

Systematic Identification of Sensory Heritage in Living Cultural Practices: A Participatory Framework for Climate-Endangered Smells and Flavours

L.P. Queiroz

luanagu@stud.ntnu.no

Norwegian University of Science and Technology

B.C.L. Rodrigues

Norwegian University of Science and Technology

R.I. Ribeiro

Universidade Paulista

A.M. Ribeiro

Faculty of Engineering, University of Porto

I.B.R. Nogueira

Norwegian University of Science and Technology

Perspective

Keywords: Sensory heritage, Intangible Cultural Heritage, Digital text mining, Participatory research

Posted Date: October 8th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11113257/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Systematic Identification of Sensory Heritage in Living Cultural Practices: A Participatory Framework for Climate-Endangered Smells and Flavours

L.P. Queiroz ^{†1,4*}, B.C.L. Rodrigues ^{†4}, R.I. Ribeiro²,
A.M. Ribeiro¹, I.B.R. Nogueira^{3,4}

¹LSRE-LCM, ALiCE, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, Porto, 4200-465, Portugal.

²Universidade Paulista, Rua Vergueiro, 1211 – Paraíso, São Paulo, 01533-000, Brazil.

³Heritage Science Laboratory Ljubljana, Faculty of Chemistry and Chemical Technology, University of Ljubljana, Večna pot 113, Ljubljana, 1000, Slovenia.

⁴Chemical Engineering Department, Norwegian University of Science and Technology, Sem Sælandsvei 4, Kjemiblokk 5, Trondheim, 793101, Norway.

Abstract

A silent and rapid erosion of global sensory heritage is currently occurring, driven by industrialization, social erosion, and the intensifying pressures of climate change. This study introduces a novel, universally applicable interdisciplinary framework structured as a modular four-stage pathway designed to identify and prioritize climate-endangered sensory expressions within any living cultural practice. Developed as a generic and language-agnostic methodology adaptable to diverse geographic and linguistic contexts, the pipeline integrates automated digital mining, contextual literature audits, and ethical participatory inquiry to transition from broad digital footprints to community-validated meanings. Validated through its application to Brazilian traditions, specifically the Festa de Iemanjá and the Lavagem do Bonfim, the framework introduces a key innovation: an objective sensory density metric that separates true cultural centrality from general digital popularity. Furthermore, by adapting sensory panel logic into ethnographic protocols, the research establishes an innovative human-to-digital

bridge that achieves analytical rigor while centering practitioners as the primary locus of interpretive authority. Ultimately, this methodology provides a scalable, cross-cultural blueprint for safeguarding intangible heritage, ensuring that the sensory anchors of identity can be preserved across any country or culture.

Keywords: Sensory heritage, Intangible Cultural Heritage, Digital text mining, Participatory research

* corresponding author: L.P.Queiroz - luanagu@stud.ntnu.no

1 Introduction

The unique potency of olfactory and gustatory stimuli is rooted in the specific evolutionary architecture of the human brain, where the olfactory bulb maintains a direct and privileged projection to the limbic system [1, 2]. Unlike visual or auditory cues that are processed through the thalamus, scents and flavours engage the amygdala and hippocampus almost instantaneously, facilitating the phenomenon often described as the Proustian effect, which is characterized by unusually vivid and affectively charged autobiographical memories [1, 3–5].

From an evolutionary standpoint, this direct chemical sensing operated as a fundamental survival mechanism in early human societies, serving as the primary diagnostic tool for identifying environmental hazards, distinguishing toxic plants from vital nourishment, and navigating wild landscapes [2, 5]. As human societies transitioned from basic survival to complex social organization, these ancestral chemosensory pathways were gradually repurposed into sophisticated cultural practices. The shared consumption of safe foods, the communal processing of aromatic plants, and the use of natural scents in early rituals transformed basic biological responses into rich social bonds. Over time, this evolutionary trajectory positioned smells and flavours not merely as physiological triggers, but as the foundational anchors of human culture, encoding social values, spiritual meaning, and emotional narratives that organize a community’s collective identity and sense of belonging [6–8]. Consequently, when a specific aroma or traditional flavour profile vanishes, the resulting loss is not merely aesthetic or ecological, but cognitive and historical, effectively erasing a biological key to the cultural archive that sustains generational continuity [9, 10].

Despite this foundational role, sensory heritage currently exists in a critical classification limbo within international and national protection frameworks [11, 12]. While formal policy frameworks, such as the UNESCO 2003 Convention for the Safeguarding of the Intangible Cultural Heritage, protect social practices, festive events, and traditional craftsmanship, they rarely recognize volatile organic compounds, scent profiles, or flavour signatures as standalone heritage assets in their own right [13, 14]. This systemic policy ambiguity has left olfactory and gustatory expressions comparatively understudied and technically undocumented within mainstream heritage science, creating a major vulnerability where the outer mechanics of a tradition are protected while its sensory essence is allowed to fade [14, 15].

Compounding this regulatory oversight, a silent and rapid erosion of global sensory heritage is actively occurring as traditional cultural expressions fade under the weight of interconnected global crises. As communities are fragmented by urbanization and migration, the embodied apprenticeship required to transmit sensory knowledge is disrupted, leading to a state where older participants retain a diverse sensory library that the youth can no longer access or recognize [16, 17]. Furthermore, the violent reality of armed conflicts and mass displacement destroys not only the material bases of traditions but also the stable environments where scents and flavours serve as instruments for preserving national and cultural identity [18].

Climate change acts as a critical threat multiplier in this process of cultural disappearance, fundamentally altering the ecological and agricultural conditions upon which sensory traditions depend [19–21]. Rising temperatures and shifting precipitation patterns mutate the chemical foundations of culture by altering the production of volatile organic compounds (VOCs) in aromatic plants and skewing the traditional terroir of heritage foods [22, 23]. The critical endangerment of aromatic species, such as the frankincense-producing *Boswellia ogadensis* or the genetic erosion of aromatic flora in regions like Alentejo, demonstrates that the botanical palette of human ritual is physically shrinking [24–26]. When combined with air pollution that weakens floral scents and reduces the richness of natural fragrances, this results in a systemic degradation of the sensory cues that once defined everyday life and sacred ritual [23, 27].

Over the last decade, research on olfactory and gustatory heritage has accelerated across the disciplines of chemistry, museology, anthropology, and heritage science. Early studies established systematic approaches to documenting heritage smells by combining instrumental VOC analysis with archival and interpretive strategies [15, 28, 29]. A particularly influential contribution is the framework developed by [Bembibre and Strlič 2017](#), which formalized the identification, analysis, and archiving of historic odors within heritage institutions. This methodology integrates analytical chemistry, sensory evaluation, and heritage interpretation to document smells associated with objects, buildings, and collections, positioning smell within conservation as both scientific evidence and lived experience. Subsequent research has indicated a growing global interest in the field, with projects such as ODEUROPA harnessing natural language processing and computer vision to build resources like the Smell Explorer and the European Olfactory Knowledge Graph [30, 31]. Similarly, ODOTHEKA advanced an archival model for heritage odors combining chemical profiling with sensory evaluation to address authenticity and display safety [32], while the Osmothèque preserves formulas and historical reconstitutions to support cultural transmission [33].

However, a critical look at these initiatives reveals a major imbalance: most existing literature is backward-looking and heavily focused on physical objects. Current methods are primarily designed to document and conserve stable heritage assets inside controlled museum settings, such as analyzing the odors of mummified remains, old artworks, or historic architecture [34–37]. By contrast, the living sensory experiences that communities continuously create and share in open environments remain largely understudied. This gap is especially severe regarding the flavour layer of intangible

cultural traditions. While traditional recipes are frequently written down and protected, the actual flavour profiles and sensory experiences that define them are rarely documented, leaving them highly vulnerable to fading away over time [11, 12, 38].

This problem is made worse by current heritage policies, which usually safeguard the outer mechanics or physical steps of a ritual but fail to protect the specific sensory experiences that give it authenticity. Without explicit protection, the unique tastes and smells of entire regions are left vulnerable to industrial standardization and environmental loss [13, 14]. Sensory anthropology helps fill this gap by showing how olfactory and gustatory perception are dynamically shaped by social factors, religious traditions, and history Ramšak 2024. By shifting focus from passive observation to active participant sensing, researchers can use field tools like smell mapping and narrative elicitation. This approach makes it possible to document the real-time, shared character of community smellscape and urban place-making, capturing the fragile core of a tradition while it is still actively practiced [40, 41].

Building on these interdisciplinary advances, the proposed methodological framework expands existing heritage approaches by shifting the analytical lens toward living, community-anchored cultural expressions in open environments [42]. This approach seeks to identify and prioritize sensory practices that are culturally significant yet vulnerable to the mounting pressures of environmental and social change. To achieve this, the study develops a structured, heritage-oriented pathway that seamlessly integrates systematic evidence mapping and contextual literature reviews with deep ethnographic and participatory inquiry.

This operational workflow is built upon four continuous, connected stages. The process initiates with multi-source identification, drawing on field observations, community archives, and digital media to capture distinctive regional practices. Next, a contextualized literature audit situates these practices within scientific and cultural frameworks to assess their documented history and recognized functions. The third stage utilizes ethical participatory interviews to bring lived experiences and everyday vocabulary to the forefront, ensuring local communities remain central to defining sensory importance. Finally, the pipeline concludes with an interpretive synthesis and prioritization matrix that transforms this mixed data into a reasoned selection of case studies. Rather than serving as a closed or static archive, this framework establishes a functional baseline methodology designed to support, guide, and inform future safeguarding actions and active cultural preservation applications across diverse settings [43].

2 Methodology

The present study adopts a robust interdisciplinary research design that synthesizes frameworks from heritage science, analytical chemistry, ethnography, and environmental engineering to systematically identify and prioritize sensory expressions at risk of disappearing. This methodological approach is structured as a continuous process pipeline, illustrated in Figure 1, which transitions from broad exploratory evidence gathering toward refined community-validated safeguarding proposals. The investigation begins with a digital mining phase, where automated searches are executed across

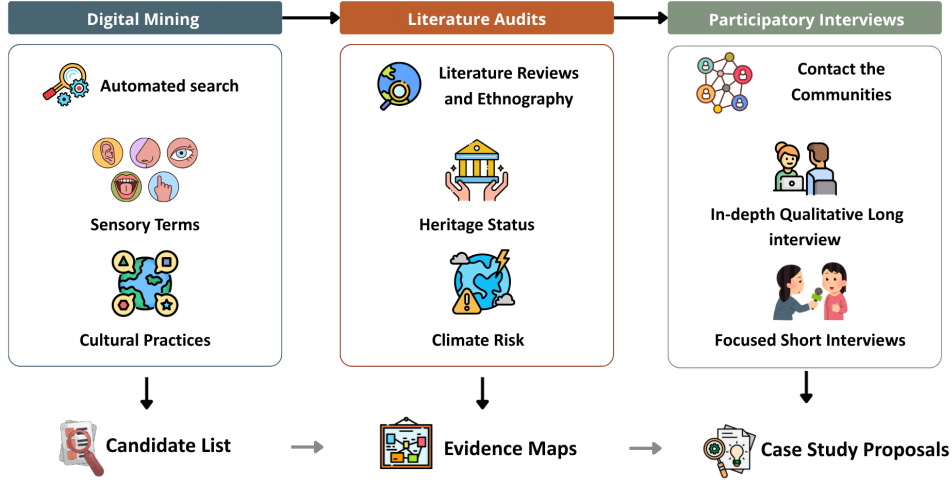


Fig. 1: Integrated interdisciplinary workflow for identifying and validating at-risk sensory heritage.

diverse public sources to identify how specific sensory terms co-occur with living cultural practices. By interrogating these digital traces through evidence-mapping logic, the research captures the initial public visibility and relative prominence of scents and flavours, resulting in a structured candidate list of culturally significant practices.

Upon establishing this list, the methodology advances to the second stage, which involves literature audits, in which each candidate practice is subjected to a critical synthesis of academic, historical, and institutional documentation. This stage is essential for verifying the formal heritage status of the practice through official registries, such as those maintained by IPHAN (National Historic and Artistic Heritage Institute) or UNESCO (the United Nations Educational, Scientific and Cultural Organization), while simultaneously evaluating the material bases and ecological vulnerabilities associated with climate change. The integration of these documentary and ethnographic perspectives produces comprehensive evidence maps that situate each sensory practice within its broader socio-environmental system and identify potential mismatches between scholarly attention and lived cultural centrality.

The final stage of the pipeline transitions into ethical and participatory inquiry, focusing on deep engagement with the communities that bear and transmit these sensory traditions. This phase involves establishing transparent relationships with community representatives to conduct in-depth qualitative long interviews with selected knowledge holders, complemented by focused short interviews with active participants during living heritage events. By utilizing memory elicitation, narrative anchors, and vernacular descriptions, this stage shifts interpretive authority to the practitioners, ensuring that local meanings and values guide the characterization

of scents and flavours. The resulting synthesis of documentary, scholarly, and participatory evidence culminates in the development of case study proposals that are both culturally grounded and methodologically ready for analytical preservation and scientific capture.

To initiate the exploratory digital mining phase, the framework addresses the inherent difficulty of documenting heritage that exists outside of institutional archives and within open, unbounded environments. To surface culturally significant scents and flavours that might otherwise remain undocumented, the methodology leverages an evidence-mapping logic inspired by sensory-ethnographic guidance that emphasizes preparatory cabinet research before entering the field. This approach utilizes digital archives and search engines to trace olfactory and gustatory references within public discourse, recognizing that methodological guidelines for smell research remain fragmented rather than unified [39]. To move beyond a purely mechanical data collection process, the study acknowledges that sensory terminology is fluid and highly dependent on cultural and linguistic contexts. Consequently, a prior scoping step is necessary to define the search space and ensure that the evidence-gathering phase is methodologically comparable and transferable across regions.

During this scoping phase, informal consultations were conducted with heritage practitioners, supplemented by a general review of institutional inventories to identify regions where scents and flavours are structurally embedded in living practices. Brazil was selected as the initial application context given the clear importance of sensory practices within its documented religious festivities, food traditions, and community cultural expressions. While the current study is tailored to this specific regional and linguistic context, the underlying workflow remains modular; the analytical steps are transferable to other settings provided that locally appropriate search strings and languages are adapted. This scoping phase also preserves flexibility for project-specific constraints, allowing the subsequent evidence-gathering and prioritization steps to be applied directly within any prescribed geographical or cultural scope.

Following the choice of the initial study context, the methodology implements a systematic search design to retrieve textual references to sensory language associated with candidate events. To ensure this approach remains globally applicable, the framework uses a flexible, language-agnostic vocabulary strategy rather than a rigid regional glossary. This method constructs a target dictionary by mapping core sensory concepts into any chosen local language, expanding the keywords to account for regional grammatical variations, gender differences, and common synonyms. This generalized layout ensures high lexical coverage across diverse cultures without compromising search efficiency. For the specific application of this case study, a bilingual infrastructure combining Portuguese and English was deployed. This broad capture strategy effectively handles the mixed nature of public text, allowing for the stable detection of sensory references in both formal institutional documents and informal online environments. The specific vocabulary used for the queries in this initial application is organized by language and sensory domain in Table 1.

The search queries were executed using the SerpAPI Google Search Engine interface, which enables the high-throughput, automated retrieval of search results and accompanying metadata [44]. By extracting snippets, ranked URLs, and hit counts,

Table 1: Multilingual sensory vocabulary used for automated evidence retrieval.

Portuguese (Smell)	Portuguese (Flavour)	English (Smell)	English (Flavour)
cheiro	sabor	smell	flavour
odor	gosto	odour	flavour
aroma	paladar	fragrance	flavour
aromática	tempero	scent	seasoning
aromático	culinário	olfactory	spice
fragrância	gustativo	odorant	gustation
perfume			
olfativo			
olfativa			
odorífera			
odorífero			

the project establishes a quantitative baseline for sensory prominence while ensuring the process remains stable and easily auditable. To translate this raw digital data into a prioritized list of heritage candidates, the methodology employs a tri-metric analytical framework. First, the total number of hits provides an estimate of an event’s overall prominence in the digital sphere, serving as an indicator of public visibility and active cultural transmission. Second, a density measure is computed to quantify the relative weight of sensory language within the discourse of each event. By calculating the ratio of sensory-specific hits to total event hits, this normalization step controls for popularity bias, ensuring that globally famous events do not appear sensorially relevant merely due to the scale of content they generate. Finally, the top-ranked URLs are classified into topic categories to enable a qualitative interpretation of the communicative spaces in which these references circulate. Using the Open Directory Project (ODP) taxonomy as a benchmark ontology for organizing web content, URLs are matched to thematic and functional criteria [45, 46].

As summarized in Table 2, this classification allows the dataset to distinguish whether sensory references emerge primarily in institutional descriptions, media coverage, commercial promotion, or community-generated discourse. This structured approach embeds quantitative metrics within a contextual web ontology, allowing the interpretation of scent and flavour references in relation to the specific communicative environments in which they are produced and consumed.

With the digital landscape mapped and the initial candidate list established, the methodology transitions directly into its second analytical layer: a comprehensive and contextualized literature review. This stage moves beyond surface-level online mentions by placing each identified sensory practice within deep scientific, historical, and cultural scholarship. To achieve this, the audit evaluates four core diagnostic questions: how the practice is framed in academic discourse, its level of official institutional recognition, its specific material bases, and the degree to which these foundations are threatened by environmental or structural pressures.

To ensure that this phase accounts for the documented under-indexing of humanities and regionally grounded research in traditional bibliometric platforms [47, 48], a diversified search strategy was implemented. Searches were conducted across an array of global and regional databases, including Scopus [49], Web of Science [50], OpenAlex

Table 2: Thematic categories used for the functional classification of web-based heritage sources.

Category	Description	Category	Description
Arts	Movies, Music, Arts	Business	Jobs, Real Estate
Computers	Internet, Software	Games	Video Games, RPGs
Health	Fitness, Medicine	Home	Family, Cooking
Kids and Teens	School Time, Teen Life	News	Newspapers, Weather
Recreation	Travel, Outdoors	Reference	Maps, Education
Institutional	Institutional Pages	Shopping	Clothing, Food, Gifts
Social Media	Facebook, Youtube	Society	People, Religion
Sports	Baseball, Soccer	Miscellaneous	Other Webpages

[51], and ProQuest [52], utilizing all known variations of event names to capture the full spectrum of culturally embedded knowledge. While Scopus and Web of Science provide robust scientometric data, they frequently yielded few unique results for specific regional events; consequently, the records were fully encompassed and expanded by the more inclusive outputs of OpenAlex and ProQuest, which formed the core of the final corpus for synthesis.

The resulting records are harmonized into unified datasets to ensure data integrity, a process involving the standardization of titles, abstracts, and unique identifiers. This harmonization is followed by meticulous manual verification to remove non-scholarly entries and correct metadata errors, ensuring the corpus maintains a high academic standard. Once cleaned, a focused bibliometric analysis is performed using established performance analysis and science mapping techniques [53, 54] to measure the scholarly footprint of each practice over time. This allows the research to identify temporal patterns of consolidation and distinguish between peer-reviewed articles, book chapters, and theses. To gauge intellectual impact, citation data is retrieved via Google Scholar [55], which was selected for its inclusive indexing. Due to the lack of an official API for large-scale export [56], data is gathered manually to identify the most influential works as structured indicators of a topic’s consolidation.

To look deeper into the conceptual structure of the heritage being studied, the review employs advanced text mining techniques on English-language abstracts. Word frequency analysis is conducted using the WordCloud library in Python [57] to generate visual representations of term importance. Simultaneously, relational structure between concepts is identified through term co-occurrence networks constructed using CountVectorizer from scikit-learn [58] and implemented with NetworkX [59] as undirected weighted graphs. To group these concepts automatically and avoid subjective manual classification, the framework measures the connection strength between word pairs using Jaccard similarity. The Jaccard coefficient calculates a normalized association score between any two terms based on their joint and individual appearances across the literature corpus. This statistical relationship is defined as:

$$J_{ij} = \frac{c_{ij}}{df_i + df_j - c_{ij}} \quad (1)$$

where J_{ij} represents the similarity score between term i and term j , c_{ij} is the co-occurrence count indicating the number of abstracts where both terms appear together, and df_i and df_j represent the individual document frequencies, which count the total number of abstracts containing term i or term j respectively. By dividing the shared appearances by the total unique documents containing either term, this index provides an unbiased mapping of the dominant thematic concentrations within the academic literature.

In addition to academic framing, the review evaluates institutional legitimacy by analyzing official heritage frameworks, including IPHAN registries, municipal inventories, and UNESCO Intangible Cultural Heritage documentation. This mapping is critical for identifying potential mismatches between scholarly attention and lived cultural centrality. The third analytical dimension specifically examines whether sensory elements are grounded in identifiable material bases, such as specific botanical species or ecological resources. Finally, the review assesses whether these physical substrates are subject to documented environmental or structural pressures, linking ecological fragility directly to cultural continuity. By serving as a structured scoping instrument, this integrated review identifies critical gaps in knowledge and safeguarding, ensuring that the subsequent participatory research functions as a targeted inquiry into the most underexamined areas of sensory heritage.

Building upon the foundations established through digital evidence mapping and contextual literature audits, the methodology advances into a Participatory Research (PR) framework designed to center the community perspective in the safeguarding process [60]. This stage is essential because individuals and their cultures exist in a dual relationship where individuals shape their community and its cultural surroundings while the culture simultaneously defines the individual. Consequently, it is impossible to fully grasp the importance of a cultural expression, whether it is the soul of a historical building or the essence of a sensory tradition, without the perspective of the people who live it [60, 61]. For this reason, this research connects with many different subgroups within these communities to view the heritage from diverse angles and comprehensively understand its significance [61]. This collaborative approach ensures that the inquiry is not extractive but is instead based on transparency and mutual benefit, allowing community members to validate, reframe, or contest the candidate sensory elements identified earlier in the study.

The core of this inquiry involves long, in-depth conversations with carefully selected knowledge holders, including ritual masters, traditional artisans, and community leaders [60]. These participants represent a broad spectrum of experience: some have been involved for generations through family lineages, while others were recently welcomed into the practice; some hold high leadership positions, while others are hands-on practitioners dedicated to keeping the culture alive day-to-day. To ensure these accounts are comprehensive and possess the analytical rigor required for scientific capture, the interview design is inspired by the principles of sensory evaluation science, specifically the standards of consistency and representativeness [62–64]. The methodology utilizes a logic of descriptor association where participants act as a bridge between human experience and digital documentation. This approach allows researchers to look deeper into the meaning behind different cultural groups by encouraging panelists to connect

their sensory impressions with various adjectives. These associations range from literal flavour targets to personal, memory-based descriptions, effectively anchoring subjective signals within a specific cultural background [2]. By using these descriptive links, the study identifies the emotional value and importance of specific scents and flavours, ensuring the characterization is grounded in both cultural meaning and physiological response.

The interview protocol follows a structured yet flexible sequence that begins with narrative elicitation to activate sensory memories, effectively triggering the vivid emotional recall often described as the Proustian effect [1]. Participants are invited to describe their personal history with the tradition and reconstruct specific events step-by-step, allowing sensory elements to emerge naturally before the researcher introduces predefined categories. Crucially, this approach goes beyond standard social and cultural analysis by adapting the core logic of scientific sensory panels into open, qualitative questions. The protocol is specifically designed to capture key sensory dimensions, such as hedonic preferences, aromatic tones, and intensity levels, that are typically measured in a laboratory setting. However, instead of forcing participants to use rigid adjective pairs or clinical polarity profiles, the framework translates these technical metrics into open-ended discussions where participants correlate sensory traits directly with their own memories and feelings.

Through this adapted framework, the inquiry aims to identify characteristic aromas and flavours while probing the differences between authentic traditional elements and more recent industrial additions. This process helps the team understand how different people see the evolution of their culture and what paths they believe are necessary to safeguard it. Participants are encouraged to use their own everyday language and are free to add any information they find relevant, such as historical facts, poems, citations from music, or personal stories. Preserving these local ways of describing experience is a vital part of safeguarding intangible heritage, as it captures deep cultural meanings that standardized scientific terms might easily miss.

Following these sessions, findings are discussed iteratively with key stakeholders to co-design the final fieldwork strategy. This post-interview phase includes interdisciplinary team meetings where experts from fields such as chemical engineering, data science, heritage science, neuroscience, and the arts discuss the qualitative data. The goal is to identify which parts of the interviews trigger insights for each specific field so they can be explored further. This validation culminates in short in-situ intercept interviews conducted with a broad range of participants while the sensory stimuli are actively present in the environment. These conversational dialogues get the point of view of average citizens who participate in the living culture but do not necessarily organize it, helping the researchers understand what makes the common member of the community value these experiences. During these intercepts, participants use a 10-point scale to rate the intensity and overall presence of the smells and flavours they connect to the event. Crucially, the interviewees explicitly evaluate the concrete examples they experience, rating them both in terms of their broad event importance and their own personal preference. This quantitative system confirms whether the specific sensory markers identified by specialists truly resonate with the wider community.

Ethical principles guide every stage of this participatory cycle [64]. Before any dialogue begins, participants receive clear information regarding the study objectives, the secure storage of data in institutional repositories, and their right to withdraw at any time [64]. Verbal authorization and written consent are obtained as standard practice, and all transcripts are anonymized to protect the identity of the contributors, which is a prerequisite for authentic engagement in sensitive heritage contexts. By triangulating documentary evidence with deep ethnographic inquiry and sensory logic, this methodology provides a comprehensive qualitative foundation, ensuring that sensory practices are culturally grounded, community-validated, and prioritized for safeguarding against environmental change.

3 Methodological Application: Mapping the Sensory Footprint of Brazilian Cultural Expressions

The implementation of the diagnostic pipeline begins by testing the framework within a specific geographic context. While this methodology is inherently flexible and can be seamlessly adapted to any country or cultural landscape by altering the linguistic inputs, Brazil was selected as the initial application setting. This territory serves as an ideal validation case due to the distinct and central role that sensory elements play within its documented religious celebrations, traditional foodways, and community rituals. By focusing on this specific context, the research can rigorously evaluate the "sensory density" metric to distinguish between events that are merely famous and those where smells and flavours serve as structural anchors of identity. To establish a baseline of public visibility and sensory centrality, the methodology analyzed three complementary indicators: total hit counts, the density of sensory-related vocabulary, and the distribution of document types across top-ranked digital sources. Table 3 summarizes the quantitative findings for five major cultural events, providing the evidentiary basis for the subsequent stages of the framework.

Table 3: Aggregated metrics for public visibility and sensory density across selected Brazilian events.

Cultural Event	Total Hit Count	Sensory Density (%)
Lavagem do Bonfim	1,610,000	13.1
Festa de Iemanjá	1,090,000	29.2
Círio de Nazaré	5,630,000	8.06
Marujadas de São Benedito	1,120,000	12.0
Yaokwa	29,200	7.00

The resulting data reveals a fundamental distinction between general digital notability and the specific centrality of scents and flavours within cultural discourse. Although the Círio de Nazaré exhibits the highest overall web visibility with over five million indexed hits, its sensory density is significantly lower than that of urban Afro-Brazilian celebrations. In sharp contrast, the Festa de Iemanjá demonstrates the most substantial sensory embedding with a density score of 29.2%, despite having a smaller

total digital footprint. This discrepancy reinforces the critical importance of the normalization step established in the methodology, as it confirms that popularity alone does not imply sensory relevance. By distinguishing general prominence from relative sensory centrality, the density metric functions as a precise diagnostic tool to identify where olfactory and gustatory elements are truly essential to the heritage expression.

To examine the specific triggers of this sensory recognition, the research employed a term-level breakdown of the density metric, as illustrated in Figure 2.

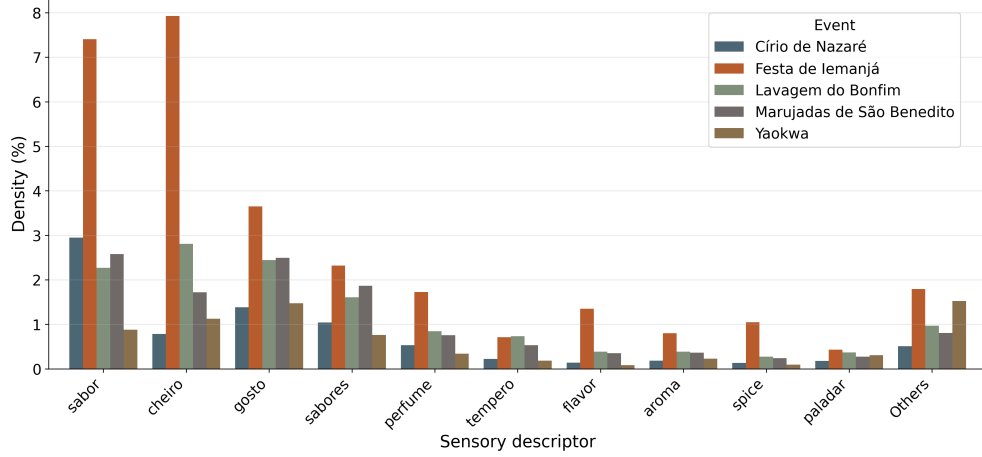


Fig. 2: Terms-level distribution showing the prominence of specific olfactory and gustatory descriptors.

The analysis indicates that Portuguese terms such as *cheiro* (smell), *sabor* (taste), and *perfume* (perfume) are the primary drivers of the high density observed in the Festa de Iemanjá and the Lavagem do Bonfim. These results suggest that sensory language is structurally integrated into the public representations of these festivities, indicating a high degree of cultural recognition for their specific aromas and flavours. In contrast, events such as the Yaokwa ritual present lower non-negligible references, which may be attributed to the different communicative environments in which these events circulate. Figure 3 presents the distribution of document types, clarifying the digital context of this sensory discourse.

Across the investigated events, digital discourse is consistently dominated by social media and reference pages, suggesting that the observed variations in sensory density are not a result of platform bias but reflect genuine differences in cultural perception. A relevant distinction is observed in the profile of the Yaokwa ritual, which shows a stronger concentration in institutional and reference sources and a smaller social media presence compared to urban festivities. This formal profile reflects its indigenous context and circulation through ethnographic narratives rather than participatory digital public discourse. Conversely, the dominance of social media in the Festa de Iemanjá and Lavagem do Bonfim could suggest that these celebrations remain deeply embedded in lived and publicly shared sensory experiences. By combining these indicators, the

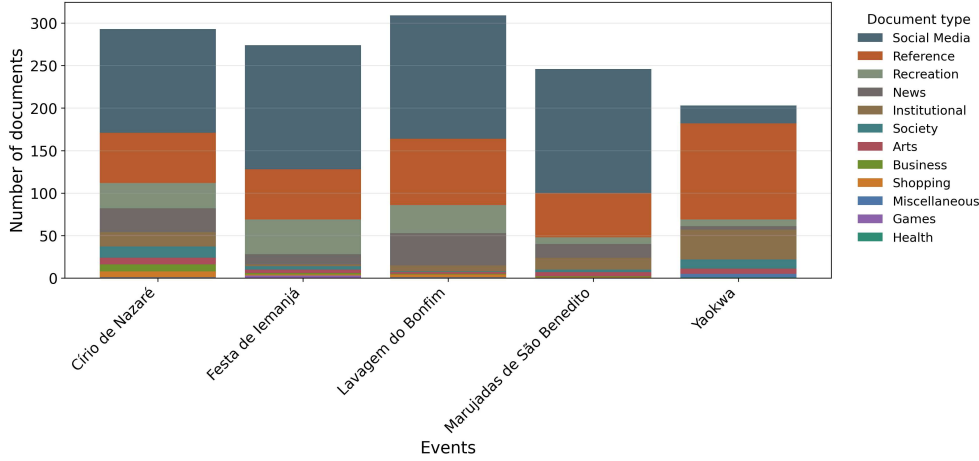


Fig. 3: Thematic distribution of document types among the top-ranked digital sources.

pipeline identifies the Lavagem do Bonfim and the Festa de Iemanjá as the strongest initial candidates for analytical preservation. It is important to note that while this baseline mapping suggests these events are excellent choices, this selection functions as a working hypothesis. The subsequent qualitative interviews and field steps serve to validate or adjust this focus, allowing the framework to loop back and re-evaluate candidates dynamically if field data reveal different sensory realities. While this initial online mapping builds a clear sensory footprint, a deeper look into how these practices are documented in formal scientific records helps pinpoint real safeguarding gaps.

The quantitative digital mapping of public discourse establishes a clear "sensory footprint" for the selected Brazilian traditions, yet a deeper inquiry into how these practices are documented within the formal scientific record is necessary to identify existing safeguarding gaps. This analytical layer shifts from the broad digital visibility of the web toward a structured scientometric evaluation of scholarly visibility and thematic framing. To achieve this, a comprehensive literature corpus was consolidated from Scopus, Web of Science, OpenAlex, and ProQuest, specifically targeting the Festa de Iemanjá and the Lavagem do Bonfim as primary case studies. While established scientometric sources like Scopus and Web of Science provided a high-level overview, they yielded significantly fewer unique results for these regionally grounded events compared to the more inclusive indexing of OpenAlex and ProQuest, which ultimately formed the core of the synthesized corpus. The specific retrieval parameters and results of this academic search are detailed in Table 4.

A closer look at these search metrics reveals an important academic reality: traditional, mainstream indexes like Scopus and Web of Science returned almost zero unique results for these prominent regional celebrations. This severe under-indexing implies that traditional global bibliometric platforms suffer from a significant geographic and structural bias when tracking intangible or regionally grounded traditions. Conversely, open-access catalogs like OpenAlex and full-text repositories like ProQuest yielded the vast majority of relevant literature. This dynamic demonstrates that relying solely

on conventional elite databases would completely obscure the academic footprint of regional living heritage, making inclusive indexing platforms absolutely essential for comprehensive preservation work.

Table 4: Retrieval results for scholarly records associated with the Brazilian case studies across academic databases.

Database	Scope	Case study	Hits	Query ID
OpenAlex	Title/ Abstract	Festa de Iemanjá	39	Q _{Iem}
OpenAlex	Title / Abstract	Lavagem do Bonfim	31	Q _{Bon}
Scopus	Title/Abs/Keys	Festa de Iemanjá	1	Q _{Iem}
Scopus	Title/Abs/Keys	Lavagem do Bonfim	2	Q _{Bon}
WoS	Title/Abs/Index	Festa de Iemanjá	0	Q _{Iem}
WoS	Title/Abs/Index	Lavagem do Bonfim	1	Q _{Bon}
ProQuest	General (FT)	Festa de Iemanjá	15	Q _{Iem}
ProQuest	General (FT)	Lavagem do Bonfim	21	Q _{Bon}

Query definitions. Q_{Iem}: "festa de iemanjá" OR "festa de iemanja" OR "festa de yemoja" OR "festa de yemojá" OR "festa de yemanja" OR "festa de yemanjá".

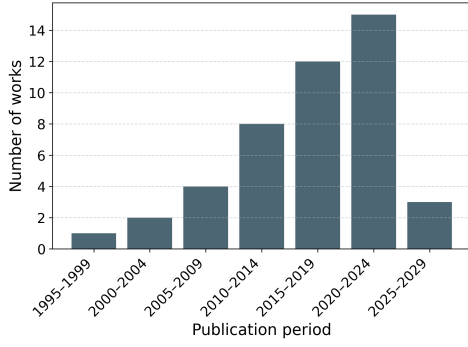
Q_{Bon}: "lavagem do bonfim" OR "festa do bonfim" OR "festa do senhor do bonfim" OR "lavagem do senhor do bonfim".

FT = searches full text when available.

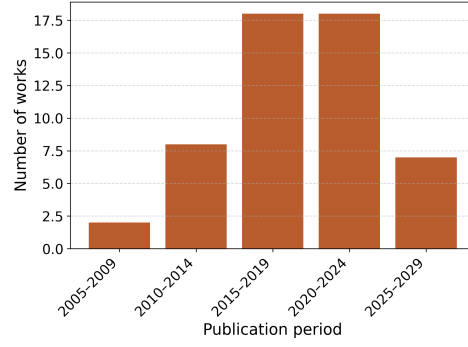
The chronological breakdown of these academic works, shown in Figure 4, points to a clear and recent growth in research for both traditions. For the Lavagem do Bonfim, scholarly interest rose gradually after 2005 and accelerated rapidly after 2010, peaking between 2020 and 2024. The Festa de Iemanjá shows an even steeper growth curve after 2010.

This sharp increase post-2010 is not accidental; it mirrors a broader, systemic shift in both global and Brazilian heritage fields. Specifically, this period aligns with the mature implementation of intangible cultural heritage frameworks following the 2003 UNESCO Convention, local milestones like IPHAN’s formal 2013 registry of the Bonfim festival, and an expanding academic interest in Afro-Brazilian history and sensory anthropology. This timeline shows that while these traditions have deep historical roots, their treatment as subjects of rigorous scientific and heritage inquiry is a contemporary trend, signaling an increasing institutional and academic effort to document living cultural practices before they are impacted by social or environmental loss.

The linguistic profile of this scholarly production reveals a notable discrepancy between volume and academic reach. Although the majority of the literature is published in Portuguese, English, and Spanish, publications exhibit substantially higher mean citation counts. This pattern, visualized in Figure 5, demonstrates that linguistic mediation functions as a powerful structuring factor in the international visibility of these practices. While the core knowledge is produced within the regional context of Brazil, its impact on global heritage discourse is disproportionately amplified when framed within globally dominant scholarly languages.

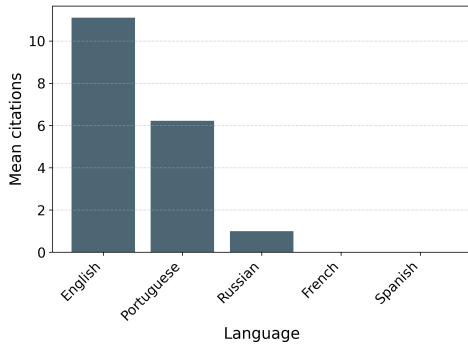


(a) Lavagem do Bonfim

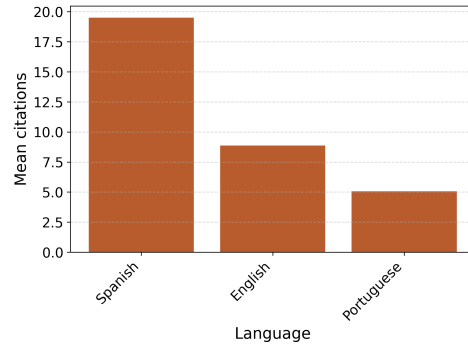


(b) Festa de Iemanjá

Fig. 4: Chronological distribution of academic publications for the selected cultural practices.



(a) Lavagem do Bonfim



(b) Festa de Iemanjá

Fig. 5: Correlation between publication language and average academic citation impact.

Beyond quantitative trends, an analysis of the most influential works identifies a prevailing thematic focus on identity, religion, and social symbolism. Scholarship on the Lavagem do Bonfim frequently situates the celebration within broader debates on Afro-Brazilian identity, the negotiation of religion in public space, and cultural hybridity. Similarly, the literature on the Festa de Iemanjá is anchored in questions of syncretism and the construction of cultural continuity through ritual performance. While some Iemanjá-focused studies engage with nature through the lens of sacred ecology, these discussions typically treat the environment as a symbolic domain rather than a material or sensory one.

The conceptual structure of this literature is further clarified by the lexical patterns found within the abstracts. As seen in the word clouds (Figures 6 and 7), academic

discourse is dominated by terms such as religious, cultural, heritage, and place, reinforcing a framing that prioritizes devotional practice and regional identity. In the Bonfim corpus, visibility is given to the civic and sociopolitical aspects of the festival, while the Iemanjá corpus shows a stronger embedding in Afro-religious identity and ritual practice.

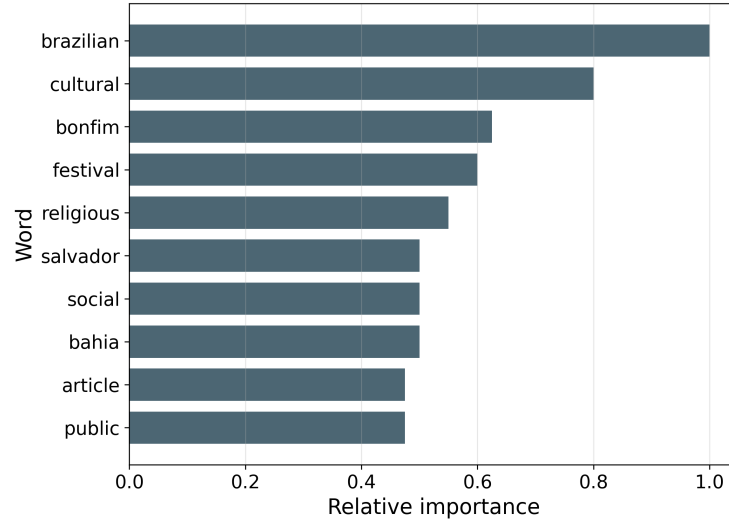


Fig. 6: Dominant thematic terms within the Lavagem do Bonfim scholarly corpus.

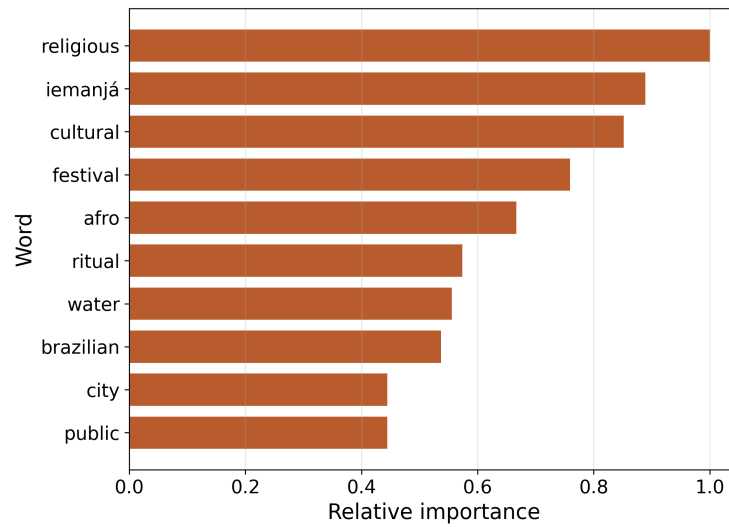


Fig. 7: Dominant thematic terms within the Festa de Iemanjá scholarly corpus.

The relational organization of these dominant concepts, previously analyzed through complex network mapping, is synthesized in Table 5. This summary highlights how scholarly perspectives are primarily anthropological and sociological, with a persistent focus on syncretism and public visibility. Crucially, explicitly sensory vocabulary remains notably absent from the core thematic structure of both corpora. While sensory dimensions are occasionally present at the periphery, they are not structurally central to the current academic framing of these celebrations.

Table 5: Primary thematic clusters and concept associations identified in the term co-occurrence networks.

Thematic Axis	Category	Core Associated Concepts
Religiosity	Ritual practice	Religious, Ritual, Rituals, Religions, Bonfim, Iemanjá, Senhor
Identity	Afro-Brazilian belonging	Afro, African, Brazilian, Identity, People, Cultural
Geography	Place and territory	Bahia, Salvador, Brazil, Rio, City, Space, Place
Public life	Social and political visibility	Public, Social, Political, Popular, Festival, Festivals
Heritage	Memory and cultural continuity	Heritage, History, Cultural, Present, Celebrations, Important
Scholarship	Academic framing	Article, Study, Research, Analysis, Field, Process

This comprehensive review confirms that while these traditions are academically visible and conceptually consolidated, their sensory and material bases, including distinct botanical formulations, traditional scent preparations, and unique flavour combinations, remain comparatively implicit and technically undocumented. The prevailing focus on symbolic and historical aspects leaves the actual sensory living practices at risk of being lost to environmental change or generational amnesia. This identified gap directly validates the objective of this study, emphasizing the urgent need for a methodology that explicitly prioritizes the identification and safeguarding of the sensory dimensions that define the authenticity of living heritage. While it is important to analyze historical documentation, it is equally vital to protect living culture and heritage in the present before it is lost.

The second analytical axis interrogated the formal protection status of the Lavagem do Bonfim and the Festa de Iemanjá to determine how administrative frameworks align with lived sensory value. Institutional recognition serves as a primary indicator of acknowledged cultural importance, yet this stage revealed significant gaps in contemporary heritage policy. The Lavagem do Bonfim has been recognized as Intangible Cultural Heritage of Brazil by IPHAN since 2013 [65].

While federal recognition places the event within a national safeguarding framework, the official documentation focuses almost exclusively on historical, religious, and social dimensions. Although the ritual washing is the central act, the specific material components, the ancestral savoir faire, and the traditional knowledge that guide the practice are not framed as heritage elements requiring explicit protection.

The Festa de Iemanjá presents a different configuration, holding formal recognition at the municipal level in Salvador, which has established localized protection guidelines to preserve its religious importance within Afro Brazilian traditions. However, like

the Lavagem do Bonfim, the festival lacks international recognition from bodies such as UNESCO, and official narratives prioritize symbolic ancestry over the material substrates of the ritual. This emphasis is not inherently negative, but it demonstrates that a cultural expression cannot be seen merely as a finished object. Instead, it must be understood within the complexity of the multiple parts that build and compose it. It is not enough to protect the event itself without protecting the knowledge transmission, the ancestral *savoir faire*, the ingredients, the tools, and the vital work of the people involved in keeping it alive.

For example, practitioners have reported that the traditional ceramic vessels used for the *água de cheiro* are now manufactured much thinner than the historically thick clay vases. Because of this, the water becomes hot along the route, which alters the evaporation rate and results in a noticeably different sensory profile during the washing of the stairs. This uneven pattern suggests a disconnect between the high social legitimacy of these events and the lack of explicit codification for their sensory dimensions. If sensory practices remain implicit in policy, their material bases remain vulnerable despite the formal recognition of the event as a whole.

Fully grasping these expressions requires acknowledging the dual relationship between the individual and the community, where practitioners shape the culture around them while the culture defines their individual identity. Consequently, it is impossible to understand a sensory tradition without the perspective of the practitioners who live it. For this reason, this research engaged various subgroups within these communities to comprehensively map cultural significance from diverse standpoints [60, 61]. Central to this human dimension are the Baianas, who serve as religiously connected custodians of Afro-Brazilian heritage in Salvador [66]. They sustain and transmit the culinary and traditional knowledge that ensures the "soul" of the celebration survives across generations [66, 67].

By engaging with these knowledge holders, the research identified the specific material bases that carry the olfactory and gustatory identity of each celebration. In the Lavagem do Bonfim, the olfactory environment is actively constructed through the preparation of *água de cheiro* (scented water), carried in clay vessels by the Baianas for the ritual washing [65, 67]. This volatile mixture is produced by macerating aromatic plants, including rue (*Ruta graveolens*), lavender (*Lavandula angustifolia*), basil (*Ocimum basilicum*), *levante* (*Hyptis brevipes*), macassá (*Tanacetum vulgare*), and *betis-cheiroso* (*Piper eucalyptifolium*) [65]. Beyond these botanical preparations, commercial lavender perfumes (*alfazema*) function as a shared and ritually meaningful olfactory marker for both participants and observers. The gustatory dimension is further anchored by street vendors selling *acarajé*, a deep-fried bean fritter associated with Candomblé offerings, creating an atmosphere where the aroma of palm oil defines the multisensory experience of the festival [65, 68].

The Festa de Iemanjá maintains botanical continuity using *alfazema* and aromatic herbs, utilized as offerings delivered to the sea. Species such as *quiroiô* (*Ocimum gratissimum*), *beti-cheiroso*, and particularly white roses are symbolically linked to the deity and arranged in scented baskets [69]. These offerings often include cosmetic "vanity" items like soaps and perfumes, adding additional olfactory layers to the ritual space

[69, 70]. To assess the conservation status of this heritage, the scientific names of identified plant species were cross-referenced with the IUCN Red List and the Angiosperm Risk Prediction Model [71, 72]. As detailed in Table 6, most plants appear to be at low immediate risk, yet several remain unevaluated or lack confident predictions, highlighting the need for continued ecological monitoring.

Table 6: Conservation and threat levels for identified botanical species used in ritual practices.

Plant Species	IUCN Threat Level	Predicted Threat Level
<i>Ruta graveolens</i> L.	Least Concern	Not Threatened - Confident
<i>Hyptis brevipes</i> P.	Not Classified	Not Threatened - Confident
<i>Tanacetum vulgare</i> L.	Not Classified	Not Threatened - Confident
<i>Lavandula angustifolia</i> M.	Least Concern	Not Threatened - Confident
<i>Ocimum basilicum</i> L.	Not Classified	Not Threatened - Confident
<i>Piper eucalyptifolium</i> R.	Not Classified	Not Threatened - Low Confidence
<i>Rosa rubiginosa</i> L.	Least Concern	Not Threatened - Confident

The final component of this application integrates sensory panel logic into the field validation process. To bridge the "distance of meaning" between professional lexicons and community experience, participants were treated as assessors who connected sensory signals with a broad range of descriptors, including personal memory-based associations [64]. This transition from individual qualitative recall to group consensus allows for a high-precision characterization of the heritage.

The identification of these material substrates provides the necessary framework to explore the human dimension of the research pipeline, moving from the physical presence of plants, culinary flavours, and perfumes to the lived meanings assigned to them by practitioners. To comprehensively map the significance of these sensory markers, the study engaged a constellation of voices that span the entire cultural landscape of the state of Bahia, including religious leadership, heritage governance, and cultural practitioners.

Deep qualitative insights were provided by Wagner Roberto Rodrigues, a Yoruba priest and Ifá initiate whose expertise clarifies the cosmological activation of scents, alongside Antonioni Afonso, a sociocultural manager responsible for the safeguarding plans of the Festa de Iemanjá. The professional and religious continuity of these traditions was further detailed by Rita Santos of the Associação Nacional das Baianas de Acarajé (ABAM) and Lucinólia Rita, a practicing Baiana, while the institutional and inter-religious management of the Bonfim Church was represented by Leila Vaz, manager of the Irmandade do Senhor do Bonfim. Researchers Dr. Ronilda Iyakemi Ribeiro and Rodrigo Ribeiro Frias of the São Paulo University (USP) provided the interpretive bridges necessary to connect these contemporary practices to Yoruba-derived diasporic transformations.

By applying the logic of descriptor association, a core principle adapted from sensory panel science, these in-depth interviews revealed that scents such as dendê oil

and alfazema are not merely decorative but function as "sensory keys" that structure the ritual environment. For experts like Wagner, the smell of boiling dendê oil is a theological symbol of dynamism and generative force, effectively "opening the door of the sacred" to signal the beginning of ritual time. This spiritual activation through scent demonstrates how olfactory cues act as anchors for collective memory, a process often described by participants through narrative descriptors such as "strength," "activation," and "ancestrality". Antonioni similarly identifies lavender as a defining olfactory marker that mediates between individual devotion to the orixá and the collective identity of the city itself, suggesting that smell operates as a stabilizing element across generations even as other aspects of the celebrations adapt to modern pressures.

This embodied transmission of knowledge is inseparable from the labor and ritual responsibility of the practitioners. For Rita Santos and Lucinólia Rita, the preparation of acarajé is a form of communal pedagogy where sensory knowledge is transmitted through doing rather than textual instruction. In this context, flavour becomes a ritual language, specifically the rich, pungent profile of dendê, which carries cosmological meanings preserved through the ancestral leadership and historic role of women within the community. However, the interviews also highlighted significant threats to this sensory continuity, ranging from the environmental degradation of coastal ecosystems discussed by Antonioni to the socio-economic pressures of commercialization and the rising cost of traditional ingredients like artisanal palm oil. Safeguarding these sensory expressions, therefore, requires an interdisciplinary approach that links heritage science with environmental policy and local safeguarding frameworks.

To validate these specialist narratives against the broader community's perception, the research incorporated short in-situ intercept interviews during the celebrations, capturing the immediate experiential perspective of 52 participants at the Lavagem do Bonfim and 20 at the Festa de Iemanjá. Following the integrated sensory panel logic, these dialogues utilized a 10-point scale to quantify the intensity and hedonicity of the sensory environment. During the Lavagem do Bonfim, respondents rated olfactory intensity at an average of 8.7 and hedonicity at 9.22, describing the mixture of perfumed waters and street-food aromas as a decisive factor in their feeling of "participating" in the living culture. While flavour intensity and hedonicity were also rated highly (9.2 and 9.69, respectively), respondents were more readily able to verbalize olfactory memories, suggesting that scent serves as the primary atmospheric marker of the event. The most frequent descriptors for these experiences are summarized in Table 7.

A similar pattern emerged during the Festa de Iemanjá, where alfazema water was identified by nearly all participants as the scent of purification and spiritual presence. The average olfactory intensity was rated at 8.43, with a maximal hedonicity score of 10, indicating that the community perceives the olfactory environment as essential to the ritual meaning of the coastal landscape. Flavour was again secondary in the symbolic hierarchy, with participants rating intensity at 9.31 and hedonicity at 9.77, though descriptors were more diverse and often linked to social conviviality rather than the central liturgical act, as shown in Table 8.

Ultimately, these combined narratives and community ratings confirm that scents and flavours are the foundational structures of ritual space and cultural identity.

Table 7: Frequency of sensory descriptors reported by community participants during the Lavagem do Bonfim.

Smell Descriptor	Frequency	Flavour Descriptor	Count
Lavender (Alfazema)	32	Acarajé	10
Água de cheiro	4	Dendê	9
Rue (Arruda)	3	Cerveja	7
Lavender, roses, and flowers	3	Feijão/Feijoadá	7
Herbs	2	Água	6
Coconut (rotting)	2	Carne no churrasco	2
Mixture of lavender/água de cheiro	1	Abará	2
Other	4	Dendê/Acarajé	2
		Other	6

Table 8: Frequency of sensory descriptors reported by community participants during the Festa de Iemanjá.

Smell Descriptor	Frequency	Flavour Descriptor	Count
Lavender (alfazema)	15	Acarajé	2
Seabreeze and lavender	3	Bahian food	2
Seabreeze	1	Peixe	2
Lavender, roses and flowers	1	Cerveja	2
		Sea/salinity	2
		Other	2

By grounding the methodological framework in both the metaphysical activation described by specialists and the high hedonic importance reported by the average citizen, the study demonstrates that the sensory experience of these celebrations is intrinsically tied to specific markers. These in situ interviews show that the formal scientific point of view and the deep affective importance felt by the community do not always perfectly match, but the true value of this methodology lies in finding the critical balance between the two.

4 Discussion

The implementation of this integrated diagnostic pipeline provides an empirical basis for evaluating the scientific and cultural significance of sensory heritage within the current landscape of environmental and social change. By combining digital mining, literature audits, and participatory inquiry, the methodology transitions from observing broad digital footprints to analyzing the nuanced, community-validated meanings of vulnerable traditions. Instead of treating these practices as static history, the framework demonstrates how sensory cues function as active links to collective memory that sustain generational continuity. This multidimensional approach allows heritage research to move beyond physical objects and document the lived experiences that define intangible culture.

The findings from the regional application in Brazil demonstrate that popularity in the digital sphere does not necessarily correlate with the structural centrality of sensory experience. This is evidenced by the discrepancy between the *Círio de Nazaré*, which exhibited the highest overall digital visibility, and the *Festa de Iemanjá*, which demonstrated the most substantial sensory density at 29.2 percent. Such a discrepancy reinforces the necessity of the normalization step established in the framework, confirming that the sensory density metric serves as a useful diagnostic tool to identify where smells and flavours are truly essential to heritage expression. Furthermore, the dominance of social media in the digital discourse of urban Afro-Brazilian festivities indicates that these traditions remain active, lived experiences that circulate within contemporary community-led spaces rather than being confined to retrospective or institutional narratives.

An important methodological contribution of this framework is the creation of a human-to-digital bridge through the integration of sensory panel logic into ethnographic inquiry. By treating practitioners, such as the *Baianas* who serve as custodians of traditional knowledge, as calibrated assessors, the methodology applies a structured approach to qualitative documentation that aligns human perception with analytical mapping. The use of narrative elicitation to trigger memory recall allows for the capture of vernacular descriptors that anchor sensory signals within specific cultural backgrounds. This qualitative depth is supported by the quantitative ratings obtained during immersive fieldwork, where the ten-point scale assessments of intensity and hedonicity confirmed a high degree of community consensus regarding the importance of scents like *dendê* and *alfazema*. These sensory markers function as cultural interfaces, where the smell of boiling *dendê* oil or the scent of lavender water structures the ritual environment.

However, the scientific analysis also highlights the vulnerability of the material bases upon which these sensory traditions depend. While many identified botanical species, such as *Ruta graveolens* or *Ocimum basilicum*, currently appear to be at low immediate conservation risk, the broader threat of climate change remains a significant factor. The mutation of volatile organic compounds due to rising temperatures and shifting precipitation patterns represents an ongoing erosion of the chemical foundations of culture. This systemic degradation of sensory cues, when coupled with the sensory amnesia driven by urbanization and the increasing distance between generations, presents a risk of severing the intergenerational link required to recognize and transmit sensory knowledge.

The results of this study underscore a significant gap in current heritage policy, which frequently safeguards the mechanics of a ritual while failing to protect the specific sensory experiences that make it authentic. Even within established frameworks like IPHAN, recognition typically focuses on historical and social dimensions, leaving the material substrates of scent and flavour implicit and unprotected. By providing a structured pathway for the systematic identification and prioritization of these endangered expressions, this methodology establishes a transferable blueprint for addressing the neglect of the flavour and odor layers of intangible heritage. Ultimately, the approach ensures that these volatile anchors of human history are documented and

validated by the communities themselves, supporting biocultural continuity against the mounting pressures of a changing world.

5 Conclusions and Future Perspectives

This study establishes an interdisciplinary diagnostic pipeline that supports the identification and prioritization of sensory heritage under potential risk from environmental and social change. By socializing data science, heritage management, and sensory anthropology, the framework provides a structured pathway to document cultural expressions that exist outside traditional institutional archives. The application of this methodology within the chosen regional context demonstrates that digital mining can effectively detect the public sensory footprint of living rituals. Furthermore, the sensory density metric serves as an effective tool to filter out general global fame in favor of true cultural centrality, ensuring that safeguarding efforts are directed toward the expressions most vital to a community’s sense of belonging and generational continuity.

A primary contribution of this work is the integration of sensory evaluation principles into ethnographic inquiry, transforming qualitative narrative recall into structured data suitable for heritage analysis. This approach successfully addresses a significant gap in current heritage policy, which frequently safeguards the external mechanics of a ritual while leaving the underlying material substrates of scent and flavour implicit and unprotected. By demonstrating that specific sensory markers function as foundational structures of the ritual environment, the methodology provides a systematic way to validate the intangible dimensions of living traditions through the perspective of the practitioners themselves without relying on repetitive institutional narratives.

Looking toward future perspectives, the modular design of this workflow allows for its immediate expansion to other geographic regions and linguistic contexts. The core innovation of this approach lies in its ability to connect digital public data with deep local knowledge, providing a scalable and highly adaptable model for modern heritage preservation. The next logical phase of this research involves linking these community-validated narratives to the analytical characterization of volatile organic compounds by utilizing portable chemical sensors to record the molecular signatures of threatened sensory environments. This integration will facilitate the creation of a comprehensive sensory archive that combines chemical evidence with lived experience, opening new avenues for digital preservation and virtual reality applications in museology.

Ultimately, the long-term goal is to develop standardized guidance for the conservation of olfactory and gustatory heritage, moving global policy from the purely symbolic recognition of rituals toward the material protection of the sensory experiences that make them authentic. The conceptual innovation of this framework lies in its capacity to treat human sensory perception as a rigorous baseline for conservation science rather than an unmeasurable variable. Future work will focus on establishing open-access databases and cross-disciplinary training frameworks to empower local communities to manage and protect their own sensory archives. By documenting these transient anchors today, the framework safeguards the chemical and cognitive foundations of culture for future generations.

Acknowledgments

Climate Changes and Scent Heritage: The Urgent Need for Capturing and Preserving Olfactory Landscapes in a Changing World – SCENTINEL, co-funded by the Joint Programming Initiative on Cultural Heritage and Global Change (JPI CH). This work was financially supported by Fundação para a Ciência e a Tecnologia, I.P./MECI through national funds: UI/BD/154743/2023 (<https://doi.org/10.54499/UI/BD/154743/2023>); LSRE-LCM, UID/50020/2025 (<https://doi.org/10.54499/UID/50020/2025>); and ALiCE, LA/P/0045/2020 (<https://doi.org/10.54499/LA/P/0045/2020>).

References

- [1] Herz, R.S., Schooler, J.W.: A naturalistic study of autobiographical memories evoked by olfactory and visual cues: Testing the proustian hypothesis. *The American Journal of Psychology* **115**(1), 21–32 (2002)
- [2] Sarafoleanu, C., Mella, C., Georgescu, M., Perederco, C.: The importance of the olfactory sense in the human behavior and evolution. *Journal of Medicine and Life* **2**(2), 196–198 (2009)
- [3] Shepherd, G.M.: Perception without a thalamus: How does olfaction do it? *Neuron* **46**, 166–168 (2005)
- [4] De Beukelaer, S., Sokolov, A.A., Muri, R.M.: Case report: "proust phenomenon" after right posterior cerebral artery occlusion. *Frontiers in Neurology* **14**, 1183265 (2023)
- [5] Sarafoleanu, C., Mella, C., Georgescu, M., Perederco, C.: The importance of the olfactory sense in the human behavior and evolution. *Journal of Medicine and Life* **2**(2), 196–198 (2009)
- [6] Classen, C., Howes, D., Synnott, A.: *Aroma: The Cultural History of Smell*, 1st edn. Routledge, London and New York (1994)
- [7] Wilson, D.A.: *Learning to Smell: Olfactory Perception from Neurobiology to Behavior*. Johns Hopkins University Press, Baltimore, MD, USA (2006)
- [8] Bratman, G.N., Bembibre, C., Daily, G.C., et al.: Nature and human well-being: The olfactory pathway. *Science Advances* **10**(20) (2024)
- [9] Herz, R.S., Engen, T.: Odor memory: Review and analysis. *Psychonomic Bulletin & Review* **3**(3), 300–313 (1996)
- [10] Lee, K.-S.: Cooking up food memories: A taste of intangible cultural heritage. *Journal of Hospitality and Tourism Management* **54**, 1–9 (2023)

- [11] Gupta, A., Misra, A.: Exploring culinary intellectual property protection. *Christ ULJ* **13**(1) (2024)
- [12] Graham, B.: *Edible Identities: Food as Cultural Heritage*. Ashgate Publishing, Ltd., ??? (2014)
- [13] Council of Europe: Convention on the Value of Cultural Heritage for Society (Faro Convention). <https://www.coe.int/en/web/culture-and-heritage/faro-convention> (2005)
- [14] Almansouri, M., Verkerk, R., Fogliano, V., Luning, P.A.: The heritage food concept and its authenticity risk factors validation by culinary professionals. *International Journal of Gastronomy and Food Science* **28**, 100523 (2022)
- [15] Bembibre, C., Strlič, M.: From smelly buildings to the scented past: An overview of olfactory heritage. *Frontiers in Psychology* **12**, 718287 (2021)
- [16] Alrhoun, M., Sulaiman, N., Pieroni, A.: Shifting herbal knowledge: The ecological and cultural dynamics behind plant use changes in the southern occitan alps. *Plants* **14**(3), 367 (2024)
- [17] Alrhoun, M., Sulaiman, N., Pieroni, A.: What drives herbal traditions? the influence of ecology and cultural exchanges on wild plant teas in the balkan mountains. *Land* **13**(12), 2146 (2024)
- [18] European Commission: European framework for action on cultural heritage. Technical report, Publications Office of the European Union (2019)
- [19] Aboulnaga, M., Abouaiana, A., Puma, P., Elsharkawy, M., Farid, M., Gamal, S., Lucchi, E.: Climate change and cultural heritage: A global mapping of the unesco thematic indicators in conjunction with advanced technologies for cultural sustainability. *Sustainability* **16**(11), 4650 (2024) <https://doi.org/10.3390/su16114650>
- [20] Cassar, M.: Climate change and the historic environment. Technical report, UCL Centre for Sustainable Heritage (2009)
- [21] Sesana, E., Gagnon, A.S., Ciantelli, C., et al.: Climate change impacts on cultural heritage: A literature review. *WIREs Climate Change* **12**(4) (2021)
- [22] Abbas, F., O'Neill Rothenberg, D., Zhou, Y., Ke, Y., Wang, H.: Volatile organic compounds as mediators of plant communication and adaptation to climate change. *Physiologia Plantarum* **174**(6) (2022) <https://doi.org/10.1111/ppl.13840>
- [23] Potera, C.: Air pollution: Floral scents going off the air? *Environmental Health Perspectives* **116**(8) (2008)
- [24] Póvoa, O., Lopes, V., Barata, A.M., Farinha, N.: Monitoring genetic erosion of

- aromatic and medicinal plant species in alentejo (south portugal). *Plants* **12**(14), 2588 (2023)
- [25] Kikowska, M., Kalembe, D., Długaszewska, J., Thiem, B.: Chemical composition of essential oils from rare and endangered species—*eryngium maritimum* l. and *e. alpinum* l. *Plants* **9**(4), 417 (2020) <https://doi.org/10.3390/plants9040417>
 - [26] Johnson, S., Abdikadir, A., Satyal, P., Poudel, A., Setzer, W.N.: Conservation assessment and chemistry of *boswellia ogadensis*, a critically endangered frankincense tree. *Plants* **11**(23), 3381 (2022) <https://doi.org/10.3390/plants11233381>
 - [27] Raguso, R.A.: Wake up and smell the roses: The ecology and evolution of floral scent. *Annual Review of Ecology, Evolution, and Systematics* **39**, 549–569 (2008)
 - [28] Bembibre, C., Strlič, M.: Smell of heritage: a framework for the identification, analysis and archival of historic odours. *Heritage Science* **5**(1), 1–11 (2017) <https://doi.org/10.1186/s40494-016-0114-1>
 - [29] Paolin, E., *et al.*: Review of voc sampling and analysis methods in cultural heritage conservation. *Applied Sciences* **14**(11), 4620 (2024) <https://doi.org/10.3390/app14114620>
 - [30] Odeuropa Consortium: Odeuropa Smell Explorer. <https://explorer.odeuropa.eu/> (2023)
 - [31] Odeuropa Consortium: European Olfactory Knowledge Graph (EOKG). <https://zenodo.org/records/10709703> (2024)
 - [32] ODOTHEKA Project: ODOTHEKA: A Heritage Research Hub Project. <https://www.heritageresearch-hub.eu/project/odotheka/> (2024)
 - [33] Osmothèque: Osmothèque Perfume Archive Collection. <https://www.osmotheque.fr/en/about/> (2023)
 - [34] Paolin, E., *et al.*: Molecular traces of scent in ancient egyptian mummified bodies. *Journal of the American Chemical Society* (2025) <https://doi.org/10.1021/jacs.4c15769>
 - [35] Stephens, C.H., Biggs, K., *et al.*: Analysis of the naturally aged scented components of montien boonma’s house of hope. *Applied Sciences* **14**(11), 4663 (2024)
 - [36] Epping, J., *et al.*: On-site detection of vocs for cultural heritage applications. *Molecules* **28**(4), 1598 (2023) <https://doi.org/10.3390/molecules28041598>
 - [37] Tullett, W.: Smell, history, and heritage: The politics and practices of olfactory reconstruction. *American Historical Review* **127**(3), 1172–1200 (2022) <https://doi.org/10.1093/ahr/rhac147>

- [38] Larsen, E.E.: Familiar Flavors: Sensorial Experiences of Familiarity and Transnational Food Practices Amongst International Students (2019)
- [39] Ramšak, M.: The Anthropology of Smell. Springer, ??? (2024). <https://doi.org/10.1007/978-3-031-61759-1> . <http://dx.doi.org/10.1007/978-3-031-61759-1>
- [40] Xiao, J., *et al.*: Recent advances in smellscape research: A review. *Frontiers in Psychology* **12**, 700514 (2021) <https://doi.org/10.3389/fpsyg.2021.700514>
- [41] Davis, D.: Sensing the city: Smell and the urban imagination in istanbul. *International Journal of Heritage Studies* **23**(9), 1–17 (2017) <https://doi.org/10.1080/13527258.2017.1317646>
- [42] Rodrigues, B.C.L., Queiroz, L.P., Fleming, B., *et al.*: Tracing yoruba heritage in brazil through olfactory markers. *Heritage* **8**(11), 457 (2025)
- [43] ICCROM: Unesco guidance note on methodologies for safeguarding intangible cultural heritage. Technical report, ICCROM (2020)
- [44] SerpApi: Google Search Engine Results API. <https://serpapi.com/search-api>. Accessed April 10, 2026 (2026)
- [45] Open Directory Project: Open Directory Project (DMOZ). <http://odp.org/>. Human-curated web directory. Accessed February 13, 2026 (2017)
- [46] Kim, J.Y., Collins-Thompson, K., Bennett, P.N., Dumais, S.T.: Characterizing web content, user interests, and search behavior by reading level and topic. In: *Proceedings of the Fifth ACM International Conference on Web Search and Data Mining. WSDM’12*, pp. 213–222. ACM, ??? (2012). <https://doi.org/10.1145/2124295.2124323> . <http://dx.doi.org/10.1145/2124295.2124323>
- [47] Mongeon, P., Paul-Hus, A.: The journal coverage of web of science and scopus: a comparative analysis. *Scientometrics* **106**(1), 213–228 (2016) <https://doi.org/10.1007/s11192-015-1765-5>
- [48] Rodrigues, B.C.L., Queiroz, L.P., Fleming, B., Vieira, N.J., Ribeiro, R.I., Caldas, A.S., Leblebici, M.E., Strlič, M., Nogueira, I.B.R.: Tracing yoruba heritage in brazil through olfactory landscapes: A sensory approach to cultural heritage. *Heritage* **8**, 457 (2025) <https://doi.org/10.3390/heritage8110457>
- [49] Elsevier: Scopus. <https://www.scopus.com>. Accessed February 2026 (2026)
- [50] Clarivate: Web of Science Core Collection. <https://www.webofscience.com>. Accessed February 2026 (2026)
- [51] OpenAlex: OpenAlex: An Open Catalog of the Global Research System. <https://openalex.org/>. Accessed February 2026 (2026)

- [52] ProQuest LLC: ProQuest. <https://www.proquest.com>. Accessed February 2026 (2026)
- [53] Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., Lim, W.M.: How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research* **133**, 285–296 (2021) <https://doi.org/10.1016/j.jbusres.2021.04.070>
- [54] Vlase, I., Lähdesmäki, T.: A bibliometric analysis of cultural heritage research in the humanities: The web of science as a tool of knowledge management. *Humanities and Social Sciences Communications* **10**(1) (2023) <https://doi.org/10.1057/s41599-023-01582-5>
- [55] Martín-Martín, A., Orduna-Malea, E., Delgado López-Cózar, E.: Coverage of highly-cited documents in google scholar, web of science, and scopus: a multidisciplinary comparison. *Scientometrics* **116**(3), 2175–2188 (2018) <https://doi.org/10.1007/s11192-018-2820-9>
- [56] Chertow, M.R., Kanaoka, K.S., Park, J.: Tracking the diffusion of industrial symbiosis scholarship using bibliometrics: Comparing across web of science, scopus, and google scholar. *Journal of Industrial Ecology* **25**(4), 913–931 (2021) <https://doi.org/10.1111/jiec.13099>
- [57] Mueller, A.C.: Wordcloud. Zenodo (2026). <https://doi.org/10.5281/ZENODO.18332568> . <https://zenodo.org/doi/10.5281/zenodo.18332568>
- [58] Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., Thirion, B., Grisel, O., Blondel, M., Prettenhofer, P., Weiss, R., Dubourg, V., Vanderplas, J., Passos, A., Cournapeau, D., Brucher, M., Perrot, M., Duchesnay, E.: Scikit-learn: Machine learning in Python. *Journal of Machine Learning Research* **12**, 2825–2830 (2011)
- [59] NetworkX Developers: NetworkX: Network Analysis in Python. <https://github.com/networkx/networkx>. Accessed February 23, 2026 (2024)
- [60] Cornwall, A., Jewkes, R.: What is participatory research? *Social Science & Medicine* **41**(12), 1667–1676 (1995) [https://doi.org/10.1016/0277-9536\(95\)00127-S](https://doi.org/10.1016/0277-9536(95)00127-S)
- [61] Stovel, H., Inaba, N.: Iccrom’s living heritage sites programme: Background paper. Technical report, ICCROM (2002)
- [62] Stone, H., Sidel, J.L.: The Organization and Operation of a Sensory Evaluation Program, pp. 21–67. Elsevier, ??? (2004). <https://doi.org/10.1016/b978-012672690-9/50006-8> . <http://dx.doi.org/10.1016/B978-012672690-9/50006-8>
- [63] Lawless, H.T., Heymann, H.: Sensory Evaluation of Food: Principles and Practices. Springer, New York (2022). <https://doi.org/10.1007/978-1-4419-6488-5>

- [64] Rogers, L.: Sensory Panel Management: A Practical Handbook for Recruitment, Training and Performance. Woodhead Publishing, ??? (2017)
- [65] Instituto do Patrimônio Histórico e Artístico Nacional: Dossiê de Registro – Festa do Senhor Bom Jesus do Bonfim. IPHAN, Brasília, Brazil (2013)
- [66] Queiroz, L.d.P., Pessoa, R.W.S., Caldas, A.S., Ribeiro, R.I., Ribeiro, A.M., Strlic, M., Bembibre, C., Nogueira, I.B.R.: Bahia’s dendê and the forgotten knowledge: Cultural heritage, sustainability, and the marginalization of afro-brazilian traditions. *Heritage* **9**(1), 6 (2025) <https://doi.org/10.3390/heritage9010006>
- [67] Avancini, A.J.: The interculturality of the lavagem do bonfim of bahia festival. *V!RUS* **1**(22) (2021)
- [68] Castro Júnior, L.V.: Festa e Corpo: as Expressões Artísticas e Culturais Nas Festas Populares Baianas. EDUFBA, Salvador (2014). Prefácio de Carmem Lúcia Soares
- [69] Queiroz, M.M.A.: Folias divinas em redes: Patrimônio imaterial, gestão cultural e economia criativa na festa de iemanjá em salvador. PhD thesis, Universidade Federal da Bahia (UFBA), Salvador, Brazil (2021)
- [70] Ferreira, M.d.F.d.A., Carvalho, M.R.G.d.: A festa de iemanjá, “rainha dos mares”: Teias de interações afroindígenas na zona de contato. *Linguagem em Revista* (29) (2020)
- [71] IUCN: Guidelines for the Application of IUCN Red List of Ecosystems Version 2.0. IUCN, Gland, Switzerland (2024)
- [72] Bachman, S.P., Brown, M.J.M., Leão, T.C.C., Nic Lughadha, E., Walker, B.E.: Extinction risk predictions for the world’s flowering plants to support their conservation. *New Phytologist* **242**, 797–808 (2024)