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Unlocking the Potential of Cassia tora: Developing Nutrient-Rich Functional Soup for Health-Conscious Consumers

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ABSTRACT

A search for new ingredients has been fueled by the growing desire from consumers for functional foods that offer health advantages beyond simple nourishment. The resilient tropical plant *Cassia tora*, which has long been used in medicine and agriculture, has a lot of promise for usage in culinary goods with a health-conscious theme. This study highlights the nutritional, sensory, and functional qualities of *Cassia tora* leaves as a main component in a novel soup formulation. Using a 9-point hedonic scale, 30 untrained panelists participated in a systematic sensory evaluation to rate important characteristics such as taste, scent, texture, and appearance. Taste scored the highest, indicating a well-balanced flavor profile, and the findings showed good overall acceptance. Although the herbal scent was praised for being unique, the response was conflicting; indicating that more work has to be done to accommodate wider customer tastes. The soup's appeal as a ready-to-eat product was increased by the positive reviews given to its look and texture. Dietary fiber, vitamins A and C, minerals (calcium and magnesium), and bioactive substances including flavonoids and antioxidants were all found to be significantly present in the soup, according to nutritional analysis. These ingredients promote the soup's possible health advantages, which include immune system stimulation, anti-inflammatory actions, and digestive support. According to this study, *Cassia tora* is an untapped resource for creating functional meals that complement the expanding plant-based and health-conscious dietary trends. Future development suggestions include improving the visual presentation and flavor balance to increase customer happiness. The results open the door for *Cassia tora* soup's incorporation into the functional food sector by highlighting its economic potential as a natural, nutrient-rich product. This study bridges the gap between traditional knowledge and present dietary demands by reaffirming the need of investigating traditional plants in contemporary food systems.

Keywords: *Cassia tora*, Functional food innovation, Sensory analysis, Nutritional enhancement, Bioactive compounds, Consumer health trends

INTRODUCTION

Native to Asia's tropical and subtropical climates, *Cassia tora*, often called sickle senna or Tora, is a hardy herbaceous plant in the Fabaceae family. It is found all throughout Southeast Asia, India, China, and portions of Africa. It thrives in dry and semi-arid regions. Although the plant may thrive in many different types of soil, it is most frequently found in soils that are sandy, dry, and low in nutrients. *Cassia tora* is a stunning plant that may grow up to 1-2 meters tall. It is distinguished by its long, sickle-shaped seed pods and vivid yellow blooms. The robust and quickly growing plant is frequently found in disturbed environments like waste grounds and roadsides. In addition to its capacity to adapt to many environments, *Cassia tora* is well known for its therapeutic qualities, particularly in conventional medical systems like Ayurveda and traditional Chinese medicine. Its seeds, leaves, roots, and petals are used to cure a variety of illnesses in several medicinal forms, including powders, extracts, and decoctions. For example, the leaves are used topically to treat skin disorders including eczema, acne, and other dermatological concerns, while the seeds are used as a laxative (Krishnamurthy and Reddy, 2009). The plant can

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help cure symptoms including liver issues, skin diseases, and digestive difficulties because of its antibacterial, anti-inflammatory, and antioxidant qualities (Suman *et al*., 2011). According to studies, the seeds of *Cassia tora* contain anthraquinones, which aid in the plant's laxative properties, and its bioactive chemicals may help treat a number of illnesses (Singh *et al*., 2014). Apart from its therapeutic use, *Cassia tora* is crucial for sustainable farming. By transforming atmospheric nitrogen into a form that plants can use, it improves soil fertility as a nitrogen-fixing plant. This characteristic aids in the restoration of nutrient-depleted soils and is especially helpful in agricultural techniques that emphasize organic farming and soil conservation. *Cassia tora* is frequently utilized as a cover crop or green manure, particularly in areas where soil deterioration is a major issue. In addition to offering natural nitrogen enrichment, it enhances soil structure and lowers erosion (Verma *et al*., 2017). A natural yellow dye made from the plant's seeds is another use for the plant in the textile sector. This environmentally friendly dye has long been used to color fabrics, and because it is sustainable, it is a desirable substitute for synthetic dyes (Kumar *et al*., 2012). But because of its quick development, *Cassia tora* can occasionally become invasive and out compete natural plants in specific areas. To keep it from becoming a harmful species in some environments, this element has to be managed carefully. Notwithstanding its propensity for invasiveness, the plant's adaptability—from enhancing soil health to offering industrial and therapeutic applications—underlines its worth in a variety of contexts. Its pharmacological characteristics are still being studied by modern science, which is producing fresh findings on its potential in modern medicine. Research indicates that the bioactive constituents of *Cassia tora*, including as flavonoids, saponins, and tannins, have potential for the creation of new medicinal substances (Suman *et al*., 2011; Singh *et al*., 2014).The seeds of *Cassia tora* have been identified as a natural source of bioavailable iron, useful in addressing iron-deficiency anemia (Patel *et al.*, 2013). *Cassia tora* extracts have demonstrated potential as a natural preservative due to their antifungal and antioxidant properties (Ghosh *et al.*, 2019). In Ayurvedic medicine, *Cassia tora* has been used for detoxifying the blood and improving skin conditions like psoriasis and eczema (Sharma and Tripathi, 2014). The presence of beta-carotene in *Cassia tora* leaves contributes to their role in preventing vitamin A deficiency and associated vision problems (Rao *et al.,* 2016). A recent study highlighted the potential of *Cassia tora* as an ingredient in gluten-free food formulations, targeting consumers with celiac disease or gluten intolerance (Kumar and Mishra, 2020). Research and scientific studies on *C. tora* suggest this plant has enormous biological potential. Clinical and pharmacological studies utilizing standardized extracts and isolated components are necessary to explore this plant's unrealized potential. Research on *C. tora* has a lot of potential, and it might one day provide the pharmaceutical industry with important phytochemical substances (Patel *et al*., 2022). The research paper focuses on developing and standardizing methods for processing and preserving *Cassia tora*, a plant known for its wide range of medicinal properties and nutritional benefits. *Cassia tora*, traditionally used in both Ayurveda and Chinese medicine, has been recognized for its bioactive compounds such as flavonoids, anthraquinones, and glycosides, which contribute to its medicinal properties. These include antioxidant, antimicrobial, and antidiabetic effects, along with its use in treating conditions like leprosy, ringworm, constipation, and various digestive disorders. Its seeds and leaves are especially valued for their ability to scavenge free radicals and modulate metabolic pathways (Patel and Patel 2024).

Photography:

In most regions of India, cassia species are cultivated as weeds and as wild crops. It is a 30- to 90-cm-high annual foetid plant. The green, pinnate leaves are up to 6–8 cm long, with three pairs of leaflets that are clearly petiole-like, opposite, conical at one end, ovate lengthwise, and oblique at the base. Flowers are pale yellow and typically appear in virtually sessile pairs in the leaf axils. The top petals are densely packed. Subtracted or 4-angled pods are very thin, 6–12 inches long, partially septet, membrane-bound, and contain a lot of brown rhombohedra seeds.

Photochemistry:

The antimicrobial activity of *Cassia tora* extracts has been shown to inhibit the growth of food borne pathogens, including *Escherichia coli* and *Staphylococcus aureus* (Rahman and Akter, 2018). TLC-based photochemical screening of the plant extracts revealed that they, along with callas extracts, included glycoside, flanonoids, and derivatives of enthrone and anthracnose. *Cassia tora* contains phenolic compounds

that contribute to its antioxidant activity, making it effective in reducing oxidative stress (Ahmed *et al.*, 2015). Studies suggest that *Cassia tora* leaves exhibit hepatoprotective properties, which may help in protecting liver cells from damage (Choudhary *et al.*, 2016). The key ingredient that gives it its fiery armo flavor is 1-2% volatile Cassia oil. Cinnamaldehyde, gum, tannis, mannitol, coumarins, and essential oils (eugenol, pinene, and aldehydes) are its main chemical ingredients. Sugar resins and mucilage are also present. Flavonoids in *Cassia tora* are linked to its anti-inflammatory effects, potentially benefiting individuals with chronic inflammatory conditions (Jain *et al.,* 2015).

Table 1: Chemical present in *Cassia tora* leaves

Sr. No.	Chemical name	Per cent (%)
1.	Palmitate	20.8%
2.	Stearate	6.4%
3.	Oleate	5.7%
4.	Linoleate	13.1%
5.	Linolenate	26.0%

Source : Kumar *et al*. (2012)

Table 2: Nutritional composition of *Cassia tora* leaves

Nutrient	Amount per 100g
Energy	128 kcal
Protein	5.3 g
Fat	2.5 g
Carbohydrates	19.7 g
Fiber	7.2 g
Calcium	289 mg
Iron	3.5 mg
Magnesium	160 mg
Phosphorus	87 mg
Potassium	671 mg
Sodium	7 mg
Vitamin C	23 mg
Vitamin A	1370 IU
Folate (Vitamin B9)	38 mcg
Vitamin K	21 mcg

Source: Suman *et al*. (2011) and Jagannath, 2018

Toxicological investigations: Conduct studies to investigate and assess the possible adverse effects of *Cassia tora* and its active components on humans. Research should be done to identify the safest range of doses for human intake, as well as any possible negative effects that might arise from prolonged usage. Investigations of the Phytochemistry: Conduct extensive phytochemical investigations of *Cassia tora* to discover and quantify the active chemicals it contains. Research should be conducted to determine how the composition of its active chemicals is influenced by environmental variables such as soil quality and temperature (Patel and Patel, 2023).

METHODOLOGY

Process of making *Cassia tora* leaves soup:

To guarantee the correct extraction of tastes and nutrients from the ingredients, particularly the *Cassia tora* leaves, a number of procedures were followed during the production of the soup. The goal of the procedure was to produce a tasty and nourishing soup that could be tested with the senses. Incorporating *Cassia tora* leaves into functional foods like soups can enhance dietary fiber intake, which is essential for improving gut health (Das *et al.,* 2017).

Preparation of Ingredients:

Pouring 450 milliliters of water into a cooking pot was the first step. After that, 150g of tomatoes, 120g of onions, 50g of garlic, and 20g of green chilies were made as fresh ingredients. To improve the flavor extraction while cooking, these items were diced finely (Meilgaard *et al*., 2007).

Boiling the Base Ingredients:

The water pot was filled with the prepared materials, which included green chilies, tomatoes, onions, and garlic. After that, the mixture was left to boil for two minutes. A flavorful soup foundation is produced by boiling the base components, which helps release their tastes into the water (Suman *et al*., 2011). In order for the tastes of the veggies to complement the *Cassia tora* leaves when they are introduced, this step is essential.

Adding Cassia tora Leaves Powder:

After two minutes of boiling the foundation components, 150g of powdered *Cassia tora* leaves were added. *Cassia tora* is well-known for its many therapeutic benefits, and adding its nutrients to the soup is made simple by utilizing powdered leaves (Suman *et al*., 2011). In order to optimize its health advantages, the powder was gently blended into the liquid to ensure equitable dispersion.

Incorporating Corn Flour:

30g of maize flour was then added to the blend. As

a thickening agent, the maize flour aids in giving the soup the right consistency (Meilgaard *et al*., 2007). To keep the soup's smooth texture and avoid clumps, the flour was added gradually while stirring.

Seasoning:

The soup's taste was enhanced by the addition of a pinch of salt. When utilizing herbs and vegetables like *Cassia tora*, which have different tastes, salt is crucial for balancing the soup's flavor (Lawless and Heymann, 2010). To make sure it enhanced the other components without overwhelming them, the salt was used sparingly.

Simmering the Soup:

After that, the soup was left to cook over medium heat for twenty-five minutes. This stage guarantees that the tomatoes, *Cassia tora* leaves, and other components are cooked through and that all the tastes combine (Suman *et al*., 2011). The nutrients from the *Cassia tora* leaves are also released into the soup during this cooking time, adding to its health advantages.

Final Preparation:

The soup was cooked for 25 minutes, then taken off the heat and given time to cool down a little before being served. Now it was time to serve and eat the soup.

Fig. 1 : Raw materials in soup

Fig. 2 : *Cassia tora* leaves soup

The end result was a fragrant, tasty soup that had the added health advantages of the other ingredients together with the unique flavor of *Cassia tora*.

Sensory Evaluation:

To determine if *Cassia tora* soup was palatable in terms of color, flavor, texture, and general acceptability, a sensory study was carried out. The study adhered to established protocols for sensory analysis, guaranteeing that assessments were carried out in a controlled setting to reduce bias and produce accurate findings (Lawless and Heymann, 2010).

Preparation of Cassia tora Soup:

Fresh *Cassia tora* leaves that had been well cleaned to get rid of any dirt or pesticides were used to make the soup. To extract the nutrients and tastes, the leaves were coarsely chopped and then cooked in water. According to the recipe, other ingredients were added, such as spices (garlic, salt, and pepper), vegetables (carrots, onions, and tomatoes), and other flavor enhancers. After 30 minutes of simmering, the soup was filtered to get rid of any solids, leaving it smooth and uniform (Suman *et al*., 2011).

Sample Preparation for Sensory Testing:

Each participant received a consistent quantity of 50 milliliters of the prepared *Cassia tora* soup. To prevent color prejudice, the soup was served in white bowls. To guarantee that the soup was warm but not too hot to eat, it was served at a temperature of around 60°C (Meilgaard *et al*., 2007).

Selection of Panelists:

Thirty untrained panelists in all were chosen for the sensory assessment. Although these panelists lacked formal expertise in sensory analysis, they were aware of the idea of sensory testing. To guarantee a diverse viewpoint on the soup's acceptability, panelists were chosen from a diverse pool of people, including people of all ages and genders. The goal of the study was explained to each panelist before the evaluation, and their agreement was acquired (ASTM, 2012).

Sensory Evaluation Procedure:

To exclude any outside influences that can have an impact on sensory perception, the sensory evaluation was conducted in a controlled setting with uniform lighting

and temperature (Lawless and Heymann, 2010). Each sensory feature (color, scent, taste, texture, and overall acceptability) was evaluated using a structured hedonic scale. The scale was 9 points, with 1 denoting "dislike extremely" and 9 denoting "like extremely." The following sensory characteristics were used to guide the panelists' ratings of the soup;

- **Color**: The soup's visual appeal was assessed for both consistency and attractiveness.
- **Aroma**: The panelists evaluated the soup's fragrance, emphasizing its freshness and harmony of savory and herbal notes.
- **Taste**: The soup's overall flavor, which includes sweetness, saltiness, bitterness, and any other unique qualities from the *Cassia tora* and the additional components, was assessed.
- **Texture**: The soup's liquid component's smoothness and consistency, as well as any minor chunkiness or grit from the veggies and leaves, were used to grade the texture.
- **Overall Acceptability**: Taking into account all sensory aspects, panelists were asked to score their overall assessment of the soup (Meilgaard *et al.,* 2007).

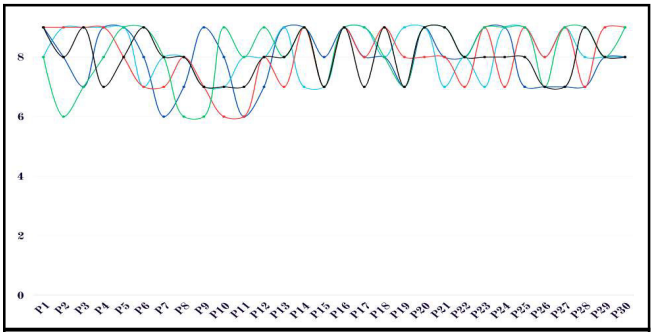

Fig. 3: Observation of Graph of Score of Different Panelist Done for the Sensory Evaluation of Soup

RESULTS AND DISCUSSION

Sensory Evaluation of *Cassia tora* Soup (Taste, Appearance, Aroma, and Overall Acceptance):

Five sensory qualities—taste, appearance, scent and general acceptability—were evaluated in the *Cassia tora* Soup sensory evaluation. In order to score the soup, the 30 panelists were given a 9-point hedonic scale, with 1 denoting "dislike extremely" and 9 denoting "like extremely." Based on these standards, each of the 30 participants gave the soup a rating; the results were then examined to ascertain the product's general acceptance as well as its particular advantages and disadvantages.

Raw Data Overview:

The dataset provides a thorough assessment of the soup by including scores from 30 people (P1 to P30) for each of the five sensory qualities. Taste, look, scent, consistency, and general acceptability were among the sensory attributes that each participant scored, with scores ranging from 6 to 9. The scores for each attribute will be examined separately in the sections that follow.

Taste:

The panelists' taste ratings exhibit a broad range, with the best score being nine and the lowest being six. The majority of respondents rated the flavor as somewhat good, as shown by the average score of 7.9. Twelve of the thirty panelists gave the flavor a score of nine, which indicates that a significant number of them thought it was very good. A small percentage of participants, however, gave the flavor a grade of 6 or 7, suggesting that they thought it was a little less attractive.

Discussion:

The high mean score for taste indicates that *Cassia tora* Soup has a flavor profile that is generally favorable. The existence of lower scores (6 and 7) would suggest that not everyone like the flavor. The taste balance might be improved; some judges could have thought the flavor was either too light or too overwhelming. The variation in scoring may also be explained by different seasoning tastes and the use of particular ingredients, such as *Cassia tora* leaves.

Appearance:

Additionally, the soup's appearance was evaluated on a 9-point scale, with values ranging from 6 to 9. The majority of panelists were reportedly satisfied with the soup's aesthetic appeal, as shown by the mean appearance score of 8. The most common rating for appearance was the highest, as shown by the appearance mode score of 9. Still, some scores were lower than others, especially 6 and 7.

Discussion:

Food appearance has a big impact on sensory evaluation since it frequently affects taste expectations and general enjoyment. With an average score of 8, most

people thought the *Cassia tora* Soup looked good. The highest grade (9) was often given, indicating that many judges found the soup's color, texture, and presentation to be aesthetically pleasing. The few lower ratings, however, suggest that some panelists thought the soup's look was unimpressive or not as attractive, which may have something to do with expectations or personal preferences.

Aroma:

Aromatic qualities are essential for arousing hunger, and in this instance, the panelists assessed the soup's scent. The average score for fragrance was 7.8, meaning that most panelists thought the scent was pleasant but not particularly so. Scores ranged from 6 to 9, with 9 being the most common score (9 occurrences). This indicates that a large number of panelists were pleased with the soup's aroma.

Discussion:

When it comes to eating, aroma is one of the most noticeable and impactful sensory aspects. The average score of 7.8 for fragrance suggests that *Cassia tora* Soup smells well, but the range of ratings suggests that some panelists didn't think the scent was as enticing. The strong herbal aroma of the *Cassia tora* leaves, which may not be to everyone's taste, might be the reason for the lower scores (6 and 7). The fact that most participants rated the soup favorably indicates that, with a few little changes, the scent may appeal to a wider audience.

Overall Acceptance:

Lastly, the soup's general acceptability was assessed, and ratings ranged from 6 to 9. The average score for overall acceptance was 7.9, indicating that the judges enjoyed the soup in general. The most prevalent response was a highly favorable one, as seen by the total acceptance mode of 9.

Discussion:

One important measure of how effectively a food product connects with its target market is overall acceptability. *Cassia tora* Soup has a great potential for consumer acceptability with a mean score of 7.9. The high frequency of 9 ratings indicates that a significant portion of the panelists thought the soup was very good. Some participants did not find the soup completely good, though, as indicated by the few lower scores (6 and 7). This might be connected to certain qualities like consistency, flavor, or aroma.

Cassia tora Soup obtained positive scores for all sensory aspects, including flavor, look, scent, consistency, and overall acceptability, according to the findings of the sensory evaluation. The majority of panelists like the soup, as seen by the mean ratings for all qualities, which varied from 7.8 to 8.0. Nonetheless, the existence of lower ratings (6 and 7) indicates that there is room for development to accommodate all customer preferences.

- With 12 out of 30 panelists giving the taste a 9, taste had the highest frequency of positive evaluations, suggesting that many participants thought the flavor was very good. However, minor tweaks to the seasoning can be required to accommodate a larger audience.
- The soup's visual attractiveness was deemed less striking by some, but appearance was also highly evaluated, with the highest score being given regularly.
- Responses to aroma were a little more mixed, with some panelists giving the soup's scent a lower grade than anticipated, indicating that not everyone would find the herbal scent appealing.
- There was a high level of acceptance overall, with several panelists awarding a 9, indicating a high likelihood of commercial success with just minimal adjustments.

Suggestions for Enhancement:

1. *Taste:* To balance the herbal flavor of *Cassia tora* and other ingredients, adjust the seasoning. This might entail boosting the overall complexity of the taste or lessening the potency of certain spices.

2. *Appearance:* Make an effort to improve the soup's color contrast or aesthetic attractiveness. The visual presentation might be enhanced by garnishes or minor modifications to the cooking techniques.

3. *Aroma:* Try adding complementing ingredients or lowering the strength of some spices that might overshadow the scent to balance the herbal aroma.

Summary:

Thirty panelists participated in the sensory evaluation of *Cassia tora* Soup in order to rate five important sensory qualities: general acceptability, consistency, taste, appearance, and scent. Each characteristic was scored by the panelists using a 9-point hedonic scale, with 1

denoting "dislike extremely" and 9 denoting "like extremely." The findings showed that the soup was rated well overall for every feature. With a mean score of 7.9, the soup's taste garnered the most positive evaluations, suggesting that the majority of panelists found it to be enjoyable. With a mean score of 8, the soup's appearance also received high marks, indicating that most participants found it visually appealing. However, a few lower ratings suggested that some participants were less satisfied.

Although some participants rated the soup's aroma lower, perhaps as a result of *Cassia tora*'s potent herbal perfume, the average score was 7.8, suggesting that the fragrance was generally pleasant. The soup's consistency scored an average of 7.9, indicating that while there was some variation in thickness preferences, the texture was generally good. With a mean score of 7.9 and a median of 9, the soup had excellent overall acceptability, indicating that most panelists thought it was very good. The common qualities ot *Cassia tora*, the main component of the soup, should be taken into account in addition to the sensory evaluation. The herbaceous plant *Cassia tora* is well-known for its many therapeutic and nutritional benefits. Its usage as a natural treatment for a number of ailments, including maintaining skin health, boosting digestive health, and functioning as an anti-inflammatory, are some of its noteworthy qualities. The plant is a healthy addition to the soup since it is high in vitamins, minerals, and antioxidants. Together with its culinary profile, these health advantages helped explain the soup's generally favorable reviews.

Conclusion:

With positive evaluations for flavor, look, consistency, scent, and general acceptability, *Cassia rora* Soup showed great promise in terms of sensory appeal. The soup appears to have considerable appeal based on the high mean scores for all characteristics, especially flavor and general acceptability. The few lower scores, however, point to areas that might have further improvement in order to accommodate a range of customer tastes, especially in relation to the soup's flavor, texture, and appearance.

Cassia tora gives the soup a distinctive and healthful component that improves its nutritional profile and may have medicinal advantages. Its skin advantages, digestive aid, and antioxidant qualities can make the soup even more appealing to consumers who are health-conscious. *Cassia tora* Soup can gain broader acceptance by resolving small issues such enhancing the flavor, texture, and scent. All things considered, the soup has encouraging commercial potential as a tasty and nourishing supplement to a range of diets. In addition to emphasizing the health advantages of its main component, *Cassia tora*, further research based on these findings can assist increase its acceptance and guarantee greater consumer happiness.

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