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Comparison of Non-Specific Standardization of Moringa (*Moringa oleifera*): A Systematic Literature Review

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A B S T R A C T

In an effort to ensure that *Moringa oleifera* products available on the market meet certain standards, including cleanliness, authenticity, and safety, non-specific standardization is carried out. This study aimed to carry out a systematic review to explore the non-specific standardization of *Moringa oleifera.* The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the comparison of non-specific standardization of *Moringa oleifera.* This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations. The non-specific standardization process for *Moringa oleifera* involves botanical identification, evaluation of appearance and organoleptic characteristics, measurement of water, ash, and fiber content, as well as microbiological testing and pesticide residues.

1. Introduction

Non-specific standardization of *Moringa oleifera* is the process of determining and developing parameters used to measure the quality and authenticity of *Moringa oleifera* products in general without considering certain specific components or ingredients. The purpose of this standardization is to maintain the consistency and quality of *Moringa oleifera* products in the market, ensure consumer safety, and facilitate fair trade. *Moringa oleifera*, which is also known as the moringa tree, is a plant native to tropical and subtropical regions. This plant has long been used for its various benefits in the fields of food, health, and nutrition. The most frequently used plant parts are leaves, seeds, and roots. In an effort to ensure that *Moringa oleifera* products available on the market meet certain standards, including cleanliness, authenticity, and safety, non-specific standardization is carried out. The standardization process involves botanical identification, evaluation of appearance and organoleptic characteristics, measurement of water, ash, fiber, and nutrient content, as well as microbiological and pesticide residue testing.[1,2]

Botanical identification is the initial step in the non-specific standardization of *Moringa oleifera.* This involves verifying that the specimen used is the correct *Moringa oleifera*, distinguishing it from other existing Moringa species. The appearance and organoleptic characteristics of the product are also evaluated in the standardization process. This evaluation involves visual observation of the color, aroma, and taste of the *Moringa oleifera* product to ensure quality and consistency. In addition, measurements of water, ash, fiber, and nutrient content were carried out to ensure proper humidity, cleanliness, and adequate nutritional value. Microbiological tests and pesticide

residue tests are also carried out to ensure that *Moringa oleifera* products are free from pathogenic microorganisms and are not contaminated by pesticide residues that exceed the permitted limits.[3,4]

Non-specific standardization of *Moringa oleifera* plays an important role in maintaining product quality, ensuring consumer safety, and giving confidence to the market. With clear and measurable standards, producers, suppliers, and consumers can have confidence that the *Moringa oleifera* products they buy or use meet the quality requirements that have been set. This study aimed to carry out a systematic review to explore the non-specific standardization of *Moringa oleifera*.

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding the comparison of non-specific standardization of *Moringa oleifera*. The search was performed using the terms: (1) "non-spesific" OR "standarization" OR" quality test" OR" *moringa oleifera*" AND (2) " non-specific standarization ". The literature is limited to preclinical studies and published in English. The literature selection criteria are articles published in the form of original articles, an experimental study about the comparison of non-specific standardization of *Moringa oleifera*, the control group only received liquid without therapeutic effect or no treatment, studies were conducted in a timeframe from 2000-2023, and the main outcome was a comparison of non-specific standardization of *Moringa oleifera*. Meanwhile, the exclusion criteria were animal models that were not related to the comparison of non-specific standardization of *Moringa oleifera*, the absence of a control group, and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

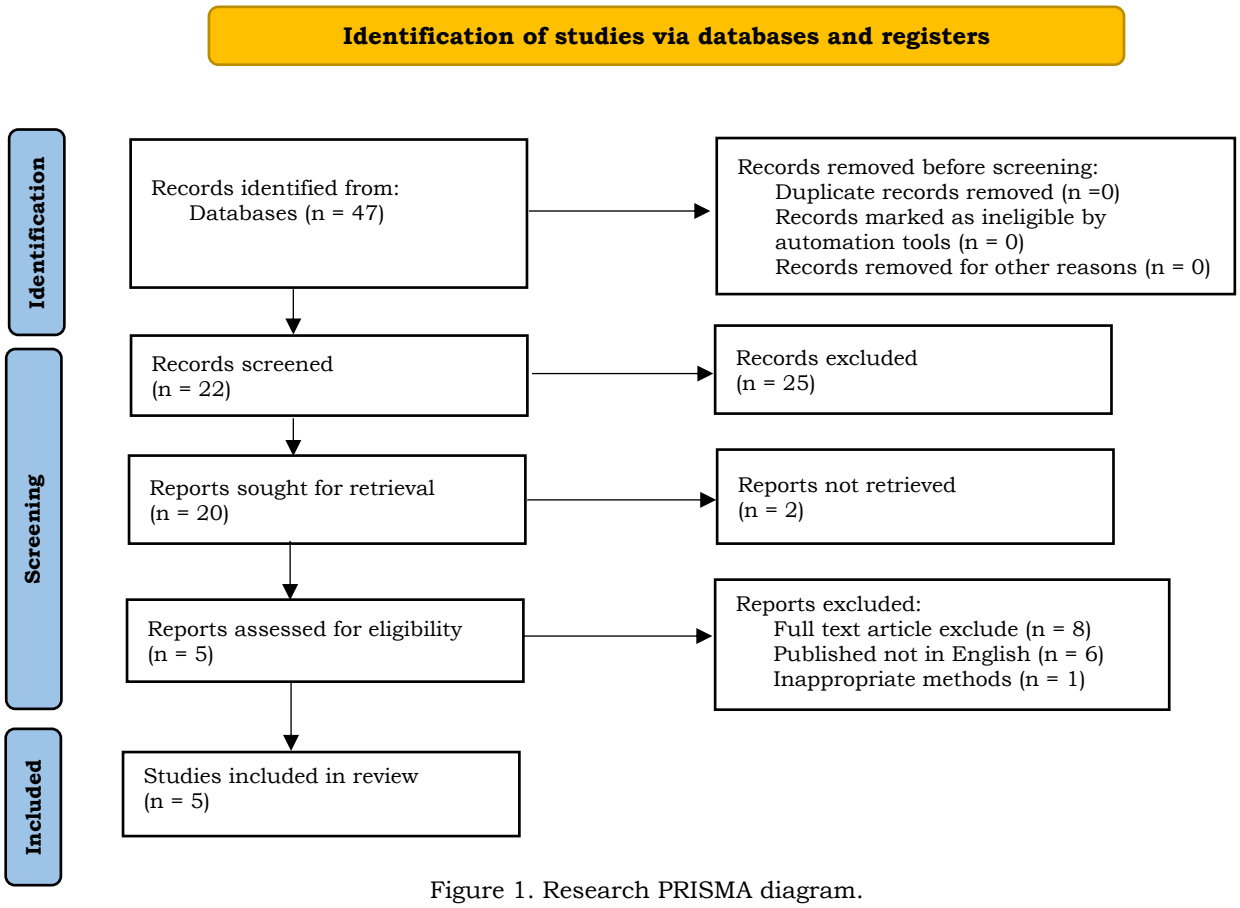

Figure 1. Research PRISMA diagram.

3. Results and Discussion

Botanical identification and verification of plants

Botanical identification and verification is an important step in the standardization of *Moringa oleifera*. This is done to ensure that the specimen used is the correct *Moringa oleifera* because there are several other Moringa species that have different morphology and characteristics. The process of botanical identification involves observing the morphological characteristics of the *Moringa oleifera* plant, such as leaf shape and texture, flower, fruit, and seed shapes, as well as stem and root characteristics. Accurate identification requires good botanical knowledge and valid references, such as a plant manual or an experienced botanist.[5]

In addition, botanical verification also involves the comparison of specimens with reliable botanical references, such as herbarium collections whose identity has been confirmed. In some cases, DNA analysis can also be used to verify species on a molecular basis. By identifying and verifying *Moringa oleifera* botanically, errors in species identification can be avoided, which can affect product quality and authenticity. This also ensures that standardization and further research are carried out on the right species, thereby obtaining consistent and accountable information about *Moringa oleifera*.[6]

Visual evaluation and organoleptic observation (such as color, aroma, and taste) of *Moringa oleifera* products

Visual evaluation and organoleptic observation are important aspects of standardizing *Moringa oleifera* to ensure product quality and consistency. Pay attention to the color of *Moringa oleifera* products. *Moringa oleifera* leaves usually have a dark green to green color brown. Unusual or non-specific colors may indicate blemishes or impurities. The smell of *Moringa oleifera* products can provide clues about the quality and cleanliness of the product. A fresh, fragrant, and distinctive aroma can be considered an indicator of good quality. Unusual, rotten, or unpleasant odors can signal a problem with the product.[7]

If possible, *Moringa oleifera* products can be tasted to evaluate their taste. Distinctive and balanced taste is an indicator of good quality. A bitter, sour, or unpleasant taste can indicate contamination or poor quality. Pay attention to the texture of *Moringa oleifera* products. The leaves should have a crunchy texture and not wilted. *Moringa oleifera* seeds can be inspected to make sure they don't have any defects such as damage, rot, or excess moisture. The visual evaluation also includes an assessment of product uniformity. Pay attention to whether the products are of uniform size, shape, and color. Significant non-uniformity may indicate defects or non-conformance.[8]

Water content in *Moringa oleifera* products

Measurement of the moisture content in *Moringa oleifera* products is an important step in standardization to ensure proper humidity and prevent the growth of unwanted microorganisms. Water content that is too high can cause the product to be susceptible to microbial damage and quality degradation. Moisture content measurement is carried out using appropriate analytical methods, such as the gravimetric method or the oven method. In the gravimetric method, the *Moringa oleifera* product is weighed before and after it is thoroughly dried to remove water. The difference in weight is then used to calculate the percentage of water content in the product.[9]

Suitable moisture requirements for *Moringa oleifera* products may vary depending on the type of product and its intended use. However, in general, dried *Moringa oleifera* products usually have less than 10% to 12% moisture content. These requirements may be set based on industry standards or applicable regulations. By ensuring an appropriate moisture content, the risk of the growth of unwanted microorganisms can be reduced. Water is an important factor for microbial development, and reducing the water content in the product can help maintain the freshness, stability, and shelf life of *Moringa oleifera* products. In addition, regular measurement of moisture content is also necessary

while monitoring the quality of *Moringa oleifera* products. This helps in detecting any fluctuations in moisture content that may indicate problems in the production, packaging, or storage of the product.[10]

Ash content

Determination of the ash content in *Moringa oleifera* products can provide an indication of product cleanliness and purity. Ash content is a measure of the amount of inorganic minerals remaining after organic matter is burned at high temperatures. High ash levels in *Moringa oleifera* products can indicate the presence of contaminants such as soil, sand, dust, or other insoluble particles. These contaminants can come from inadequate handling processes, unclean processing, or environmental conditions that are not properly maintained. To determine the ash content, *Moringa oleifera* products are usually tested by the combustion method. This process involves burning the product at high temperatures to remove organic matter while preserving the inorganic minerals. The remaining ash is then weighed and calculated as a percentage of the initial product weight.[11,12]

Quality standards or industry requirements may have set maximum limits for the ash content in *Moringa oleifera* products. This limit may vary depending on the intended use of the product and applicable regulations. Manufacturers usually try to ensure that their products meet the limits set to ensure the cleanliness and purity of the product they produce. By determining the ash content, manufacturers can carry out regular quality monitoring to ensure their *Moringa oleifera* products meet set quality standards. If the ash content exceeds the specified limits, corrective measures can be taken to improve the cleanliness and purity of the product, such as carrying out purification processes or improvements to the production process and product handling.[13]

The level of ash content that is considered high in Moringa products may vary depending on the quality standards set. In general, however, an ash content exceeding 5% to 7% can be considered an indicator of high ash levels in Moringa products. A high ash content usually indicates the presence of contaminants such as soil, sand, dust, or other insoluble particles in the product. This can be caused by unclean processing, poor handling, or environmental conditions that are not properly maintained during the production or storage of Moringa products.[14]

Fiber content

The fiber content in *Moringa oleifera* can be an important indicator for evaluating the nutritional value and quality of the product. Fiber is an important component in food that cannot be digested by the human body but has an important role in maintaining digestive health. Soluble fiber helps maintain gut health and promotes regular bowel movements. This can help prevent constipation and improve overall digestive quality. Dietary fiber can help control the absorption of sugar in the body, thereby helping to maintain a balanced blood sugar level. This can be beneficial for people with diabetes or at risk for diabetes. A high-fiber diet is associated with a reduced risk of heart disease. Fiber can help reduce low-density lipoprotein (LDL) in the blood and increase high-density lipoprotein (HDL). Fiber makes you feel full longer, which can help control your appetite and maintain a healthy weight. Fiber serves as food for the microorganisms that inhabit the gut, known as gut microbiota. Having a balanced gut microbiota can support overall health.[15]

Moringa oleifera leaves have a high fiber content. In general, the fiber content in Moringa leaves can reach around 6-7 grams per 100 grams. *Moringa oleifera* seeds also contain quite high fiber. The fiber content in Moringa seeds can range from 3-5 grams per 100 grams. *Moringa oleifera* powder, which is obtained from leaves that are dried and crushed into a powder, is also a good source of fiber. The fiber content in Moringa powder can reach around 7-8 grams per 100 grams.[16]

Microbiological test

Microbiological testing is an important step in the standardization of *Moringa oleifera* products to ensure that the product is not contaminated by pathogenic microorganisms or meets the established microbiological limits. This test aims to identify and measure the number of microorganisms present in the product.[17]

The total plate count (TPC) test was performed to calculate the total number of colonies of microorganisms growing on agar media in a product. This gives an overview of the level of cleanliness and purity of the product. Usually, the general limit for the total plate count is less than 10^4 up to 10^6 colony forming colonies per gram of product. These limits indicate acceptable levels of microorganisms in the product. The Salmonella test was conducted to detect the presence of Salmonella in *Moringa oleifera* products, which, if found, could pose a risk of gastrointestinal infection to consumers. The general limitation for Salmonella is not to be detected in significant amounts (i.e., < 10 colony-forming colonies per gram of product) in *Moringa oleifera* products.[18]

An *E. coli* test is performed to detect the presence of *E. coli* in the product and ensure that the product is free from pathogenic strains. The limitation for *E. coli* is not to be detected in significant amounts (i.e., < 10 colony-forming colonies per gram of product) in *Moringa oleifera* products. Fungus and mold test is carried out to detect the presence of molds and molds, which can cause product spoilage or produce mycotoxins which are potentially hazardous to health. *Moringa oleifera* is expected to be free from detectable mold and mildew growth.[18]

Pesticide residue test

Pesticide residue testing is an important step in the standardization of *Moringa oleifera* products to ensure that the product meets safety requirements and that pesticide residue levels are below permissible limits. Pesticides are compounds used to protect plants from pests, diseases, or weeds. However, excessive or inappropriate use of pesticides can leave residues in plant products, including *Moringa oleifera*. Therefore, pesticide residue tests are carried out to detect and measure the presence of pesticides in products and ensure that levels are below established limits. The pesticide residue test process involves taking samples of *Moringa oleifera* products and laboratory analysis using chromatography or spectrometry techniques. This method allows the identification and measurement of the amount of pesticides that may be present in the product. The safe limit for pesticide residue levels varies from 0.15 mg/kg simplicia to 0.36 mg/kg simplicia.[19,20]

4. Conclusion

The non-specific standardization process for *Moringa oleifera* involves botanical identification, evaluation of appearance and organoleptic characteristics, measurement of water, ash, and fiber content, as well as microbiological testing and pesticide residues.

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