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## A study on development of value added food product: Aloe laddoo for therapeutic and medicinal properties

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### Abstract

India is known for its diverse rich sources of herbal plants over 3000 to 5000 species of medicinal properties. *Aloe vera* Barbadosensis Miller species has anti-inflammatory, antiseptic and antibiotic properties. The aim of the study was to develop and standardize a food product which would be beneficial to improve immunity with incorporation of *Aloe vera* for its therapeutic effects. The objectives of the study include standardization of the food product, conducting sensory evaluation, microbial analysis and assessing nutritional framework of the food product. The study consisted of phases wherein formulation, standardization, sensory evaluation and microbial analysis of the food product along with cost and nutritional parameters were evaluated. Aloe laddoo consists of edible *Aloe vera*, edible gum, wheat flour, gram flour, jaggery, desiccated coconut and ghee. The nutritional composition of the product per serving is 426 kcal, 52.7 g carbohydrates, 9.03 g proteins and 2.01 fats. After sensory evaluation and microbial analysis of the food product, the shelf life of laddoo was found to be approximately 15 days at cold temperature. Low microbial activity is seen with help of spread plate and pour plate techniques, hence ensuring food safety. The product was soft in texture, easy to digest and sweet in taste along with its immunity enhancing properties. Apart from this, moderate protein is ensured which adds to satiety. Hence, it can be consumed by people from all age groups. Since the importance of immune rich foods has become widespread post COVID pandemic, this laddoo is an excellent alternative immunity boosting recipe.

**Keywords:** Nutrition, therapeutic food product, immunity booster, superfood, *Aloe vera*, laddoo, healthy recipe, Indian recipe

### Introduction

India is known for its diverse rich sources of herbal plants over 3000 to 5000 species of medicinal properties (Petrovska, (2012) [11]. *Aloe vera*, a traditional herb, indigenous to most Mediterranean and African countries (Foster *et al.*, 2011) [5]. *Aloe vera* Barbadosensis Miller species has anti-inflammatory, antiseptic and antibiotic properties (Sánchez., *et al.* 2020) [15] Owing to its succulent properties, *Aloe vera* is a rich source of nutrients and essential minerals. It is among the oldest known medicinal plants gifted by nature; hence often called a miracle plant. It is the most applied medicinal herb used world-wide due to its properties of antiseptic, antibacterial, skin healer and immunity boosting. It can be addressed as a general health tonic which according to Bhowmik *et al.* has a composition of a large range of vitamins like vitamin B12, Vitamin A, B-complex vitamins, Vitamin C, Vitamin E and folic acid.

*Aloe vera* (*Aloe barbadensis* Miller) belongs to the Liliaceae family, traditionally being utilized as a contemporary folk remedy. There are over 250 species of *Aloe vera* grown around the world; Nonetheless only two species viz. *A. barbadensis* Miller and *A. arborescens* are considered of great importance in opinion to processing of it. Fresh *Aloe vera* leaves give two components, which is bitter yellow latex from peripheral bundle sheath called *Aloe vera* sap and a mucilaginous gel from parenchymatous tissue. The scrutiny and use of gel has increased dramatically in the field of health care and cosmetics. It can be utilized as a valuable added ingredient for food application due to its biological activities and functional properties. *Aloe vera* gel has a bitter taste which can be unpleasant in raw state and its palatability could be enhanced with addition of some other fruit juices.

*Aloe Barbadensis* Miller, one of the species of *Aloe vera*, has the whole extract component that exhibits essential biological effects. The leaves has thick epidermis consisting of mucilaginous gel in the parenchymal cells which manifests nutritious bio-active constituents including anthraquinones, alkaloids, enzymes, glycoproteins, vitamins and polysaccharides along with polysaccharides which are accountable for effective treatment for skin care as well as other therapeutic and cosmetic applications.

Recently, *Aloe vera* has captivated the attention as functional food in the health industry. The constituents like Anthrone, chromone, *Aloe vera* sin, hydroxyaloin, glycoprotein lectin A, glucomannan, and acemannan are among the many active ingredients with wound healing, anti-inflammatory, anti-tumor, anti-ulcer, anti-neoplastic, and anti-viral effects.

Hence, the aim of the present study is to develop a healthy product by incorporating *Aloe vera* gel extract into home based food products and study food development process through sensory evaluation, microbial testing and shelf life estimation.

## 2. Materials and Methods

### 2.1 Standardization of the product

#### 2.1a. Ingredients used to prepare the recipe

*Aloe vera* pulp (50 gram), Gram flour (30 gram), Jaggery (10 gram), Ghee (5 gram), Edible gum (5 gram), Semolina {Rawa} (15 gram), Nutmeg (2.5 gram), Desiccated coconut powder (garnishing- 5 gm) are the ingredients used to make the recipe of aloe ladoo. The traditional Indian home made ladoos are modified by addition of *Aloe vera* for medicinal and therapeutic properties.

#### 2.1b. Method of Recipe Making

In a kadhai (pan). Dry heat the besan flour and wheat flour until an aroma appears, and color changes into a slight goldenish brown color. In another small kadhai (pan), 5 g ghee is added and edible gum is shallow fried. The edible gum swells up, and the blending of the gum in the blender is carried out. Furthermore, the powdered edible gum is dry heated on low flame. Thereby, Jaggery (10 gm) and gram flour (30 gm) is added, on low flame along with powdered edible gum and a pinch of nutmeg powder. The mixture is prepared by the action of sauteing, melting of jaggery by heat, and the dough thickening process. After mixture preparation, the dough is kept aside to cool down, and brought to normal room temperature. Scrapped *Aloe vera* gel (50 gm) is added to the mixture at room temperature. Small, round, soft textured ladoos are prepared from this mixture. The ladoos are garnished with desiccated coconut.

### 2.2 Sensory evaluation

In order to evaluate a food product, a five-point likert scale was used to understand the perspective and view-point of consumers towards the product. The scale or ranking by the consumer was based on five sensory aspects. The scale was centered on the number of 3 for the value of 'average'. The sensory aspects considered were aroma, texture, taste, visual aspect (appearance) and overall quality of product mentioned in the scorecard. The sensory aspect of appearance or the visual aspect was the first pathbreaker in the eyes of the consumer. In spite of being a healthy product, visual appearance of the product, appealing to the consumer, was considered important. The texture of the product was determined to decide if the consumer considers the product as desirable and appealing. Other aspects like aroma and flavor

(taste) were considered dependent on each other and could decide if the product has the potential of what it claims to be (Pambo *et al.*, 2018)<sup>[9]</sup>.

### 2.3 Microbial Pour Plate Method

The pour Plate Method technique was established in the laboratory of Robert Koch is simple, less resource-consuming, easy, and economical; however, it requires the sample to be in liquid or suspension. The pour plate method is a microbiological laboratory technique for isolating and counting the viable microorganisms present in a liquid sample, which is added along with or before molten agar medium prior to its solidification. This technique is used to count viable microorganisms in the given sample by enumerating the total number of colony-forming units (CFUs) within and/or on the surface of the solid medium. It is mostly used for enumerating bacteria; however, Actinobacteria, molds, and yeasts can also be isolated and enumerated (Clark, 1965)<sup>[3]</sup>.

Prior to performing the pour plate technique, 1 ml of the sample is supposed to be serially diluted to make the microbial load in the sample between 20–300 CFU/mL (suitable colony counting range is 20–200). Certain points to be noted while preferring this technique are: If the sample is liquid, then it can be serially diluted with sterile distilled water or sterile broth.

If the sample is solid or semisolid, it must be first emulsified and then serially diluted to reduce microbial load up to the permitted range (Clark, 1965)<sup>[3]</sup>

The sample was added to the Petri plate and then the 15 mL of specific molten agar medium of about 40–45 °C (less than 50 °C) was poured in the Petri plate. After pouring in the Petri plate, the plate was swirled quickly to properly mix the sample with the medium. The medium is allowed to solidify and is incubated, usually at 37 °C for 24–48 hours to grow the microorganisms present in the sample. Following the incubation, the viable microorganisms in the sample will grow into visible colonies on the surface of and within the medium. The visible colonies can be counted and CFU/mL can be calculated using the following formula:

$$CFU/mL = \frac{\text{Total number of colonies obtained} \times \text{dilution factor}}{\text{volume of specimen used (aliquot)}}$$

Certain points noted are, if the colonies are uncountable or fused or more than 300 CFU/mL or less than 20 CFU/mL, it is recommended to repeat the process for getting the optimum count (Clark, 1965)<sup>[3]</sup>.

### The general procedure for performing the pour plate method can be summarized as follows

#### 1. Sample preparation

The sample was in solid form, therefore it was dissolved in sterile distilled water (1 gm mixed 9 ml of solvent to get concentration of 10-1 gm/ml) to make the microbial load to the range of 20–300 CFU/mL (Clark, 1965)<sup>[3]</sup>.

#### 2. Media preparation

Suitable media (general-purpose media like Nutrient Agar and Plate Count Agar for bacteria, and Potato Dextrose Agar or Sabouraud Dextrose Agar for fungi) were prepared and autoclaved. The media was allowed to cool to about 40–45 °C (maximum up to 55 °C). The sterile Petri plates were arranged and labeled at the edge of the bottom of the plate with required information (Clark, 1965)<sup>[3]</sup>.

### 3. Inoculation

1 ml of diluted sample was dispensed in the center of the Petri plate using a sterile micropipette or calibrated pipette. The lid of the bottle was opened and the mouth was flamed. 15 mL of sterilized molten media was poured at the appropriate temperature above the sample. The lid of the plate was closed then the sample in the media was mixed properly by gently swirling the plate. The plate was swirled in an “S” or “8” shape (Clark, 1965)<sup>[3]</sup>.

### Shelf Life of Product

Shelf life was determined by assessing the physical, sensory aspects and microbial content estimations. A small piece of the laddoo was kept in an airtight glass jar. It was kept in the refrigerator for evaluating the shelf life of the product to ensure the best period for consumption without any side-effects (Corradini, 2018)<sup>[4]</sup>.

### 3. Results

#### 3.1 Execution of the idea

The idea of incorporating therapeutic rich *Aloe vera* into traditionally made laddoos was executed by modifying the home-made laddoos into Aloe laddoos. The basic aim of incorporating *Aloe vera* into this recipe was to increase nutritional and therapeutic benefits in a food recipe consumed in Indian households on a common basis. The ingredients were selected in order to execute a sustainable product. Gram flour, Wheat flour, Ghee and Jaggery were selected as the ingredients to ensure perfect binding of the recipe. Firstly, the required amount of dry ingredients was weighed using a weighing scale. Furthermore, according to one serving, ingredients were cooked together to formulate a soft textured, sweet in taste, palatable laddoo. The laddoo also serves as a dessert alternative which can be provided to all age groups.

#### 3.2 Modification of the product

Modification of the product was made to improve the texture and taste by addition of granulated wheat (semolina) in powdered form instead of wheat flour. Additionally, *Aloe vera* was incorporated only after cooling down the dough mixture of laddoo to room temperature, in order to prevent the elimination or destruction of nutritive factors present in *Aloe vera* gel. The product was found to be soft in texture, easy to digest and sweet in taste along with its immunity enhancing properties. Apart from this, moderate protein was ensured which adds to satiety. Hence, it can be consumed by people from all age groups.

#### 3.3 Nutritional Content

According to Indian Food Composition Table 2017, the nutritional composition of the product per serving was found to be 426 kcal, 52.7 g carbohydrates, 9.03 g proteins and 2.01 fats. Each serving contains 6 small sized pieces of laddoo. Each laddoo consists of 43 kcal, 6 gm carbohydrates, 1.25 gm proteins and 0.95 gm fats. Based on previous published literature, research suggests that *Aloe barbadensis miller* species provide Vitamin A, Vitamin C, Vitamin E, Thiamine, Riboflavin, Cyanocobalamin, Choline, Folic acid and many other antioxidants. Other health benefits are wound healing, prevention from progression towards conditions like kidney stones, cancer, high cholesterol and high blood pressure (Keerthi *et al.*, 2016)<sup>[6]</sup>. Edible gum being a winter superfood builds immunity and stamina with added benefits of *Aloe vera*. Besan adds up to the protein requirement and helps in binding of laddoo.

**Table 1:** Nutrition value of the product

Nutritional Content		
Ingredients	Per laddoo (16 gm)	Per serving (100 gm)
Energy	43 kcal	255 kcal
Carbohydrate	6 gm	25.5 gm
Sugar	1.6 gm	10 gm
Protein	1.25 gm	7.5 gm
Fats	0.95 gm	5.7 gm
Fibre		4.72
Soluble:	0.78 gm	3.50
Insoluble:		1.22



**Fig 1:** Aloe Laddoo

#### 3.4 Sensory Evaluation

The recipe was highly acclaimed by the testers assessing food quality, sustainability and practicality to express the therapeutic effect of the product. The objective of the food evaluation included characteristics such as ‘taste’, ‘appearance’, ‘texture’, ‘odor’, and ‘overall quality’. Score ranging from 1 to 5 was assigned to such characteristics, wherein 2, 4, 5 score was mostly provided by the testers for this product. Hence, the product was approved for further product specification process.

#### 3.5 Product Specification

**3.5 a. Microbial Analysis:** In Order to check microbiological safety, analysis was performed by the pour plate method. Minute sample of the product was placed in a tight container preventing microorganism exposure. Afterwards the sample was placed in a selective culture medium and incubated at 25 degree celsius. The microbial tests revealed that the product is sustainable for future use. The pH found was about 3.45 and bacteria count was about 25-250 CFU/gm. Therefore, microbial analysis revealed that further speculation of assessing shelf life and sustainability can be predicted.



**Fig 2:** Microbial Analysis

### 3.5 b Shelf Life

The formulated product was stored in a tight closed glass jar at the refrigerator to avoid any contamination and test the shelf life. It was found that the product sustained for approximately 15 days after which the color and texture started to fade away.

### 3.5 c Label Information

The label information should include specification of preserving the product by refrigerating and details regarding storage like shelf life of the product which was found to be 15 days.

## 4. Discussion

According to recent literature, beneficial composition of *Aloe vera* gel diminishes if heat treatment is given for a longer period of time, therefore in this study heating of *Aloe vera* was completely avoided. *Aloe vera* was directly added to the dough mixture at room temperature. Even if microbial quantity is reduced by heating, mucopolysaccharide structure was seen to deteriorate (Ramachandra & Rao, 2008) [13]. Therefore for therapeutic effect, *Aloe vera* gel was scooped out from parenchyma cells of fresh *Aloe vera* leaves. The mucilaginous gel loses its properties when exposed to air, therefore storing of the *Aloe vera* gel before cooking is a crucial step. The entire process of development of food product starting with execution of the idea by considering practicality and benefits, making of the product by trial and error of the recipe many a times, modification for better adaptability, sensory evaluation to judge the view of consumers, microbial analysis to interpret the bacterial content to take the process forward and finally estimating the shelf life of the product gives detailed overview of generation of this food product. The food product helps in the introduction of therapeutic superfoods like *Aloe vera* in day to day foods. Studies have suggested certain contraindications of *Aloe vera* use: It may cause redness, burning, stinging sensation and rarely generalized dermatitis in sensitive individuals. Allergic reactions are mostly due to anthraquinones, such as aloin and barbaloin. Abdominal cramps, diarrhea, red urine, hepatitis, dependency or worsening of constipation. Contraindicated in cases of known allergy to species of the Liliaceae family. In such cases label information should be specific about such contraindications. To the best of the author's knowledge, this is the first study that assimilated *Aloe vera* as a therapeutic addition to Indian home-made foods which are easily made with day-to-day used ingredients. Increasing the nutritional compositions, therapeutic effects of Indian recipes was the major ultimatum which was found to be constructive and effective. The main limitation of this food development process is that storing ladoos in room temperature is restricted and shelf life more than 2 weeks is not considerable. The study contributes to existing published literature about use of *Aloe vera* in food products. The process of food product development was found to be quite effective and successful.

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