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PROTOCOL

Total phenolic compounds in plant-based beverages consumed in Latin America: protocol for a systematic review

Compuestos fenólicos en bebidas vegetales consumidas en América Latina: protocolo para una revisión sistemática

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KEYWORDS

Polyphenols

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ABSTRACT

Introduction: Latin America is one of the regions with the highest concentration of biodiversity. Plant-based beverages hold a special place in culture, identity, and food heritage. Currently, these beverages have sparked great interest in the scientific community, the market, industry, and consumers because they are considered nutritional and potentially functional sources due to the presence of bioactive compounds such as polyphenols. Multiple studies have linked the protective effect of these compounds against adverse health events; however, no studies are known to have reviewed the polyphenol content of plant-based beverages in the region.

Objective: To provide an overview of the total phenolic content of plant-based beverages consumed in Latin American countries.

Methods: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) 2015 statement guided this protocol. Observational or experimental studies that evaluated total phenolic compounds in plant-based beverages consumed in Latin America will be included. Articles that estimate the total phenolic compounds in beverages, including juices and infusions, will be included. Electronic search strategies will be developed for the following bibliographic databases: ScienceDirect, PubMed/MEDLINE, LILACS, and Scopus. The search strategy and selection process results will be presented in a flow chart and summarized in the text. The main results will be presented in a descriptive synthesis.

Results: The main results will be presented in a descriptive synthesis. The review of the databases is expected to be completed in December 2025.

Conclusions: This review will provide a synthesis of the total phenolic content in plant-based beverages consumed in Latin America.

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PALABRAS CLAVE

Polifenoles

Bebidas

América Latina

América del Sur

América Central

RESUMEN

Introducción: América Latina es una de las regiones con mayor concentración de biodiversidad. Las bebidas de origen vegetal ocupan un lugar especial en la cultura, la identidad y el patrimonio alimentario. Actualmente, estas bebidas han despertado gran interés en la comunidad científica, el mercado, la industria y los consumidores, ya que se consideran fuentes nutricionales y potencialmente funcionales debido a la presencia de compuestos bioactivos como los polifenoles. Diversos estudios han vinculado el efecto protector de estos compuestos frente a eventos adversos para la salud; sin embargo, no se conocen estudios que hayan revisado el contenido de polifenoles en bebidas de origen vegetal en la región.

Objetivo: Proporcionar una visión general del contenido total de polifenoles en bebidas de origen vegetal consumidas en países de América Latina.

Métodos: Este protocolo siguió la declaración PRISMA-P 2015 (Elementos de Reporte Preferidos para Protocolos de Revisiones Sistemáticas y Meta-análisis). Se incluirán estudios observacionales o experimentales que evalúen el contenido total de polifenoles en bebidas de origen vegetal consumidas en América Latina. Se incluirán artículos que estimen el contenido total de polifenoles en bebidas, incluyendo jugos e infusiones. Se desarrollarán estrategias de búsqueda electrónica para las siguientes bases de datos bibliográficas: ScienceDirect, PubMed/MEDLINE, LILACS y Scopus. La estrategia de búsqueda y del proceso de selección se presentarán en un diagrama de flujo y se resumirán en el texto.

Resultados: Los principales resultados se presentarán en una síntesis descriptiva. Se espera que la revisión de las bases de datos esté finalizada en diciembre de 2025.

Conclusiones: Esta revisión proporcionará una síntesis del contenido total de polifenoles en bebidas de origen vegetal consumidas en América Latina.

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KEY MESSAGES

1. This systematic review protocol aims to provide an overview of the total phenolic content of plant-based beverages consumed in Latin American countries, enhancing understanding of their nutritional benefits and potential contributions to the prevention of non-communicable diseases.
2. The review will compile and analyze studies that emphasize the cultural and health importance of plant-based beverages and their contribution to regional food biodiversity.
3. Rigorous search and data evaluation methodologies will be employed using databases such as ScienceDirect, PubMed, LILACS, and Scopus, ensuring accurate and representative results of the region's beverage diversity.
4. Latin America is one of the regions with the highest concentration of biodiversity on the planet. This information is crucial because it will help summarize the updated evidence on the total phenolic content of beverages consumed in the region.

CITATION

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INTRODUCTION

Latin America is one of the regions with the highest concentration of biodiversity on the planet. Brazil, Colombia, Mexico, Ecuador, Peru, and Venezuela are home to the greatest biological diversity in the world[1]. In these countries, 178 ecological regions have been identified, representing more than 50% of the world's biodiversity and 40% of the flora and fauna species[2]. This biodiversity is reflected in people's dietary habits. For example, these natural resources are used to produce various plant-derived beverages consumed in Latin America (tea, coffee, red wine, fruit juices, chocolate, fermented drinks based on cereals and nuts) and are important sources of bioactive compounds in the human diet[3-5].

Plant-based beverages are naturally lactose-free, with a diversified nutritional profile that depends on the raw material, origin, and processing, among other factors[6,7]. Plant-based beverages are colloidal systems containing solid and liquid particles[8,9]. These beverages are divided into two main categories: (1) alcoholic beverages, beverages containing ethyl alcohol, which mainly comprise wine, beer, and (2) non-alcoholic beverages, which are distinguished in the form of water (drinking, mineral, and potable), stimulating beverages (coffee, tea, chamomile, etc.), and refreshing beverages (soft drinks, juices, and syrups). The Spanish Food Code excludes concentrated extracts that are not consumed as a beverage per se, powder bases without associated liquid preparation, and extracts used solely as a chemical input[8,10].

Plant-based beverages have a special place in the market and have currently gained greater interest in the scientific community, the food industry, and consumers, since they are considered nutritional and potentially functional sources due to the presence of compounds of biological importance[6], which include biologically active proteins, phytosterols, biogenic amines, some vitamins, and polyphenols[9,11].

Polyphenols are bioactive compounds produced as a secondary result of plant metabolism, responsible for the color, aroma, flavor, and texture of plant-based foods. Their biological activity has been associated with the prevention of non-communicable diseases due to their anti-inflammatory, vasodilatory, antithrombotic, antilipemic, antiatherogenic, immunomodulatory, antimicrobial, cardioprotective, and antioxidant properties[12-15].

To date, no study has summarized the total phenolic content in beverages consumed in Latin America, except for one study conducted on traditional Mexican fermented beverages, which identified not only functional aspects but also cultural, microbiological, and chemical aspects[16]. This information is of great importance because it will contribute to summarizing the updated evidence on the polyphenol content of foods traditionally consumed in Latin America in the form of beverages. It may be helpful in the food and pharmaceutical industries, as well as in preserving Latin American food heritage and contributing to the well-being of the population. Therefore, our objective is to provide an overview of the total phenolic content of plant-based beverages consumed in Latin American countries. This objective is derived from the following research question: what is the content of total phenolic compounds in plant-based beverages consumed in Latin America?

METHODS

Study Design

The development of this protocol was also based on elements of the Preferred Reporting Items for Systematic reviews and Meta-Analyses Protocols (PRISMA-P) 2015 statement[17] and registered in the Open Science Framework (https://doi.org/10.17605/OSF.IO/8E4NQ). Table 1 outlines the components of the review using the Participants, Intervention, Comparison, Outcomes, and Study design (PICOS) structure. The conceptual difficulty of applying PICOS to food composition studies is acknowledged. Therefore, the term "Participant" was adjusted to be interpreted as "Subject of study," in this case, plant-based beverages.

Table 1. Components according to PICOS structure

Subject of study	Plant-based beverages consumed in Latin America.
Intervention / Exposure	Estimation of the content of total phenolic compounds.
Comparison	Different types of beverages.
Outcome	Quantification of total phenolic compounds.
Study design	Observational and experimental studies.

Eligibility Criteria

Table 2 summarizes the inclusion and exclusion criteria. Observational or experimental studies from peer-reviewed journals that evaluated total phenolic compounds in plant-based beverages consumed in Latin America will be included. Articles that estimate the total phenolic compounds in beverages, including juices and infusions, will be included. Vegetable extracts will not be considered as vegetable beverages. Studies that have estimated the total phenolic content only in the raw material will not be included. There will be no time restrictions, we will not apply any language filters. Articles that mention total phenolic content without providing measurement techniques will be excluded. Studies that do not include data on the total amount of polyphenol will be excluded. Those reporting polyphenol subgroups without the total polyphenol count will be excluded from the analysis.

Table 2. Criteria for eligibility for the review

Inclusion Criteria	Exclusion Criteria
Observational and experimental studies on plant-based beverages consumed in Latin America	Studies without data on the quantity of total phenolic compounds (e.g., only general mention without specific measurements or identification)
Studies reporting the total phenolic content in the beverages including juices and infusions	Studies in which polyphenols were analyzed in extracts or raw materials instead of in the beverage
Studies using different analytical methods to assess the total phenolic content	Reviews, systematic reviews, meta-analyses, editorials, letters to the editor, and conference abstracts
Articles published without language restriction	Studies based solely on composition from secondary sources (e.g., databases)
Studies conducted in Latin American countries or outside of Latin America only if they analyze beverages whose origin or traditional consumption is Latin American.	Beverages based solely on ingredients of animal origin (e.g., dairy products or beverages without plant content)
	Duplicate publications or studies with overlapping data (only the most complete and recent version will be included)
	Studies with insufficient methodological detail (e.g., no description of analytical techniques)

Information Sources and Search Strategy

Electronic search strategies will be developed for the following bibliographic databases: ScienceDirect, PubMed/MEDLINE, LILACS, and Scopus. The search strategy will include the MeSH terms "Phenols", "Polyphenols", "Lignans", "Stilbenes", "Beverages", "Fermented Beverages", "Latin America", "South America", and "Central America" with their respective related terms using AND and OR Boolean operators. Table 3 presents the search strategy that will be used in the different electronic databases.

The screening will be conducted in two stages: (1) title and abstract screening will be done independently by two reviewers (SMBP and MDR) using Rayyan, a web application designed to assist with research such as systematic reviews; (2) Following the title and abstract screening, full-text assessment of eligibility, again performed independently by two researchers with disagreements adjudicated by consensus or a third reviewer. Duplicates will be removed automatically using Rayyan's duplication tool, followed by manual verification to ensure accuracy. Human reviewers will perform all screening without AI assistance to maintain methodological rigor. The PRISMA methodology will be used for the review [18].

Data extraction

The data extraction of eligible studies will be carried out independently by two reviewers (SMBP and MDR). Disagreements are documented and resolved through discussion or by consulting a third reviewer. A spreadsheet will be developed and piloted to include information on author name, year of publication, country of study, study design, quantitative estimation of polyphenols; total polyphenol concentration and individual polyphenol compounds, analytical method used for quantification, unit of measurement, type of beverage, ingredients linked to polyphenol content, sample size, processing methods, health outcome associations (if reported). While this information on health associations will be treated as descriptive secondary data and will not replace the primary objective of the study.

Risk of bias in individual studies

Since no bias assessment tools are specifically designed for this type of study, those reporting validated methods for the quantification of total polyphenols and demonstrating statistical validity will be analyzed. Furthermore, articles will be analyzed to ensure they report the application of validated methods, measure uncertainty, describe metrological traceability criteria, and report whether internal quality controls were established for measurements. Disagreements between review authors regarding the risk of bias in individual studies will be resolved through discussion, with a third review author involved as necessary.

Data synthesis

To ensure consistency and comparability across studies, we will apply the following transformations to the raw extracted data. Individual polyphenols will be classified into major categories: Flavonoids (flavonols, flavanones, flavan-3-ols, anthocyanins, isoflavones), Phenolic acids (hydroxybenzoic acids, hydroxycinnamic acids), Stilbenes (e.g., resveratrol), Lignans, Other polyphenols (e.g., tannins, coumarins). Total polyphenols will be recorded, as this is an inclusion criterion for the studies. All reported polyphenol concentrations will be converted to milligrams per liter (mg/L) for liquid beverages.

The beverages will be grouped into two categories: alcoholic (wine, beer, chicha, etc.) and non-alcoholic (herbal teas, fruit juices, grain-based drinks like horchata, etc.). If a study reports polyphenol content at different stages (e.g., raw material vs. final beverage), we will extract the data for the final processed beverage. If a study compares multiple batches/varieties, we will calculate an average value (weighted by sample size if available).

Our results will be described narratively, and they are important for summarizing the evidence on the total phenolic content that has been reported in different plant-based beverages consumed in Latin America, as well as the ingredients that have been studied

Table 3. Pilot search in electronic database

Data Base	Keywords
PubMed	((((Phenols[MeSH Terms]) OR ("Phenolic compounds"[Title/Abstract])) OR (Polyphenols)) AND ((((((((((((Beverages[MeSH Terms]) OR ("Fermented Beverages"[MeSH Terms])) OR ("Plant-based beverages"[Title/Abstract])) OR ("Vegetable Beverages"[Title/Abstract])) OR ("Plant-Derived Beverages"[Title/Abstract])) OR (Tea[MeSH Terms])) OR ("Teas, Herbal"[MeSH Terms])) OR ("Fruit and Vegetable Juices"[Title/Abstract])) OR (Wine[MeSH Terms])) OR (Cacao[Title/Abstract])) OR ("Zea mays"[MeSH Terms])) OR (Chicha[Title/Abstract])) OR (Coffee[MeSH Terms])) OR ("Ilex paraguariensis"[MeSH Terms]))) AND (((((((((("Latin America"[MeSH Terms]) OR ("South America"[MeSH Terms])) OR ("Central America"[MeSH Terms])) OR (Mexico[MeSH Terms])) OR (Chile[MeSH Terms])) OR (Argentina[MeSH Terms])) OR (Colombia[MeSH Terms])) OR (Brazil[MeSH Terms])) OR (Peru[MeSH Terms]))
LILACS	(mh:"Fenoles" OR tw:"phenolic compounds" OR tw:"compuestos fenólicos" OR mh:"Polifenoles" OR tw:"polyphenols" OR tw:"polifenoles") AND (mh:"Bebidas" OR mh:"Bebidas Fermentadas" OR tw:"plant-based beverages" OR tw:"bebidas a base de plantas" OR tw:"vegetable beverages" OR tw:"bebidas vegetales" OR tw:"plant-derived beverages" OR mh:"Té" OR mh:"Tés Herbales" OR tw:"fruit and vegetable juices" OR tw:"jugos de frutas y verduras" OR mh:"Vino" OR tw:"cacao" OR mh:"Zea mays" OR tw:"chicha" OR mh:"Café" OR mh:"Ilex paraguariensis") AND (mh:"América Latina" OR mh:"América del Sur" OR mh:"América Central" OR mh:"México" OR mh:"Chile" OR mh:"Argentina" OR mh:"Colombia" OR mh:"Brasil" OR mh:"Perú")
Scopus	(TITLE-ABS-KEY ("Phenols" OR "Phenolic compounds" OR "Polyphenols")) AND (TITLE-ABS-KEY ("Beverages" OR "Fermented Beverages" OR "Plant-based beverages" OR "Vegetable Beverages" OR "Plant-Derived Beverages" OR "Tea" OR "Teas, Herbal" OR "Fruit and Vegetable Juices" OR "Wine" OR "Cacao" OR "Zea mays" OR "Chicha" OR "Coffee" OR "Ilex paraguariensis")) AND (TITLE-ABS-KEY ("Latin America" OR "South America" OR "Central America" OR "Mexico" OR "Chile" OR "Argentina" OR "Colombia" OR "Brazil" OR "Peru"))
Science Direct	("polyphenols" OR "phenolic compounds") AND ("plant-based beverages" OR "vegetable beverages" OR "plant-derived drinks") AND ("Latin America" OR "South America" OR "Central America")

and the methods of analysis. In addition, our review contributes to expanding knowledge about Latin American diets, studies on biodiversity and bioactive compounds, and to identifying the limitations of research in this field and the gaps in knowledge.

RESULTS

The review of the databases is expected to be completed in December 2025. The selection phase will be carried out over the following semester.

DISCUSSION

The aim of this systematic review protocol is to provide an overview of the total phenolic content of plant-based beverages consumed in Latin American countries. In this region, different beverages are important sources of bioactive compounds in the human diet[3-5]. These compounds have been associated with the prevention of non-communicable diseases[12,13-15,18,19], which are major causes of morbidity and mortality worldwide[20]. This will be the first systematic review that aims to present an overview of the total phenolic content of plant-based beverages consumed in Latin American countries. It is essential to develop a detailed protocol for the systematic review before starting it, which will optimize its methodological quality and results. The stages of study identification, selection, and data extraction will be performed in duplicate, and a third reviewer will assess any conflicting information. The lack of inclusion of gray literature could be considered a limitation, it typically lacks the peer-review standards necessary to adequately assess the methodological quality of the analytical data[21]. The aim of this study is to synthesize only the quantitative evidence from peer-reviewed studies to ensure consistency and comparability.

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AUTHOR CONTRIBUTIONS

SMBP: Guarantor of the systematic review protocol, conceptualization, design, identification of the research questions, search strategy, inclusion/exclusion criteria, writing, revising and editing, and manuscript submission.
AMV: Identification of the research questions, conceptualization, inclusion/exclusion criteria, writing, original draft, revising and editing, and protocol registration.
MDR: Identification of the research questions, conceptualization, search strategy, inclusion/exclusion criteria, original draft, writing, revising, and editing.
All authors made significant contributions to the development of methodology. All authors significantly contributed to the writing of and approved the final manuscript.

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CONFLICTS OF INTEREST

The researchers declare that they have no conflict of interest. It is anticipated that none of the investigators is a coauthor of one of the studies likely to be included in the review.

PROTOCOL REGISTRATION

OSF Registries OSF.IO/8E4NQ; https://doi.org/10.17605/OSF.IO/8E4NQ

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