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FORMULATION AND EVALUATION OF PAPAYA LEAF ENRICHED CHOCOLATE

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ABSTRACT
Papaya (Carica Papaya Lin) are rich in bioactive compounds including flavonoids and alkaloids and papain these are well known for their antioxidant and therapeutic benefits. These study focuses on formulating and evaluating a functional chocolate enriched with papaya leaf juice to enhance its health benefits because chocolate is the most acceptable by children and it will be a best approach for incorporating papaya benefits in the diet of children. It will be highly useful in the dengue pediatric patients to increase the platelet level. The approach helps to develop a new formulation of papaya leaf. The study suggest that papaya leaf chocolate can serve as a functional nutritious product. The formulation was assessed for texture, sensory, acceptability and shelf life. The formulation maintained a desirable textures, taste and overall acceptability. Pineapple juice was used in this formulation to mask the bitter test of Papaya juice.

KEYWORDS: *Papaya Leaf Juice, Pineapple Juice Dark Chocolate, Cardamom, Arrowroot Powder.*

1. INTRODUCTION

Functional foods are special foods that offer extra health benefits beyond just providing basic nutrition. They can help prevent diseases fix nutrient deficiencies and even promote growth and development. Examples of functional foods include fortified foods with added vitamins, minerals, probiotics or fiber as well as nutrient rich fruits and their parts, vegetables, nuts and whole grains. Various useful benefits of functional foods are described below.

May prevent nutrition deficiency as these have rich source of important nutrients involving vitamins, minerals, healthy fats and fibers. It may also give protective action against certain diseases. The large number of antioxidants present in functional foods help to destroy free radicals and prevent certain chronic conditions like heart disease, diabetes, cancer.

Certain foods rich in fiber can help regulate blood sugar levels and support growth by providing essential nutrients. Chocolate, with its rich flavor profile, can mask unpleasant tastes of active ingredients. Derived from fermented cocoa beans, chocolate comes in various forms, such as liquid, paste or blocks. When infused with drugs, chocolate can deliver medication while bypassing first-pass metabolism, offering a unique drug delivery system.

Chocolate's versatility allows it to be formulated into diverse flavors and textures, and its low water content makes it resistant to microbial growth and hydrolysis. These properties, combined with its palatability, make chocolate a promising medium for medicine delivery, offering a stable and effective way to administer drugs.[2]

Medicated chocolate is a Novel Drug Delivery System where a suitable drug is incorporated into chocolate. Chocolate composition including polyphenols and antioxidants from cocoa makes it a unique medium for delivering of active ingredients. It's semi-solid suspension properties allow for the incorporation of fine vehicle for various therapeutic applications.

Medicated chocolate is prepared using the chocolate base and drug is infused in this prepared base. Medicated chocolate is found to be best approach to administer drugs to the children via oral root as it increases patient compliance by masking its taste. Many phytochemicals have bitter, unpleasant and dis-agreeable taste so medicated chocolate will be an efficient approach to overcome this.[3]

Papaya leaves contain various nutrients and compounds including vitamin, minerals, magnesium-ion, carbohydrates, proteins, phytochemical like tannin, saponins and flavonoids. Showing potential in cancer prevention by suppressing DNA topoisomerase altering signaling Pathways. Immune system modulation by increasing nitric oxide cytokines. Anti-inflammatory effects by modulating Pro-inflammatory cytokinin's. Dengue treatment through activating specific genes.

It is taken in various forms such as juices, capsules and some new approaches towards the formulation of papaya include

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nanoparticle of Papaya leaf popping balls etc.[4,5] The objective of this study is to formulate and develop a Papaya leaf chocolate that combines the nutritional benefits of chocolate with therapeutic properties of Papaya leaf juice. The study aims to develop a stable and palatable chocolate formulation incorporating Papaya leaf juice because chocolate is most widely consumed food and children friendly.

The chocolate was evaluated for general appearance, physical evaluation, also evaluated for presence of carbohydrate, proteins, amino acids and stability. Assess the acceptability and consumer preference of the Papaya leaf chocolate that promote health and well-being.

2. NEED OF WORK

- Utilize papaya leaf's nutritional benefits: Incorporating nutrients of papaya into chocolate can provide a unique way to consume these nutrients.
- Explore alternative uses for papaya leaves: This work explores their potential as a functional food ingredient.
- Develop a novel functional food product: Papaya leaf chocolate can offer a new and innovative way to deliver health benefits.
- Evaluate the physicochemical and sensory properties: This study assesses the chocolate's quality, stability, and acceptability, ensuring it meets consumer expectations.
- Develop a product that combines nutritional value with a delicious taste.

3. OBJECTIVE

- To formulate a papaya leaf enriched chocolate with more nutritional properties.
- To develop a papaya leaf chocolate that is acceptable by dengue patients.
- To mask and reduce bitterness of papaya leaf juice.
- To develop a papaya leaf formulation that is acceptable by pediatric patients.
- To add therapeutic benefits of papaya leaf in chocolate.

4. ADVANTAGES OF CHOCOLATE DRUG DELIVERY SYSTEM

- It serves as water resistant medium for active agents sensitive to moisture.
- Exhibiting resistance to microbial growth
- Resistance to hydrolysis
- Avoid first pass metabolism of drug

5. CHOCOLATE FUNCTIONAL PROPERTIES

The history of chocolate spans thousands of years originating from ancient miso America during the time chocolate gain large popularity. Chocolates popularity endures across age groups worldwide making it a beloved treat. Chocolate has various potential health benefits due to its rich composition of bio active compounds.[6]

- Chocolate can support gut health
- Flavonoids, phenolic acids and procyanidins in chocolate protect against cell damage.
- Chocolates polyphenols reduce the risk of cardiovascular disease.
- Neuro-protective effects of chocolate flavonoids may help improve cognitive function reduce the risk of neuro-degenerative disease like Alzheimer's and promote neuroplasticity.
- Chocolate contains compounds like serotonin and phenyl ethyl amine which can help improve mood and reduce stress.
- Chocolate reduce inflammation, some studies suggest that chocolate polyphenols may help to prevent the growth of certain types of cancer.[7]
- Chocolate can be used as a medium to administer medicines that are bitter in taste. Chocolates are rich in carbohydrates fat and fat nutrient flavonoids this assures the health benefits of dark chocolate.[6]

6. MATERIALS AND METHODS

➢ **Materials**

- Papaya Leaf Juice
- Pineapple juice
- Arrowroot powder
- Amla
- Milk powder
- Cardamom
- Dark chocolate

6.1. Papaya Leaf Juice



Fig (1) Papaya Leaf Juice

Scientific name: Carica papaya lin.

Family: Caricaceae

Common names: Papaya, pawpaw.

Native origin: Tropics of American and was first cultivated in Mexico.

Papaya leaf juice may have following health benefits such as it is used as platelet increasing herb in Dengue fever, have wound healing properties and promote tissue repair. May prevent or slow cancer cell growth, relieve digestion disorder such as colic and stomach pains. It may help relieve diarrhea and gastro-intestinal issues. Also has antioxidant and anti-inflammatory effects, collagen production and immune function.

Papaya leaves are rich in vitamins like Vitamin A, C, E, also contain minerals like magnesium and iron. Phytochemical composition of papaya leave are alkaloid, flavonoids such as quercetin and kaempferol. Saponins is a type of glycoside

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which have antimicrobial and inflammatory properties. Its bitter taste limits its use which is due to the presence of saponin in it.[8] So, to increase the use of papaya in medicine and enhance patient compliance this study aims to develop Papaya leaf chocolate to hide its bitter taste and incorporate its medicinal and nutritional ingredients in chocolate.[4,5] Figure 1.

6.2. Pineapple Juice



Fig (2) Pineapple Juice

Scientific name: Ananas comosus
Family: Bromeliacea
Common name: Pineapple
Native origin: South America.
Bromelain enzyme helps breakdown protein and supports gut health. It reduces swelling and pain conditions like arthritis, supports bone health, Boost immunity, prevent cancer, manage cardiovascular health and fertility. May help in weight management.[9] As seen pineapple is rich in nutrients and has various health benefits it also shows promising bitter and unpleasant taste masking properties. In a study pineapple juice was used to mask the bitter taste of turmeric and ginger. So, in this work Pineapple juice is used as a bitter taste masking agent.[10] Figure 2.

6.3. Arrowroot Powder



Fig (3) Arrowroot Powder

Scientific name: Maranta arundinacea linn
Family: Marantaceae
Native origin: West Indies, Indonesia,
Philippines, India, Sri Lanka.
Arrowroot powder is a starch extracted from rhizome of several tropical plants. It contains carbohydrate, fats and proteins which help to nourish human cells. It is widely used in food industry as a natural thickening agent due to high viscosity, stabilizing agent due to neutral taste, fine texture, excellent digestibility. Arrowroot powder contains Amylopectin and amylose give it strong thickening properties. Arrowroot thickens at lower temperature. So, it helps the product to thicken and stay stable.[11] Figure 3.

6.4. Amla



Fig (4) Amla Powder

Scientific name: Phyllanthus Emblica linn.
Family: Euphorbiacea
Common name: Amla, Balaka, kimalaka, kemlaka.
Native origin: India, Sri Lanka, Malaysia,
China.
Amla is an Indian gooseberry which is rich vitamin C, Magnesium, Manganese, potassium, phosphorus and zinc etc. This gives various health benefits like anti-inflammatory, in cardiovascular health, as antioxidant, boost immune system, prevent aging. As Amla has large amount of antioxidant it can prevent the oxidation and degradation of the product for long period of time and improve shelf life of product. It adds vitamins, minerals and antioxidants to the papaya chocolate.[12] Figure 4.

6.5. Milk Powder

Dairy ingredients like milk powder, butter milk and lactose are essential in chocolate making which help in enhancing flavor, adjusting texture and influencing processing. Milk powder impacts chocolates viscosity, tempering, temperature and improve texture. In the creation of chocolate, milk powder serves as a practical substitute for liquid milk. The properties of milk powder significantly impacts the characteristics of chocolate. Free milk fat improves bloom stability, particle shape, size and quality of chocolate.[13]

6.6. Cardamom

Scientific name: Elettaria Cardamom
Synonyms: Cardamom, Elaichi
Family: Zingiberaceae
Native origin: Southern India, Sri Lanka, Tanzania.
Chemical constituents of it are Essential oils like cineole, terpinene, linalool, eugenol, terpenes. It is traditionally used as a digestive agent and in respiratory disorders. Also shows effective activity against microbe's also acts as antiseptic, carminative. Cardamom is a priced spice renowned for its distinctive aroma and flavor derived from seed of Elettaria Cardamom Maton. Cardamoms unique flavor and aroma are attributed to its essential oils comprising Alpha terpinol acetate and 1,8-cineole. Due to its aromatic and flavoring agent it is

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used in medical products to mask taste. In the study it is used as a flavoring agent.[14,15]

6.7. Dark Chocolate



Fig. (5) Dark Chocolate

Botanical name: Theobroma Coca

Synonym: Cocoa tree, Coca tree

Family: Malvaceae.

Chemical constituent: flavonoids, polyphenol, Fatty acids, phenylethylamine

Dark chocolate is a versatile and nutritious food that offers numerous health benefits due to rich contains of oxidants, flavones and Polyphenols. It has potential to prevent cardiometabolic illnesses, improve cardiovascular outcome, protect against cell damage and inflammation. Boost blood flow to brain improving cognitive function. Phenylethylamine stimulates the brain to produce endorphins.

It has ability to mask the bitter taste. In present study dark chocolate serves as the base for the incorporation of carica papaya leaf juice aiming to develop a novel and palable functional chocolate with potential health benefits.[15,16] Figure 5.

MATERIALS



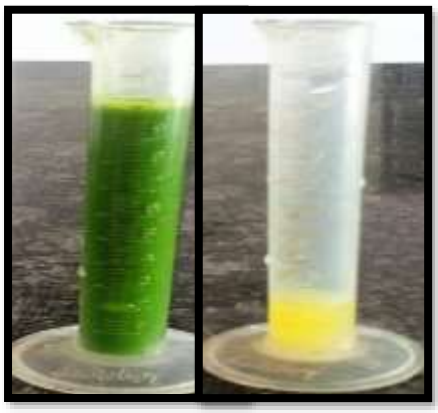


Fig (6) Materials

Table: 1 Materials

Sr. No.	Ingredients	Quantity taken			Category
		F_1	F_2	F_3	
1.	Dark chocolate	20g	20g	20g	Antioxidant Agent
2.	Papaya leaf juice	5 ml	10 ml	20 ml	Herbal extract
3.	Pineapple juice	2 ml	2 ml	2 ml	Taste masking agent
4.	Arrowroot powder	2g	2g	2g	Thickening agent
5.	Amla powder	1g	1g	1g	Preservative
6.	Milk powder	4g	4g	4g	Flavouring and Texturizing agent
7.	Cardamom powder	0.3g	0.3g	0.3g	Flavouring agent

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6.8. METHOD

Fresh papaya leaves were thoroughly washed under running water to eliminate dust and impurities and crushed using a mechanical juicer to extract juice.

⇩

Dark chocolate was melted using hot water bath. To the melted chocolate freshly extracted papaya leaves juice, Pineapple juice and arrowroot powder where added.

⇩

The mixture was heated on water bath for approximately 10 minutes with continuous stirring.

⇩

Add Amla powder, Cardamom powder and milk powder to the mixture. Heating was continued for an additional 2 minutes.

⇩

After achieving the desired consistency, the heating process was stopped. The warm chocolate preparation was poured into silicon mold and placed in a freezer for 2 to 3 hours.

⇩

Once fully set the chocolate were demolded and packed into aluminum wrappers.[17,18]



Fig (7) Chocolate formulation

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7. EVALUATION TEST OF CHOCOLATE

7.1. General appearance or organoleptic evaluation.

In this chocolate is evaluated for its color, odor, texture of chocolate etc. It is important to ensure that chocolate is formulated in such a way that it will be readily acceptable by the consumers and is formulated within the criteria of formulation.

7.2. Physical Evaluation

7.2.1. Melting Point

It is conducted to determine melting point of the chocolate. To perform this, experiment a simple set up was assembled. Glass beaker containing water was placed on a tripod stand and burner was positioned underneath to heat the water. A porcelain dish holding the medicated chocolate and a thermometer were placed on top of the beaker this setup allowed for control heating and temperature monitoring.[19]

7.2.2. Weight Variation

The weight of different chocolate recipes was measured individually and collectively. The average weight was calculated and compared to each individual weight using a formula to determine the percentage deviation. This help assess the consistency of chocolate products.

7.2.3. Hardness

To evaluate the hardness of a material a simple test can be performed. An indenter a specially designed object is pressed into the material surface with a specified force the hardness is then determined by measuring either the depth of the intenders or size of the resulting impression. This test provides valuable information about the materials resistance to deformation and wear.[18]

7.2.4. Fat Bloom Test

To check for fat Bloom the chocolate was subjected to a temperature cycle heated to 40 degrees Celsius for 30 minutes then cool to 20 degrees Celsius and keep for 8 hours. After this process the chocolate sample was inspected for signs of bloom, which appears as a whitish or streaked appearance on the surface.[20]

7.3. PH test

The pH of the chocolate formulation was measured using pH meter.[21]

7.4. Chemical Test

- Test for carbohydrates:

The Fehling's test is a simple chemical test used to detect carbohydrates in samples including herbal chocolate.

- Test for proteins:

The protein test is a laboratory analysis used to determine the protein content in herbal chocolate. This test is crucial for evaluating the nutritional value of product.

- Test for amino acids:

To test for amino acids the solution was heated and mixed with 5% Ninhydrin after boiling for 10 minutes a purple or blue color indicated the presence of amino acids confirming a positive result.[18,22]

7.5. Stability

The formulated chocolate was tested. The chocolate was wrapped in aluminum foil and evaluated for organoleptic properties including color, odor, taste and appearance to assess their stability and quality over time.[22]

8. RESULT AND DISCUSSION

Table: 2 Observation

Sr.No.	Test	F_1	F_2	F_3
1.	Appearance	Glossy, Shiny,	Glossy, Shiny,	Glossy, Shiny,
2.	Color	Non-streaks	Non-streaks	Non-streaks
3.	Texture	Dark brown	Dark brown	Dark brown
4.	Taste	Smooth	Smooth	Smooth
5.	Odor	Sweet	Sweet	Sweet
6.	Melting point	39°C	37°C	30°C
7.	Hardness	4.1 Kg/cm2	4.17 Kg/cm2	3.1 kg/cm2
8.	Fat bloom	No	No	No
9.	pH	6.7	6.5	6.4
10.	Stability	Stable	Stable	Stable

8.1. General appearance / organoleptic evaluation

- **Appearance:** All the formulations of chocolate appeared Glossy, Shiny, with no streaks. Color of the chocolate formulations appeared dark brown showing uniformity in the chocolate formulation process.
- **Texture:** F_1 and F_2 formations had a smooth texture indicating proper blending and homogenization of ingredients but F_3 had very smooth texture and did not harden properly due to large amount of papaya juice.
- **Taste:** All chocolates had a sweet test across all formulations does have a balance sweetness.
- **Odor:** F_1, F_2, F_3 had a pleasant smell.

8.2. Physical evaluation

8.2.1. Melting point

Melting point of formulations were observed as follows. F_1 and F_2 formulations have a melting point which is perfect for oral disintegration of chocolate indicating that it will be easily soften quickly at body temperature. F_3 has less melting point

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than above two due to which chocolate melted quickly at room temperature.

8.2.2. Weight variation

The average weight was determined and calculated the percentage deviation by using the formula of weight variation. The weight variation was found to be 0.81% for F_2 formulation.

8.2.3. Hardness

Hardness test done using an intender confirming that F_1 and F_2 chocolate formulated are within an acceptable hardness range. F_2 shows an ideal hardness for regular consumption with good handling properties.

8.2.4. Fat Bloom test

After 20-degree Celsius heating the samples for 8 hours were observed for fat bloom. As no fat Bloom was observed this indicated proper fat distribution and chocolate is prepared properly this ensure chocolate stability during storage.

8.3. pH test

The pH of the formulation found to be within a closed range of 6.4 to 6.7 indicating stability in acidity of formulation. Figure 8.



Fig (8) pH of Chocolate

8.4. Chemical test

- **Test for carbohydrates**
  A mixture of equal parts Fehling's solution A and B was added to the sample and heated. The appearance of a brick-red colour confirmed the presence of carbohydrates.
- **Test for proteins**
  Add 1 to 2 ml of sodium hydroxide solution, then add 5 to 6 drops of copper sulphate solution to it. Appearance of violet color indicates presence of protein.
- **Test for amino acids**
  Test solution is heated and 5% ninhydrin solution was added and boil it for 10 minutes. Appearance of purple or bluish color indicates presence of amino acids.

8.5. Stability

The chocolate was found to be stable with no significant changes in physical appearance and organoleptic properties.
Above all the formulation F_2 showed the results within acceptable criteria.

9. CONCLUSION

The study successfully formulated and evaluated papaya leaf chocolate, combining the nutritional benefits of chocolate with the therapeutic properties of papaya leaf juice. The results showed that Formulation F_2 exhibited optimal physical properties, including a smooth texture, glossy appearance, and suitable melting point (37°C). The chocolate formulations demonstrated stability, with no significant changes in physical appearance or organoleptic properties. Chemical tests confirmed the presence of carbohydrates, proteins, and amino acids. The pH range (6.4-6.7) indicated stability in acidity.

Formulation F_2 stood out for meeting key standards in hardness, weight variation, and resistance to fat bloom, showcasing its potential as a functional food. This innovative product leverages papaya leaf's health benefits, positioning it as a promising option in the functional food market. The study highlights the therapeutic potential of papaya leaf chocolate, emphasizing its safety and benefits. Future research and clinical trials could further validate its effectiveness and long-term health impacts.

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