for allergen information (5) 2.4. Identification on the dish (3) 2.5. Clear and objective communication (45) 2.6. Social media communication (5)	"What is even more helpful is when menus include icons or symbols indicating potentially allergenic foods." "First, it should be on the menu, with clear labeling of all ingredients, including seasonings." "I think separate menus for people who have questions and for those who have allergies would be helpful." "And then the staff could come back to the table and confirm, saying, 'This is your order,' perhaps with a different flag, so that it receives special attention." "I think that at least the basic information would already help a lot." "Some places already have posts explaining coeliac disease, which makes us feel safer nowadays."
3. Digital communication and delivery limitations	3.1. Labelling on packaging (1) 3.2. Detailed information and allergy information fields on online platforms (5) 3.3. Separate menu (1)	"For delivery, I think there could be a sticker on the bag or box, or some kind of paper that comes with it already indicating this." "And in delivery apps, there could be a way to indicate that the person should include this in the notes field." "Especially on platforms, when they are on iFood or in their menu, the information should be more detailed." "Delivery menus do not describe the ingredients of the food." "I believe that, especially in delivery platforms like iFood, there should be a different menu related to allergens."
4. Regulatory and policy expectations	3.4. Perceived value of certification seals (3) 4.1. Need for regulatory and public policy action (8)	"If the restaurant has a certification seal, you can trust it more; at least that is how I feel." "There should be some law or specific recommendation about this, and perhaps that is what is missing here in Brazil."
5. Impact on social participation	5.1. Restriction or avoidance of social outing and events (13) 5.2. Bringing one's own food as a condition for participating (10) 5.3. Embarrassment, stigma and trivialization by others (9) 5.4. Exclusion from shared and celebratory eating (6)	"Sometimes I skip events because I know I will have no way to eat there." "I have to bring my own packed meal, I have to bring my own food, otherwise I do not take part." "People start huffing, start rolling their eyes (...) and then I often feel very embarrassed." "I mention it and people mock it a little, make a joke, give a small laugh." "For birthdays at school we have to send his separate kit (...) he cannot take the sweets from the table."

^a Number of context units coded within each meaning core.

symbols) (Nahle et al., 2025). This gap is partly structural: delivery platforms mediate access to menu information yet are rarely treated as accountable actors, and without mandatory allergen fields or standardised warning formats, risk-relevant information competes with promotional content and is left to each establishment's discretion. The only hypersensitivity-related symbol identified online marked the absence of lactose, an intolerance rather than an IgE-mediated allergy. Its presence therefore does not indicate that establishments communicate about substances capable of causing anaphylaxis, and the two should not be read as interchangeable indicators of hypersensitivity communication. Because local laws target physical menus while online interfaces often fall outside their scope, regulation did not translate into better digital communication (Nahle et al., 2025; Vicentini et al., 2026b). The near absence of warning messages is especially concerning online, where ordering removes the real-time verbal interaction with staff that consumers rely on when written information is missing. In Canada, 66% of food-allergic individuals reported never ordering through third-party platforms, against 35% of non-allergic consumers (Shirani et al., 2025), a pattern echoed by participants in Stage 2 (Section 3.2).

4.4. What explains variation in disclosure

In the absence of regulatory requirements, voluntary adoption of structured food hypersensitivity disclosure depends on operators perceiving a tangible return. Evidence on voluntary food safety adoption suggests that commercial motivations — including market competitiveness, consumer trust, and access to distribution channels — consistently drive uptake more than ethical considerations, particularly in emerging economies (Chen & Lien, 2025; Rincon-Ballesteros et al., 2024). Without a clear business case or regulatory obligation,

independent foodservice operators are unlikely to invest in redesigning their menus to accommodate food hypersensitivity communication.

The presence of local food hypersensitivity legislation was not associated with a higher overall frequency of information of any kind in physical menus — suggesting that most establishments provide some form of ingredient description regardless of regulatory context, likely driven by basic commercial practice rather than compliance. What legislation does appear to change is the format of that communication: regulated cities showed significantly higher rates of symbol- or code-based food hypersensitivity information and lower rates of ingredient-only information. EU Regulation No 1169/2011 (European Parliament and Council of the European Union, 2011)— the most comprehensive framework currently in force — specifies not only what must be disclosed but how, requiring clear visual differentiation of allergenic ingredients (Vicentini et al., 2026b). Brazilian local regulations, by contrast, vary considerably in prescriptive detail: some mandate symbol-based identification of multiple hypersensitivity-relevant substances (Ceará, 2022), while others require disclosure of only one substance (i.e., gluten) without specifying format (Rio de Janeiro, 2017). This heterogeneity dilutes the regulatory signal received by operators, producing partial rather than structural change.

Higher average customer expenditure was consistently associated with explicit food hypersensitivity information (OR = 3.46), plausibly reflecting greater capacity to invest in menu design and a consumer base with stronger expectations of transparent disclosure. The role of establishment type was more specific. Franchise networks operate through centralised quality-management systems that translate requirements into standardised procedures, including menu design, across all units, whereas independent operators must implement them individually and without corporate support. Consistent with this, chains provided explicit

information at comparable levels whether or not local legislation applied ($OR = 0.55$), while among independent establishments provision was substantially higher where legislation was in force ($OR = 8.29$). Regulation therefore appears to operate on the segment of the market with no other source of standardisation, raising independent establishments to the level chains already reach through internal procedure. Because the two effects run in opposite directions, they offset one another when establishment type is not modelled, which accounts for the attenuated main effect of regulation observed at city level.

This pattern was unchanged when legislation was disaggregated by the number of substances each law covers, which indicates that the attenuation is not attributable to treating heterogeneous laws as a single binary category. Among regulated cities, the highest proportion of explicit information was observed where the law prescribes how information must be displayed rather than where it covers the largest number of substances. Fortaleza, under a law listing ten substances and requiring standardised icons, recorded 56.0% explicit information, compared with 20.0% in Salvador under a law listing twenty-one substances and no format requirement. Only one jurisdiction prescribes a display format, so scope and prescriptiveness are confounded in the present sample and this comparison is indicative rather than conclusive. The laws themselves also mix risk categories. Belo Horizonte and Rio Grande require disclosure of sugar and Ceará of colourants alongside true allergens, which limits how far compliance with any of these instruments can be read as protection for consumers at risk of anaphylaxis. At city level, Belo Horizonte and Rio de Janeiro, whose laws require disclosure without specifying a format, both fell below 5%, indicating disclosure through text rather than symbols. Salvador reached 20.0% under the broadest legislation in the sample, a level matched by Curitiba and Brasília, where no legislation applies. This dispersion, with only a few regulated jurisdictions, contributes to the attenuated city-level effect of legislation and indicates that its impact depends both on the establishments it reaches and on whether it prescribes a communication format.

The participants' call for national regulation with enforcement mechanisms aligns with the broader pattern of findings. Local legislation shapes format but not coverage, commercial infrastructure determines who complies, and digital environments remain outside the scope of most existing rules. Consumer protection in Brazilian foodservice therefore continues to depend on individual operator decisions rather than on systemic safeguards.

4.5. Implications for practice and future research

Theoretically, the findings indicate that regulation and corporate standardisation act as substitutable sources of compliance. Chains disclosed at similar levels irrespective of regulatory context, while independent establishments responded strongly to legislation, so that the average effect of a regulation conceals opposing effects in different market segments. This has implications beyond allergen disclosure: evaluations of food safety regulation that estimate a single average effect may conclude that an instrument has failed when it is in fact working in the segment that lacks alternative sources of standardisation. The qualitative findings add a second dimension. Consumers' experiences extend beyond whether information is present, encompassing its clarity and organisation, trust in foodservice staff, and the capacity to manage risk when eating out or ordering delivery. Communication quality, rather than information presence, is therefore the more appropriate construct for future work in this field.

Foodservice establishments should move beyond ingredient-only information. Complete descriptions are a minimum standard, and structured symbol-based formats are safer and better accepted. Continuous staff training is also essential, since written information alone cannot compensate for poorly informed staff (Begen et al., 2016; Lee & Wei, 2024). Inconsistent information from staff was the most frequently coded meaning core in Stage 2 (Table 4), yet the effect of training on communication quality was not measured here and remains a priority for evaluation.

The contrast between chains and independent establishments carries different implications for each. For chains, provision was already at ceiling relative to independent operators but remained below 30% in absolute terms, which indicates that internal standardisation currently reproduces a low baseline rather than good practice. Revising corporate menu templates would raise provision across all units of a network at once, at negligible marginal cost. Sector associations and public technical assistance programmes could supply what corporate structures supply to chains, namely templates, symbol sets and model wording, which would extend disclosure without requiring each operator to design a solution individually.

Delivery platforms should implement dedicated food hypersensitivity disclosure tools: standardised fields for hypersensitivity-relevant substances, safeguards against the non-safety-related use of icons, and the option of dedicated menus for consumers with food hypersensitivity. These are low-cost measures that platforms can adopt voluntarily (Nahle et al., 2025).

For policymakers, the evidence supports a tiered approach rather than an immediate move to comprehensive national legislation. Three sequenced measures follow. First, mandatory structured allergen fields on delivery platforms would extend disclosure to the digital environment at low cost, since a single requirement reaches every establishment listed on a platform. Second, prescribing how information must be displayed, rather than only which substances must be disclosed, would address the format heterogeneity documented here. Third, enforcement and technical support would be most efficiently directed at independent establishments, which lack the internal standardisation that leads chains to disclose regardless of regulatory context. A unified national framework remains a reasonable longer-term objective, but this sequence would deliver measurable gains earlier and at lower regulatory cost (Dominguez et al., 2024; Vicentini et al., 2026b).

Three priorities for future research follow. First, the effect of staff training on communication quality, which this study could not assess. Second, the accuracy of the information disclosed, since our measures capture presence and format but not correspondence with actual recipes or cross-contact controls. Third, evaluation of whether prescribing display format produces greater gains than extending the list of substances covered, which our data suggest but cannot establish, since only one jurisdiction prescribes format.

4.6. Limitations

Several limitations should be considered when interpreting these findings. Although data were collected across 18 cities in all five Brazilian regions, the country's territorial and socioeconomic diversity means that the findings may not fully represent contexts beyond those sampled — particularly smaller cities and rural areas, which were not included. Sampling followed concentric buffers of 1 to 5 km around each city's principal gastronomic hub and therefore characterises central commercial districts rather than cities as a whole. Establishments in peripheral or lower-income neighbourhoods, where establishment profile, price positioning and clientele differ, are not represented, and any regulatory effect estimated here applies to the segment most exposed to enforcement. With 18 cities, seven of them regulated and only three with broad-scope laws, the study also has limited statistical power to estimate city-level effects. The confidence interval for broad-scope legislation ranged from 0.26 to 25.85. The interaction between regulatory status and establishment type rests on four subgroups, the smallest of which comprised 37 menus. The direction of the interaction was stable across sensitivity analyses, but the magnitude of the regulatory effect among independent establishments varied between approximately fourfold and eightfold depending on whether the smallest regulated city was included, and should be interpreted accordingly. Finally, the regulated cities in the sample are concentrated among the less affluent, so regulatory status and municipal GDP per capita are partially confounded, and the two cannot be fully disentangled at this sample size.

This study measures the presence and format of hypersensitivity information, not its accuracy. Menu content was not verified against

recipes or supply records, and cross-contamination controls in production were not assessed. A menu classified here as providing explicit information may therefore be incomplete or inaccurate, and these estimates should be read as an upper bound on the quality of communication reaching consumers. Staff training and verbal communication at the point of service likewise fall outside the evidence collected.

Online menu analysis was restricted to iFood platform, the most widely used delivery platform in Brazil. Practices on other platforms or independent delivery services may differ. Because the automated extraction relied on the textual content of each page, any warning or allergen statement presented solely as part of an image — for example, text embedded in a banner or photograph — would not have been captured, as optical character recognition was not performed. Such image-only statements are, in any case, inaccessible to assistive technologies such as screen readers, and therefore of limited value for reliable food hypersensitivity communication. In the focus group, the diversity of food hypersensitivity profiles, age groups, and sex distribution was deliberately ensured; however, perspectives from individuals with lower health literacy or limited digital access remain underexplored.

5. Conclusion

This study provides the first large-scale characterisation of food hypersensitivity communication in Brazilian foodservice menus across regulated and unregulated contexts. Local legislation was associated with more structured communication practices in physical menus, and this association was concentrated among independent establishments. Chains and franchises provided explicit information at similar levels irrespective of regulatory context, which indicates that legislation matters most where corporate standardisation does not already apply. This has direct implications for enforcement priorities, since the establishments most responsive to regulation are also those least likely to be reached by centralised compliance systems. No such effect was observed in online menus, where ingredient-only information dominated regardless of regulatory context, a gap of particular concern given the growing reliance on delivery platforms and the absence of real-time verbal communication in that setting.

Consumer perspectives reinforced and extended these findings. Incomplete ingredient descriptions, hidden allergens in composite preparations and inconsistent staff guidance were consistently identified as barriers to safe decision-making. Participants also described restricting or avoiding social occasions when meal safety could not be verified, which indicates that these communication gaps carry consequences beyond the individual purchase decision. Written information is insufficient and verbal communication is unreliable, a combination that places the burden of risk management disproportionately on the consumer.

Addressing these gaps requires coordinated and sequenced action. Foodservice establishments should adopt more complete and structured communication formats as a baseline standard, supported by staff training. Delivery platforms should implement dedicated food hypersensitivity disclosure tools. Policymakers should prioritise mandatory structured allergen fields on delivery platforms and format prescription within existing laws, with a unified national framework as a longer-term objective. These measures address the availability and format of information, which is what this study assessed; ensuring that the information disclosed is also accurate remains an equally necessary and largely unexamined requirement. Without these structural changes, improvements in food hypersensitivity communication will remain fragmented, context-dependent and insufficient to protect individuals with food hypersensitivity.

CRediT authorship contribution statement

Mariana Scudeller Vicentini: Conceptualization, Investigation, Methodology, Writing – original draft, Formal analysis. **Carolina Neves Freiria:** Writing – review & editing, Methodology, Investigation. **Mirela Nielsen Estigarribia:** Writing – review & editing, Investigation. **Giovana**

Boni Cardoso: Writing – review & editing, Investigation. **Fabiana Mag-nabosco Vargas:** Writing – review & editing, Investigation. **Elke Stedefeldt:** Writing – review & editing, Methodology, Investigation, Funding acquisition. **Laís Mariano Zanin:** Writing – review & editing, Methodology, Investigation, Funding acquisition. **Caroline Opolski Medeiros:** Writing – review & editing, Methodology, Investigation, Funding acquisition. **Verônica Cortez Ginani:** Writing – review & editing, Investigation, Investigation. **Priscilla Moura Rolim:** Writing – review & editing, Investigation, Methodology, Funding acquisition. **Tatiana Evangelista da Silva Rocha:** Writing – review & editing, Investigation, Methodology, Funding acquisition. **Iain Malcolm Ferris:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Conceptualization. **Jan Mei Soon-Sinclair:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Conceptualization. **Lisa Marie Winnall:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Conceptualization. **Diogo Thimoteo da Cunha:** Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization, Writing – review & editing.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, we used Claude Opus 5 (Anthropic) to improve the text readability.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodcont.2026.112628>.

Data availability

Data will be made available on request.

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