IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 3, April 2025
Impact Factor: 7.67

# Formulation and Evaluation of Mullberry Syrup

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**Abstract:** *This fruit provide high level of an anthocyanins, (they are the class of water soluble flavonoids widely present in fruits and vegetables) glycosides and chlorogenic acids. Mulberry plant belongs to family moracea from the genus morus. They contain certain biologically active compounds in its fruits provide several pharmacological benefits to health. This study examine the colour, phytochemicals compounds and antioxidant activity of mulberry fruits at different ripening phase. The fruits change the colour from green to white and red to black colour. The green stages contain high level of vitamin C (12mg/gdw) while black stage has highest sugar level particularly fructose (241mg/gdw) and glucose (171mg/gdw). Phenolic acid, flavonoids and y- aminobutyric increase when the ripening level increases. The important biological and chemical characteristic of mulberry fruits, such as antibacterial, antidiabetic, antioxidant, hepatoprotective, anti-inflammatory as well as anti-cancer and hypolipidemic effects. During ripening stage of mulberry fruits, different phytochemicals are present.The purpose of this work is to restore human health through analysis of leaves and fruits of mulberry plant. Mulberries, rich in nutrients and polyphenols, may be used as plant diet to help treat metabolic syndrome. Mulberry a plan rich in special chemo factor including b- sitosterol and Morin, is used to raise silkworms and may be utilized to treat diseases because of its flavonoids, anthocyanins, and alkaloids.*

**Keywords:** anthocyanins, flavonoids, antioxidants, phytochemicals, sugar, ripening stage, phenolic acids, etc

## I. INTRODUCTION

The mulberry fruits (morus alba L) which is widely grown in tropical regions like china, India,thailand and belongs to the moracea family and genus morus [1,2,3]. Due to bioactive chemicals, mulberry parts such as leaves, fruits, branches and root barks have antibacterial, antioxidant, hypolipidemic, glucosidase inhibiting the antihyperglycemic, antiobesity and antineoplastic propertie [4,5]. Mulberry plants are deciduous trees that quickly and short proliferation periods. They do well in tropical, subtropical and temperature climate [6]. Mulberry is a perennial and woody plants belongs to family moracea and genus morus. Mulberry leaves have been used for year to hyperglycemia, inflammation, cough, hypertension, cancer and fever[7]. Mulberry showed high antioxidant activity in LDL oxidation assay [8]. The fruits of mulberry are known as toot and shahtoot ( king's or "superior" mulberry). The mulberry fruits is multiple about 2-3centimetres. These fruits are consumed in different forms such as juices, wine, jams, jelly and other products for benefits of human health as they contain high quantity of carbohydrates [9].

This fruits has several medical uses they are used to cure:

- Fever
- Depression
- Tinnitus
- Weakness
- Anemia
- Dizziness
- Constipation etc.

Neutraceuticals such as minerals and vitamins available in mulberry fruits can treat many chronic diseases. This are highly cross-pollinated, seed-propagated plant with a wide range of growth forms and fruits and leaf characteristic [10]. Quantity of polyphenols, among which most common are rutin, quercetin, kaempferol, galliic acids and chlorogenic acid, present in fruits play an important role in antioxidative process and have benefits for heart, joints, blood sugar


DOI: 10.48175/IJARSCT-25076

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level [11]. Fresh fruit of mulberry are highly rated for human health because it contains vitamin, amino acid and different minerals such as Zn, Ca, Mn and Fe along with pectin and fibrin. Mulberry juice kept under a cold storage at a particular temperature for six months to one year has proven effective for an healthy skin and in prevention of throat infection [12].

Fig.1.Fruit of mulberry

### 1.1 BOTANICAL DESCRIPTION OF MULBERRY PLANT

Before conducting any plant investigation, it is crucial to through review it's botanical details, including its characteristic such as it's fast growth, woody, deciduous, deep and wide rooted nature [13]. Mulberry fruits are white to reddish colour and during the time of ripening it becomes purple or black in colour. Fruits contain many drupes which are enclosed in a fleshly perianth, upto 5cm long sub- globose or ovoid in shape. Ovary of mulberry is unicellular with presence of stigma [14]. Generally the height of mulberry is approximately 5.6 feet from ground level [15]. Mulberry leaves vary in size and shape, measuring 5.75 cm in length and 6-10 cm in width. They have sharp apex and are heavily lobed or serrate with acute apex

| Mulberry | |
|---|---|
|  | |
| *Morus nigra* | |
| **Scientific classification** | |
| Kingdom: | Plantae |
| *Clade*: | Tracheophytes |
| *Clade*: | Angiosperms |
| *Clade*: | Eudicots |
| *Clade*: | Rosids |
| Order: | Rosales |
| Family: | Moraceae |
| Tribe: | Moreae |
| Genus: | ***Morus*** L. |

Table.1.

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### 1.2 NUTRITIONAL VALUE OF MULBERRY

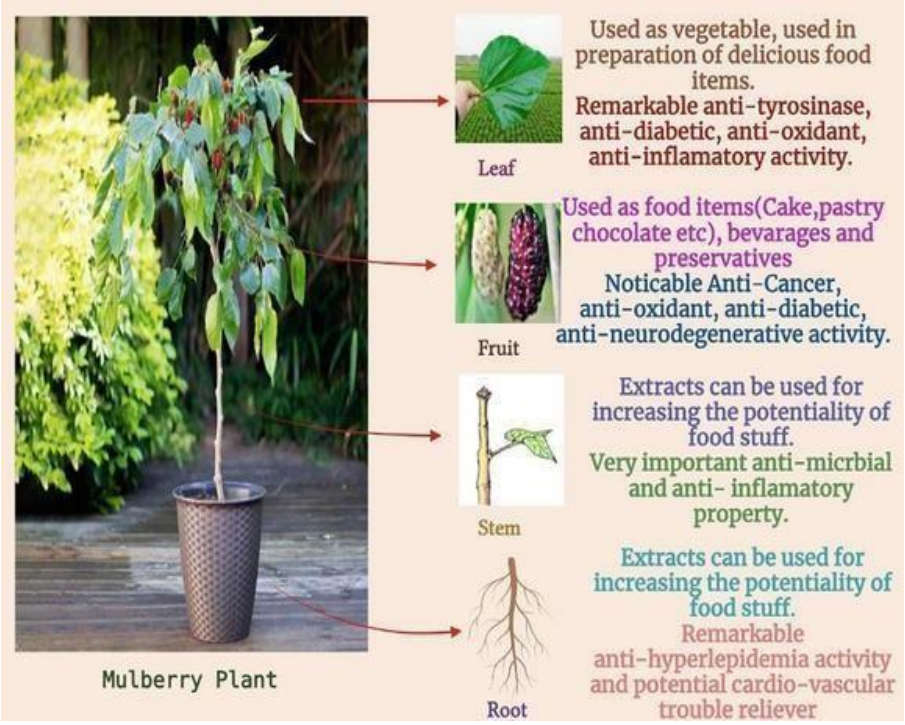


**Fig.2. Nutritional Value of Mulberry**

These fruits are less in calories (43 calories per 100 gram) they are composed of health enhancing phytonutrients compounds which includes polyphenols pigments antioxidants, minerals, vitamin, lipids, protein, dietary fibre, high water content. nutritional profile of various mulberries are pretty much same.mulberry are rich source :

- Vitamin K
- Vitamin C
- Vitamin A
- Vitamin E

### 1.3 NUTRITIONAL FACTS

Fresh or dried mulberries have high water content ( 88%) and low protein content ( 1.4%) making them heavy in carbohydrates, fibers, protein and also the fats.

- Calories -43
- Water - 88%
- Protein -1.4 gm
- Carbs-9.8 gm
- Sugar -8.1 gm
- Fibres- 1.7 gm
- Fats- 0.4 gm

Vitamin Content of Mulberry Fruit Per 100g [Table.2.]

| Vitamin | Amount | % |
|---|---|---|
| Vitamin C | 36.4 mg | 61% |
| Vitamin K1 | 7.8 mcg | 10% |

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| | | |
|---|---|---|
| Vitamin B2 | 0.1 mg | 6% |
| Vitamin E | 0.9 mg | 4% |

**Minerals content of mulberry fruits per 100g [Table.3.]**

| **Minerals** | **Amount** | **%** |
|---|---|---|
| Iron | 1.9 mg | 10% |
| Potassium | 194 mg | 6% |
| Magnesium | 18.0 mg | 5% |
| Calcium | 39.0 mg | 4% |

- **Carbs**- Fresh mulberries consist of 9.8% carbs or 14 grams per cup (140 gm) these carbs are mostly simple sugars such as glucose and fructose, but also contain some starch.
- **Fibres –** Mulberries have decent amount of fibre corresponding to 1-7% of Fresh weight. the fibres are both soluble (25%) in form of pectin and insoluble (75%) in form of lignin.
- **Vitamin and minerals –** Mulberries are rich in many vitamin and minerals, particularly vitamin C and irons:
- **Vitamin C –** An essential vitamin that is important for skin health and various bodily functions
- **Iron –** An important minerals that has various functions such as transporting oxygen throughout your body
- **Vitamin K1-** also known as phylloquinone, vitamin K is important for blood clotting and bone health
- **Potassium –** An essential minerals that may lower blood pressure and reduce your risk of health.

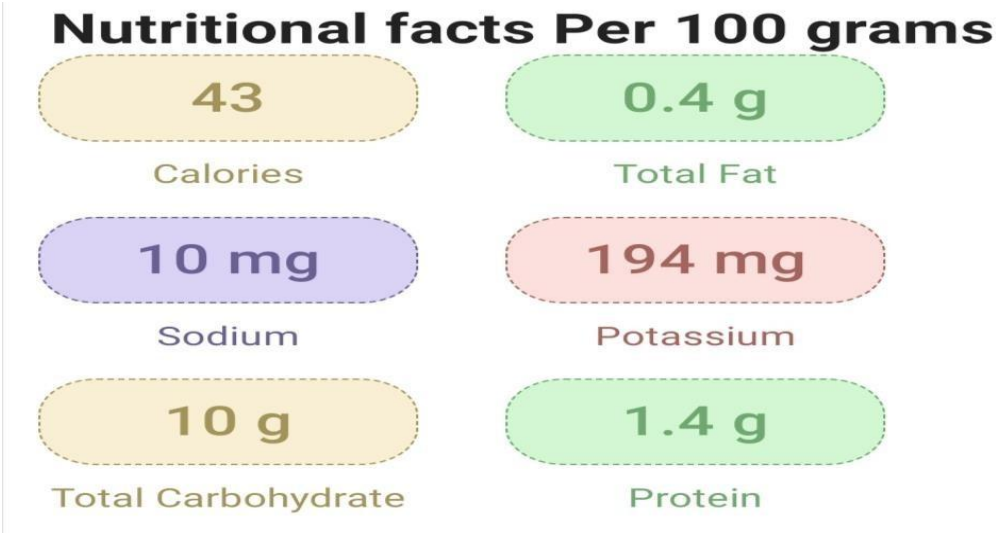


Fig.3. Nutritional facts Per 100 grams

**1.4 DESCRIPTION OF PARTS OF AN MULBERRY PLANTS**

- **MULBERRY LEAVES –** Mulberry leaves are the sole know food source for silkworms because they are rich in bioactive chemicals, vitamin, organic acids, minerals and proteins that are essential for an silkworms development [16,17,18,19].

  Three different varieties of mulberry leaves were investigated by Iqubal 2012 [ 20]. Three varieties of mulberry, M. alba had highest lipids content, M-rubra had the highest protein level, while M. nigra contained high amount of an fibres.

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- **MULBERRY TWIG AND ROOT BARKS –** Mulberry twig are used in medicine because they have potential to heal major illness in human. They are rich in tannin, arabinosis, glucose, fructose, maltose and stachyose [ 21,22 ]

**1.5 TYPES OF MULBERRY**

mulberries are divided into three distinct Species based on their colours. they are white mulberry, redmulberry,black mulberries etc Scientifically name of white mulberry is morus alba. These are Native to chaina and often bred for silkworms productions.

**WHITE MULBERRY**

Leaves are simple, alternate, and 2–6 inches long with 0–5 lobes. They have a pointed tip, coarse teeth, and three main veins that Originate from the base. The undersurface is smooth and paler than the top.

Fig.4.White Mulberry

**RED MULBERRY**

known as morus rubra these are native to eastern United State and are usually identified as the American mulberry. Leaves are simple, alternate, and 2–8 inches long. They are generally heart-shaped but can have 0–3 lobes. The leaf margins are saw toothed but are soft to the touch. The leaves are dull, dark green, scabrous (rough) on top, and usually lightly hairy beneath. The mulberry tree can reach a height of 20 to 30 feet and lifespan of 300 years
It grows on deciduous, small to medium-sized trees and shrubs with broad lobed leaves.

Fig.5. Red Mulberry

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**BLACK MULBERRIES**

known as morus nigra these are step or type Of an fruits. These fruits provide many nutrients, fibres, protein.

Fig.6. Black Mulberry

## II. PHARMACOLOGICAL PROPERTIES OF AN MULBERRY FRUITS

**ANTI-CANCER**

Mulberries contain active ingredients that can modulate apoptosis and matrix metalloproteinase, thus preventing cancer progression (Huang et al.,2013)[23]. The anti-tumor property of mulberry fruits extract (MFE) was due to progressive inhibition of nitric oxide. No Production in lipopolysaccharide (LPS) stimulated RAW 264.7 cells. Mulberries contain compound called anthocyanins, which have Chemopreventive, anti-inflammation, and antioxidant qualities. The mulberry plant contains cyanide 3-rutinoside and cyanidin 3- Glucoside, which have strong anti-cancer properties. They restrict the Invasion and the migration of an lungs cancer by suppressing the expression of urokinase plasminogen activator [24]. Anti-cancer activity of anthocyanins was well known as they inhibits the proliferation of cancer cells by modulating signaling pathways.

**ANTI-INFLAMMATION**

Cyanidin-3-glucoside (C3 G) is a known anthocyanin found in mulberry fruits, which is responsible to alter different hematological Parameters in animal systems such as inhibiting inflammatory response serum triglycerides, and high-density lipoprotein Cholesterol (Kim and Park, Citation2006)[25]. It has been reported that C3 G possesses anti-inflammatory and free radical scavenging activity which can prevent endothelial distinction (Kang et al., Citation2006)[26].The anti-inflammatory response of flavonoids of Black mulberries against pro-inflammatory cytokines in mice serum was also reported by the researchers (Chen et al., 2016).Mulberry leaves have also been shown to have an anti-inflammatory

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Fig.7. Pharmacological Properties

**ANTI-OXIDANTS**

A significant number of scientists study the antioxidant qualities of mulberry fruits since they have excellent nutritional value [27]. The Analysis of the phenolic composition and antioxidant activity of Morus alba fruit revealed a trend wherein the antioxidant activity increases with an increase in total phenolic content, and there was a significant correlation between the two (Butkhup et al., Citation2013) [28]. The mulberry fruits contain many bioactive phytochemicals Possessing high antioxidant properties. Through mulberry juice and Mulberry mark purification, Jiang et al.discovered that mulberry fruit anthocyanin exhibited antioxidant and anti-fatigue Characteristics[29].

**ANTI- DIABETICS**

According to studies, white mulberry extract, which is made from the mulberry fruit, may be able to prevent diabetes in mice that have been given streptozotocin induced diabetes.

This extract has been Shown to lower alpha-glucosidase activity, reduce fasting glucose,and increase glycosylated serum protein

## III. MORPHOLOGY OF MULBERRY PLANTS

The morphology of mulberry leaves varies depending on the type of Mulberry tree and the age of the tree:

**Shape**: Mulberry leaves are generally heart-shaped, but can also be Unlobed or have 0 to 3 lobes. The leaves of the white mulberry tree Are egg-shaped in outline.

**Size**: Mulberry leaves can range from 2 to 8 inches long and 6 to 10 Centimeters wide.

**Arrangement**: Mulberry leaves are arranged alternately on the tree.

**Margins**: Mulberry leaves have saw-toothed margins that are soft to the touch.

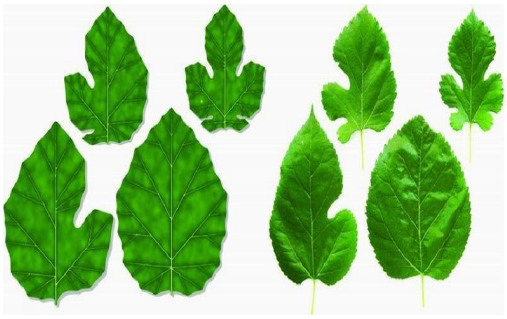

**Fig.8. Morphology of Mulberry Plants**


DOI: 10.48175/IJARSCT-25076

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**Lobes**: Lobes are more common on juvenile shoots than on mature Trees.
**Base**: The base of the leaf can be cordate or truncate.

**Habitat**

It grows as tree or shrub, but in cultivation it is raised as bush by Pruning. The plant is perennial, with highly branching root and shoots system with primary, secondary and tertiary branches.

**Stem**

Fig.9. Stem of mulberry

It is an aerial portion of plant which supports foliage of mulberry stem is divided into nodes and internodes. The colour of bark of stem varies from green, grey or brown with numerous lenticels. Most of branches are erect but some time are trailing. In nature mulberry grown as tree reaching height 20-25m

**Roots**

Fig.10. Roots of mulberry

- The mulberry roots has tap-roots, lateral roots and roots hair's.
- Hair's is confined to top of roots.

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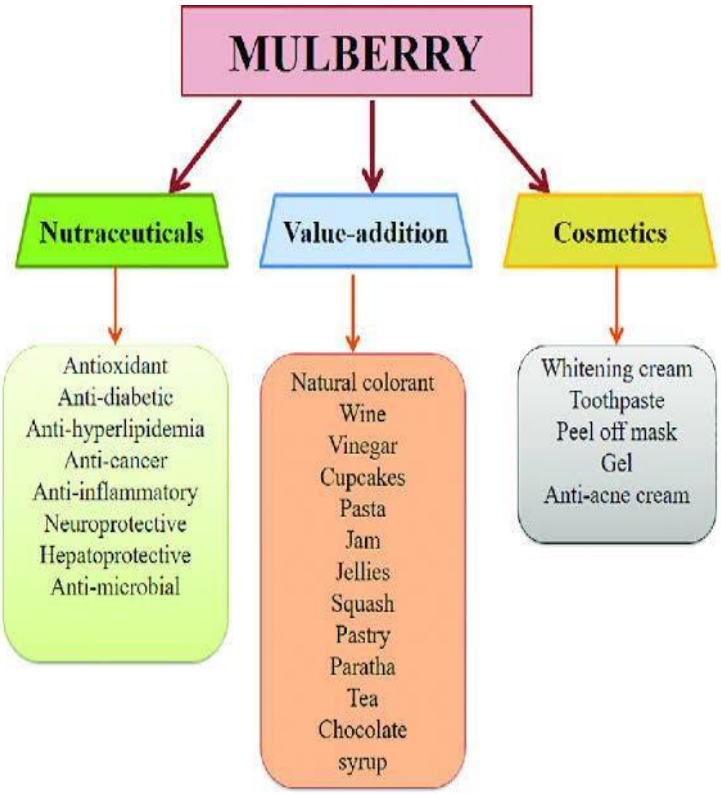
- The roots surface has many lenticells.
- The roots hair absorb water and nutrients from soil and lenticells perform respiration of roots.
- Lateral and tap roots transport and preserve water and nutrients

**Buds**

Fig.11. Buds of Mulberry

Each axial of leaf has buds. Some times two more independent buds on side of main buds are found is called accessory buds.The auxiliary buds are green which turns to brown out stages. The auxiliary buds of scale leaves of main buds peep out of buds as through they are accessory bud. Each buds is covered by 2-3 layers of scaly leaves of brown colour with hard texture.These are called scale buds/ buds are protected by convering of young leaves which are in truns covered by older and oldest leaves. Vegetative buds give rise to male or female inflorescence in addition to leaves.

## IV. APPLICATION





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## VI. PREPARATION AND FORMULATION OF BABY SYRUP

**SYRUP**

Herb syrup is prepared by adding a concentrated herbal Extract with sugar, and alcohol was also used. Herbal syrup Was made with decoction. Mixing a decoction of herbs with sugar helps to thicken the recipe and preserve it. This increases the shelf life of the formula. Added sweeteners can also help enhance the taste of certain herbs. The resulting Syrup is delicious! It is defined as a thick, sticky liquid consisting of a concentrated solution of sugar and water with or without added flavoring or medicinal ingredients [30,31,32,33].

**Fig.12.Marketed Syrup**


**Fig.13. Formulated Syrup**

**6.1 FOLLOWING ARE THE INGREDIENTS USED FOR FORMULATION:**

**INDIAN MULBERRY:** Indian Mulberry is used in many herbal and ayurvedic remedies; the alcoholic extract produced by Soxhlet is filtered and used.

**ORANGE OIL:** Citrus aurantium fruit is utilized as an antioxidant, anti-cancer, and neurological agent since it contains at least 2.5% volatile oil [34]

**ALCOHOL:** It uses in small quantity act as preservative

**INVERT SUGAR BASE:** It was prepared by mixing 2 cups (480 mL) of water with 4.4 cups (1 kg) of granulated Sugar and ¼ teaspoon of cream of tartar in a pot. The mixture was boiled over medium heat until it reaches 236◦F (114◦C), stirring occasionally. Next, remove the Mixture from the heat, cover, and let cool.[35]

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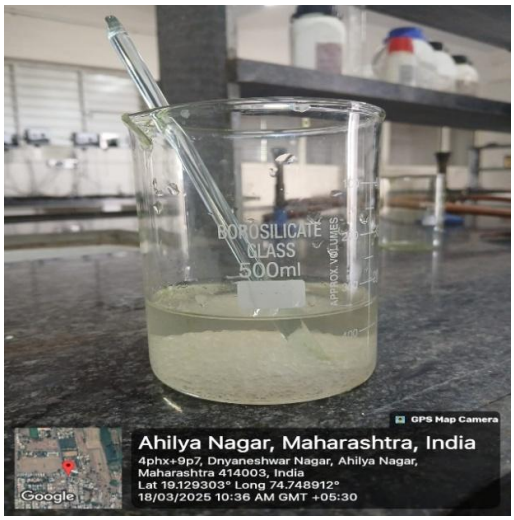


Fig.14. Mixture of sugar and water


Fig.15. Boil of sugar solution

**ROLE OF INGREDIENTS IN HERBAL SYRUP: [Table 4]**

| Sr.No | INGREDIENTS | ROLE |
|---|---|---|
| 1 | Indian Mulberry | Antioxidant, free radicals scavenging |
| 2 | Orange oil | Flavouring agents |
| 3 | Sugar base invert | Preservative |
| 4 | Alcohol | Preservative |
| 5 | Amaranth red | Coloring agent |

**PROCEDURE**

Herbal syrup was prepared by decoction method.Decoction method seen in table 5 follow. Firstly take crude fruit extract of mulberry. Then gently added cold water on it, this solution allows to stand for 15 min after this added boiling

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water on this solution stand for 30 min then filter it, strain the above solution and make up total volume of solution or sample. After completing all process infusion ready and added 25% alcohol and evaporate under vaccum at 55°c finally concentrated infusion.

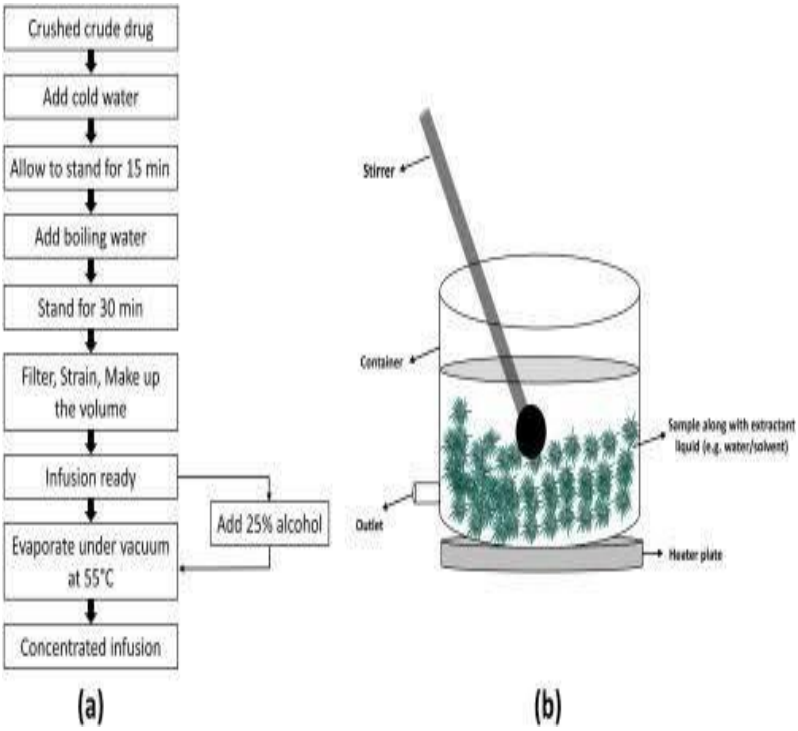


Table.5.

**SOXHLET EXTRACTION**

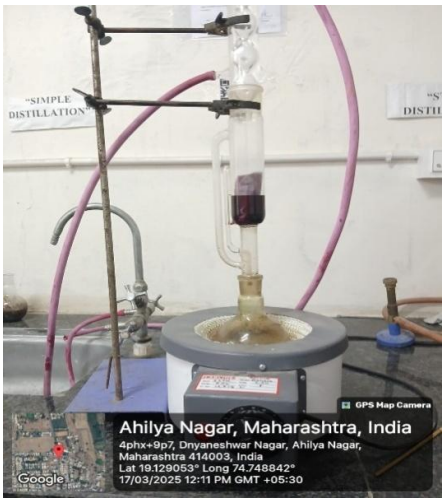


Fig.16. Soxhlet Extraction of Mulberry fruit

**1. Preparation:**

- **Sample:** The solid sample containing the desired compound is placed in a porous thimble (a filter paper or cellulose sleeve).

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- **Solvent:** The appropriate solvent, in which the target compound is soluble, is placed in a flask at the bottom of the apparatus.
- **Apparatus:** The thimble is placed in the Soxhlet extractor, which sits above the flask, and the apparatus is assembled with a condenser.

**2. Extraction Process:**

- **Heating:** The flask containing the solvent is heated, causing the solvent to boil and vaporize.
- **Condensation:** The solvent vapor rises and passes through the condenser where it condenses back into a liquid and drips onto the sample in the thimble.
- **Siphoning:** As the condenser fills with the solvent, it siphons back into the flask, carrying any extracted compounds with it.
- **Continuous Extraction:** This cycle of heating, vaporization, condensation, and siphoning continues until the desired compound is completely extracted from the sample.
- **Solvent Recovery:** Once the extraction is complete, the solvent can be recovered from the flask and the extracted compound can be collected.

**STEPS ARE FOLLOWED:**

Indian mulberry extract was obtained as fine extract from herbal creation. The extract subjected to prepare on ethanolic extract to obtain the ethanol specific active constituents by Soxhlet extraction method

Further the extract was filtered,and the aliquots of the quantities were used. All extract are mixed with each other and 50 ml of syrup was obtained.the colouring agents, flavouring agents are added into it.This obtained syrup was transferred to amber colour bottle, close it tightly and place it into cool place.

**FORMULATION TABLE FOR 50 ML** – Table.6.

| Sr.No | Ingredients | Quantity |
|---|---|---|
| 1 | Indian Mulberry Extract | 8ml |
| 2 | Orange Oil | 2ml |
| 3 | Invert Sugar Base | 33ml |
| 4 | Alcohol | 7ml |

## VI. EVALUATION PARAMETER

**DENSITY**

It was evaluated by formula as given below.

Formula for density:

Density of liquid under test (syrup)= weight of liquid under test/volume of liquid under test = w1 / V

**Density of Syrup** = 57.90 / 50 = **1.158 g/mol.**

**Density of water** = 50.93 / 50 = **1.0186 g/mol.**

**SPECIFIC GRAVITY**

Specific gravity was evaluated by the formula as given Below.

Specific gravity of liquid under test (syrup) = weight of Liquid under test /weight of water = w1/w2

Specific gravity of syrup = 57.90 / 50.93 = **1.136**

**VISCOSITY**

Viscosity of test (syrup) = Density of test liquid × time required to flow test liquid / Density of water × time required to flow water

**$\eta 2 = p2.\ t2\ /\ p1.t1\ x\ \eta 1$**

where,

**$\eta 1$** = viscosity of water


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**η2** = viscosity of test liquid
**p1** = density of water
**p2** = density of test liquid
**t1** = time req. for water to reach from point A to B.
**t2** = time req. for test liquid to reach from point A to B

| **Liquids** | **Time of flow (sec)** | | | **Mean time (sec)** | **Density** | **Viscosity** |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | | | |
| Water | 25.39 sec | 26 sec | 25 sec | 25 sec | 1.0186g/mol | 1.0012centipoise |
| Test liquid | 368 sec | 364 sec | 366 sec | 366 sec | 1.158g/mol | 16.664centipoise |

Table.7.

**η2 = p2. t2 / p1.t1 x η1**
put the value in formula,
= 1.158 x 366 / 1.0186 x 25 x 1.0012
= 423 .828 / 25.465
**η2** = 16.664 centipoise


**Fig.17. Viscosity of syrup measure by Ostwald viscometer**

**PH**

The pH of syrup was determined by the digital pH meter is 2.


Fig.18. pH of Mulberry Syrup


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## VII. RESULT

### FORMULATION

Formulation of syrup contain mulberry fruit. The syrup was formulated using the pharmacologically active dried fruit extract.

**Compositions of for syrup**

| Sr.No | Ingredients | Quantity for 50ml | uses |
|---|---|---|---|
| 1 | Indian Mulberry Extract | 8ml | Antioxidant, free radicals Scavenging |
| 2 | Orange Oil | 2ml | Flavouring agents |
| 3 | Invert Sugar Base | 33ml | Preservative |
| 4 | Alcohol | 7ml | Preservative |

### EVALUATION

**Density**

Formula for density: Density of liquid under test (syrup)= weight of liquid under test/volume of liquid under test = w1 / V

**Density of Syrup** = 57.90 / 50 = **1.158 g/mol.**

**Density of water** = 50.93 / 50 = **1.0186 g/mol.**

**2) Specific Gravity**

Specific gravity of liquid under test (syrup) = weight of Liquid under test /weight of water = w1/w2

Specific gravity of syrup = 57.90 / 50.93 = **1.136**

**Viscosity**

| Liquids | Time of flow (sec) | | | Mean time (sec) | Density | Viscosity |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | | | |
| Water | 25.39 sec | 26 sec | 25 sec | 25 sec | 1.0186g/mol | 1.0012centipoise |
| Test liquid | 368 sec | 364 sec | 366 sec | 366 sec | 1.158g/mol | 16.664centipoise |

**4) pH**

The pH of syrup was determined by the digital pH meter is 2.

## VIII. CONCLUSION

To conclude, mulberry fruit syrup is a delightful and versatile addition to various dishes and beverages. Its rich flavor, combined with potential health benefits, makes it an excellent choice for enhancing culinary creations. When made from fresh mulberries, it can offer a natural sweetness and vibrant color, appealing to both taste and presentation. Delving into the process of making syrup can ultimately deepen your appreciation for this unique fruit

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IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 3, April 2025
Impact Factor: 7.67

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Volume 5, Issue 3, April 2025
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