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EVALUATION OF THE TECHNOLOGICAL POTENTIAL OF COWPEA IN THE DEVELOPMENT OF FOOD PRODUCTS: AN INTEGRATIVE REVIEW

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ABSTRACT

Cowpea (Vigna unguiculata) is a legume of great socioeconomic relevance in several regions. With the growing demand for healthy foods, cowpea has been gaining prominence as a functional ingredient for the development of food products due to its nutritional profile. The development of products with regional raw materials, such as cowpeas, brings significant benefits to the local economy, public health, and sustainability. Therefore, this review article aims to summarize recent advances in the development of food products with cowpeas, highlighting its technological, nutritional, and sensory characteristics, in addition to identifying gaps and future research opportunities. The bibliographic search was carried out in the SciELO, CAPES Journals, Google Scholar, and institutional repositories such as Embrapa databases. Articles published between 2015 and 2024, written in Portuguese and English, and meeting some inclusion and exclusion criteria were considered. In total, 9 articles met the criteria and were analyzed qualitatively, focusing on the characteristics of the products developed, study objectives, main results, and conclusions. In general, the articles show that cowpea is a regional raw material that is expanding in the market, improving the nutritional characteristics of products, obtaining good sensory acceptance, and with excellent strategic potential to meet the needs of plant-based food production. Despite these advances, some challenges still limit the widespread adoption of cowpeas in the industry. Additional studies are needed to better understand how cowpea flour interacts with other ingredients in different food matrices, especially in ultra-processed products.

Keywords: Cowpea. Cowpea Flour. Product Development. Technological Potential.

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INTRODUCTION

Cowpea (Vigna unguiculata) is a legume of great socioeconomic importance in several regions, especially in tropical and subtropical regions, such as Northeast Brazil and countries in Africa and Asia. In addition, its importance extends to the nutritional scope because it is characterized by its high content of proteins, fibers, and essential minerals, in addition to having good adaptability to adverse climatic conditions and low cultivation cost, which makes it a strategic food for food and nutritional security in several regions of the world (Silva et al., 2016; Freire Filho, 2011).

With the growing demand for healthy foods, cowpea has been gaining prominence as a functional ingredient for the development of food products due to its nutritional profile. Studies show that it can be used in several forms, such as flour, as a partial or total replacement for refined cereals, promoting products with greater added value, such as bread, cookies, fermented beverages, and snacks (Souza et al., 2023; Andrade et al., 2023). Furthermore, its application in plant-based foods reinforces its potential to serve the expanding market for plant-based products, focused on healthy and sustainable alternatives to animal proteins (Oliveira et al., 2023).

The use of its flour, for example, has been explored to improve the functional and sensory properties of processed foods, while maintaining good acceptability by consumers (Santos et al., 2018; Almeida et al., 2021). Thus, the development of cowpea-based products not only contributes to food diversification but also adds value to the production chain of this legume.

The development of products with regional raw materials, such as cowpeas, brings significant benefits to the local economy, public health, and sustainability. For example, its application in cookies and Swiss rolls as a partial substitute for wheat flour improves the nutritional quality of the products without compromising sensory acceptance (Frota et al., 2010).

In this context, this review article aims to summarize recent advances in the development of food products with cowpeas, highlighting its technological, nutritional, and sensory characteristics, in addition to identifying gaps and future research opportunities.

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METHODOLOGY

This review article was conducted to analyze advances in the development of food products using cowpeas as a raw material, focusing on its technological, nutritional, and sensory applications. The study followed a protocol, described below.

DATA SOURCES AND SEARCH CRITERIA

The bibliographic research was carried out in the SciELO, CAPES Journals, Science Direct databases, and institutional repositories such as Embrapa. The search terms included combinations such as "cowpea", "cowpea flour", "product development", and "technological potential". Articles published between 2015 and 2024, written in Portuguese and English, were considered.

INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria were: (1) studies that addressed the development of food products using cowpeas; (2) articles that presented results on the nutritional, sensory, or functional characteristics of the products; and (3) original publications or relevant reviews. Studies outside the established time frame, duplicates in different databases and those that did not present data directly related to the topic were excluded.

SELECTION STEPS

Initially, 65 articles were identified. After reading the titles and abstracts, 25 articles were selected for full analysis. Of these, 9 met the inclusion criteria and were used in the synthesis of the results.

DATA ANALYSIS AND ORGANIZATION

The selected articles were analyzed qualitatively, focusing on the characteristics of the products developed, study objectives, main results, and conclusions. The information was organized in tables to facilitate comparison and discussion, highlighting the contributions and research gaps.

RESULTS AND DISCUSSION

Table 1, prepared based on the review, presents the main studies that address the development of food products with cowpeas. The information was summarized based on

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the objectives of the studies, their main results, conclusions, and references. Table 1 gathers data on various products, such as cookies and fermented beverages, and also focuses on recent advances, including snacks and plant-based foods.

Table 1: Technological Potential of Cowpea in Developed Foods

Title	Objective	Main Results	Conclusion	Reference
Cheese Bread Enriched with Biofortified Cowpea Flour	Develop cheese bread enriched with whole biofortified cowpea flour and evaluate its acceptance and chemical composition.	The addition of cowpea increased the levels of copper, iron, phosphorus, magnesium, manganese, and zinc, as well as protein and carbohydrate values.	Cowpea is a regional raw material with growing market potential and presents itself as an option for enriching gluten-free baked goods.	Cavalcante et al., 2016
Use of Cowpea in Extruded Snacks Formulation	Investigate the impact of adding cowpeas to snacks regarding nutritional value and texture.	Extruded snacks showed higher protein content and better functional properties with 20% cowpea in the formulation.	Cowpea contributes to the development of healthy and highly nutritious snacks compared to traditionally formulated products.	Santos et al., 2018
Sensory Analysis of Vegetarian Burgers Enriched with Cowpea	Evaluate the impact of cowpeas on the texture, flavor, and sensory acceptance of vegan burgers.	Burgers with 30% cowpea achieved a better balance between texture and flavor, with high acceptance among participants.	Cowpea is a versatile ingredient for plant-based products.	Oliveira et al., 2019
Development of Cookie Formulations with the Addition of BRS Xiquexique Cowpea Flour	Use biofortified cowpea flour to produce cookies.	Cookies with biofortified cowpea flour contain essential iron and zinc to meet the recommended daily intake, offering a healthy and nutritious alternative suitable for the food industry.	The developed cookies showed similar acceptance to the standard ones, with good sensory acceptability. The addition of biofortified cowpea flour yielded satisfactory results.	Fiorentin et al., 2019
Development of a Nugget Based on Acerola Residue (Malpighia emarginata D.C) and Cowpea (Vigna unguiculata L.)	Develop a nugget using acerola residue and cowpea.	In the Purchase Intent Test, 88% of sensory assessors rated it 4 ("probably would buy") or 5 ("definitely would buy"). The results of the Paired Preference Test showed that the preference for the developed product was similar to the preference for the standard product.	The developed nugget had excellent sensory acceptance, with no statistically significant difference in the Paired Preference Test when compared to the standard nugget.	Abreu et al., 2020

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Fermented Beverage Based on Cowpea	Develop a fermented beverage with probiotic properties using cowpeas.	The beverage showed good probiotic microorganism viability and high sensory acceptance among consumers.	Cowpea is a promising substrate for the development of functional beverages.	Almeida et al., 2021
Cereal Bar with Whole Cowpea Flour, Cashew Nuts, and Dried Banana	Develop a cereal bar with whole cowpea flour, cashew nuts, and dried bananas and evaluate its acceptance and chemical composition.	The addition of cowpeas increased the levels of ash, lipids, and proteins.	The developed cereal bar is rich in nutrients and has sensory feasibility.	Moreira-Araújo, 2021
Strategic Potential of Cowpea as an Ingredient for Plant-Based Foods	Explore cowpea as a key ingredient in plant-based products due to its high protein content and versatility.	High potential for replacing animal proteins in burgers and similar products.	Cowpea has strategic potential to meet the growing demand for plant-based food production, offering a viable and sustainable alternative for the food industry.	Oliveira et al., 2023
Development and Physicochemical and Sensory Characterization of Baked Goods Made with Whole Cowpea Flour	Develop and characterize, both physicochemically and sensorial, cakes, cookies, and bread made with partial replacement of wheat flour by whole cowpea flour.	Regarding the physicochemical characterization of the baked goods, the values for carbohydrates (53.52%, 67.84%, and 49.59%), proteins (9.68%, 12.81%, and 14.07%), and lipids (12.25%, 7.65%, and 11.60%) were highlighted for cake, cookies, and bread, respectively.	The developed baked goods had good sensory acceptance among potential consumers and can be included in the diet of healthy individuals, maximizing the nutritional benefits of whole cowpea flour, particularly its protein content.	Carvalho et al., 2023

Source: Prepared by the author, 2024.

The analysis of the studies presented in the table reveals the diverse potential of cowpeas as an ingredient in different categories of food products. Products such as breads, cookies, and extruded snacks have demonstrated functional benefits, with increased levels of protein, fiber, and other essential nutrients. For example, in the study by Cavalcante et al. (2016), the cheese bread produced increased the mineral levels considerably when compared to the standard product. In addition, Fiorentina et al. (2019), when using biofortified cowpea flour to prepare cookies, also showed that the product, in addition to being a good source of micronutrients, also has good acceptability in sensory aspects.

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Furthermore, the use of cowpeas in extruded snacks and fermented beverages, as observed in studies by Santos et al. (2018) and Almeida et al. (2021), demonstrates its applicability in practical and innovative consumption formats. These products have a high protein profile and attractive sensory characteristics, which is essential for the contemporary market, aimed at consumers seeking convenience combined with health benefits. Such advances indicate that cowpea has the potential to compete with other sources of vegetable protein, such as soy and peas, in emerging segments of the food industry.

Another highlight is the use of cowpeas in plant-based products, such as vegetarian burgers. The study by Oliveira et al. (2019) proved that the inclusion of 30% cowpea flour in these products improves the texture and flavor balance, with high acceptance by consumers. This data reinforces the strategic role of cowpeas in the plant-based food market, a growing trend driven by the search for sustainable alternatives to animal proteins.

Addy et al. (2020) emphasized that cowpeas can play a crucial role in the formulation of plant-based products, competing with other legumes such as soy and peas. This is especially relevant to serve consumers seeking sustainable and nutritious alternatives to animal proteins, such as vegetarian burgers and plant-based nuggets.

The study by Abreu et al., (2020) highlights that the nugget developed presents promising technological characteristics, such as good moldability and thermal stability. However, the balance between the ingredients was essential to achieve an acceptable texture and flavor. Sensory tests demonstrated that the inclusion of acerola residue did not compromise the acceptance of the product by consumers, especially when combined with cowpea, which provides a neutral and versatile flavor.

Figure 1 presents a graphic representation of the products developed in recent years with cowpea flour in their formulation.

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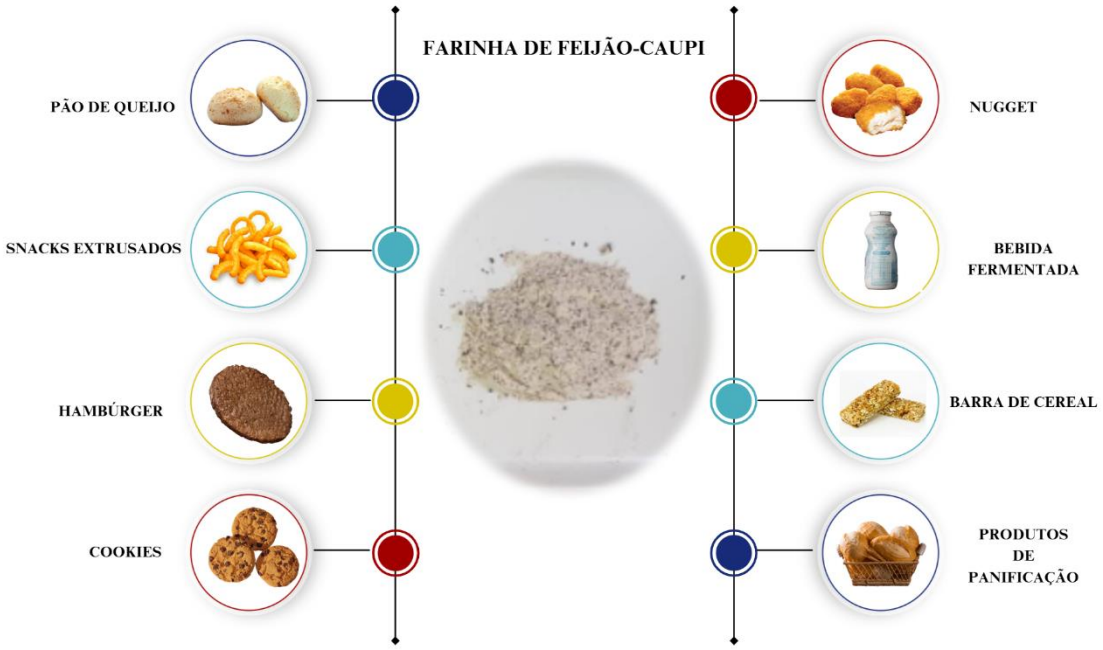
Figure 1: Products developed in recent years with cowpea flour in their formulation.



Source: Authors.

Another relevant point is the socioeconomic impact associated with the appreciation of cowpeas as a regional raw material. Encouraging its use in food products can generate greater demand for farmers, especially in the Brazilian Northeast, where it is a traditional crop. As noted by Oliveira et al. (2023), the development of plant-based products made from cowpeas not only meets the global market for sustainable food but also strengthens local economies, contributing to the reduction of regional inequalities and the promotion of food security.

The cereal bar added with whole cowpea flour developed by Moreira-Araújo et al. 2021 showed an increase in protein and mineral contents, in addition to favorable acceptance by the target audience. These results suggest the viability of cowpeas as a base for functional products that meet specific health and nutrition demands. This corroborates the data presented by Carvalho et al. (2023) who emphasized the good sensory acceptance and high protein content of the products developed, highlighting their suitability for consumers seeking to diversify their diets with more nutritious and regional ingredients.

According to Freire Filho et al. (2020), cowpea has great potential to diversify diets and strengthen food security, especially in tropical and subtropical regions where its cultivation is adopted. In addition, advances in genetic improvement have contributed to

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increasing the adaptability and productivity of cowpeas, facilitating their use in innovative food products.

Reports by Embrapa (2021) indicate that integrated production of cowpeas in technological reference units has facilitated the adoption of new technologies by farmers. This includes the introduction of specific cultivars for industrial use, and promoting the expansion of the market for enriched and functional foods, such as cereal bars and fermented beverages.

Despite these advances, some challenges still limit the widespread adoption of cowpeas in the industry. Additional studies are needed to better understand how cowpea flour interacts with other ingredients in different food matrices, especially in ultra-processed products. In addition, issues related to the stability and conservation of products over time need to be addressed to ensure commercial viability in global markets. Public policies and research incentives can play a crucial role in this context, promoting the use of this legume as a strategic ingredient for functional and sustainable food.

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