

DEVELOPMENT OF VALUE ADDED PRODUCTS FROM *FICUS RELIGIOSA*

Dissertation 1 Report

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CERTIFICATE

This is to certify that **Sandeep** (Registration No. 11715354) has personally completed M.Sc. dissertation 1 entitled “*DEVELOPMENT OF VALUE ADDED PRODUCTS FROM FICUS RELIGIOSA*” under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of dissertation has ever been submitted for any other purpose at any University.

The project report is appropriate for the submission and the partial fulfilment of the conditions for the evaluation leading to the award of Master of Nutrition and Dietetics.

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DECLARATION

I hereby declare that the work presented in the pre-dissertation report entitled “DEVELOPMENT OF VALUE ADDED PRODUCTS FROM *FICUS RELIGIOSA*” is my own and original. I have carried out the work at School of Agriculture, Lovely Professional University, Phagwara, Punjab, India under the guidance of **Dr. Ashwani Kumar**, Assistant Professor (Food Technology), School of Agriculture, Lovely Professional University, Phagwara, Punjab, India, for the award of the degree of Master of Science in Food Technology.

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I certified that the above statement made by the student is correct to the best of my knowledge and belief.

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Table of contents:

| | |
|---|-------|
| 1. Introduction..... | 5-6 |
| 2. Problem Background..... | 7 |
| 3. Review Background | |
| 3.1 Nutritional composition of various parts of <i>Ficus religiosa</i> | 8-9 |
| 3.2 Bioactive compounds in <i>Ficus religiosa</i> are related animal studies..... | 10-12 |
| 3.3 Ayurvedic formulations of <i>Ficus religiosa</i> | 13-14 |
| 3.4 Herbal food products available in market..... | 15-16 |
| 4. Proposed Research Objectives..... | 17 |
| 5. Proposed Research Methodology..... | 18-21 |
| 6. Expected Research Outcome..... | 22 |
| 7. References..... | 23-26 |

1: Introduction

Genus *Ficus* has 750 species of woody plants, from which *F. religiosa* is one of the important and usable species (Sharma *et al.*, 2016; Joseph and Raj, 2010). *F. religiosa*, commonly known as *peepal* is one of the oldest trees in Indian literature (Singh *et al.*, 2015; Gautam *et al.*, 2014). Its existence can be traced back to the Indus valley civilization (300 BC – 1700 BC) where it was embarked on the currency of that time (Pandey and Pandey, 2016; Anupama, 2014). The tree finds its documentation in the holy books of Hinduism such as Arthasastra, Puranas, Upanishads, Ramayana, Mahabharata, Bhagavad Geeta and Buddhist literature. It belongs to family *Moraceae* and genus *Ficus*. It derived its botanical name from two words i.e. '*Ficus*' a Latin word for 'fig' and '*Religiosa*' refers to 'religion' indicating its importance in Hindu and Buddhist religions (Bhalerao and Sharma, 2014). The tree is native to India and is believed to originate mainly in Northern and Eastern India. It is also found in its neighboring countries like Bangladesh, Pakistan, Nepal, Sri- Lanka and China. *F. religiosa* is known by more than 150 names (Bhalerao and Sharma, 2014). Even in India, it has various names in different regions according to their languages such as *Peepal in Hindi*, *Ashwatha in Sankrit* (Gautam *et al.*, 2014). Because of its contribution in historical events it has an important place in medicinal, mythological and religious systems of India and hence this tree is mostly seen near religious places (Rutuja *et al.*, 2015). The tree grows very large in size with wide spreading branches and brown colored bark. It has thin shiny leaves and the fruit is compressed and circular in shape. New immature leaves are red pinkish in color which turns into deep green at the stage of maturity (Panchawat, 2012). Flowering occurs in February, onset of fruits start in summers and ripening is complete before the onset of rainy season (Bhalerao and Sharma, 2014). Fruits grow in pairs together to form a single mass. Immature fruits are green in color which changes to blackish purple after ripening (Dharmender *et al.*, 2010).

All parts of this tree are rich in phytochemicals and are used in various food and medicinal preparations. The ripe fruits of *F. religiosa* are edible and rich source of proteins and minerals (Ruby *et al.*, 2000; Verma *et al.*, 2015). Fruits are rich in phytochemicals like flavonoids, terpenoids, glycosides etc., which are known to cure diseases like asthma and digestive disorders (Makhija *et al.*, 2010). The leaves contain phytochemicals such as flavonoids, terpenoids, tannins etc., which are effective in curing ailments like hiccups, vomiting, gonorrhoea

etc. (Bhalerao and Sharma, 2014). The bark contains phytochemicals like tannins, saponins, flavonoids etc. which show beneficial effects in health conditions such as diarrhea, dysentery, inflammation, bacterial infections, bleeding and paralysis (Singh and Jaiswal, 2014).

India has abundance of wealth in terms of herbal treatments for numerous diseases. Herbal plants have remedial as well as preventive properties. Whether some people cannot afford commercial medicines for treatment so they usually go for the herbal treatment. And *F. religiosa* is one of famous herb which is being consumed as indigenous medicine. Value added products prepared from *F. religiosa* such as candey, arjun tea, biscuits, dal, samosa, jeevan ras, peepal juice, slim honey, anardana churn etc. has also been reported by many researchers (Chaturvedi *et al.*, 2014; Verma and Gupta, 2015). The documentation of edible parts of tree, their availability, nutritional composition, phytochemicals and related health benefits can help food researchers to design new functional foods and nutraceuticals. This will also open up new ways for the application of this underutilized fruit. Therefore, in the present review an attempt has been made to discuss nutritional value, phytochemicals, medicinal properties and future food prospects of *F. religiosa*.

2: Problem Background

The consumption of fruits of *F. religiosa* is very limited and is confined to the rural areas only. The technologies for the development of value added products from this fruit are limited which results in the wastage of the large part of produce.

3: Review of Literature

3.1 Nutritional composition of various parts of *Ficus religiosa*

All parts of *F. religiosa* have balanced nutritional composition. Fresh fruits of *F. religiosa* have been reported to have moisture content of 62.4 g/100 g. The fruits are also rich in macronutrients and micronutrients. Fresh fruits are reported to be a good source of carbohydrates (21.2 g/100 g) and crude fiber (9.9 g/100 g). It is also a fair source of protein (2.5 g/100 g) and fat (1.7 g/100 g). Calcium (289 mg/100 g) is the most abundant mineral present in fresh fruit (Bhogaonkar *et al.*, 2014). Dried fruits of *F. religiosa* have been reported to have moisture content of 18.8 g/100 g and ash content of 4.44 g/100 g. Amounts of carbohydrates are reported approximately to be 68.33 g/100 g of dry sample (Verma and Gupta, 2015). Protein content of dried fruits is reported to be 8.48 g/100 g on drying. Dietary fiber, calcium and iron i.e. 69.43 g, 848 mg and 6 mg/100 g, respectively, has been also reported in dry fruit samples (Verma and Gupta, 2015). Besides fruit, leaves and bark of *F. religiosa* are also known for their medicinal value and have been used for the treatment of various diseases (Ruby *et al.*, 2000). Leaves are reported to have moisture content is 50.50g and 19.20 g/100 g of carbohydrates, 13.55 g/100 g of proteins and 2.5 g/100 g of fats (Wangkheirakpam and Laitonjam, 2012). Moisture content of bark has been reported to be 62.4 g/100 g. The carbohydrates and proteins content of bark are reported to be 15.4 g/100 g, 2.5 g/100 g, respectively. It is rich in minerals and a high mineral content of 13.1 g/100 g fresh basis has been reported. Dried bark powder is excellent source of iron 623 mg/100g (Singh *et al.*, 2015). A detailed composition of the various parts of *F. religiosa* is described in Table 3.1.

Table 3.1: Nutritional composition of parts of *Ficus religiosa*

| Part of <i>Ficus religiosa</i> | Nutrients with amount (approx.) (per 100 g) | References | |
|--------------------------------|---|------------|-----------------------------------|
| Fresh fruits | Moisture content | 62.4 g | (Bhogaonkar <i>et al.</i> , 2014) |
| | Carbohydrates | 21.2 g | |
| | Proteins | 2.5 g | |
| | Fats | 1.7 g | |
| | Crude fiber | 9.9 g | |
| | Ash content | 2.3 g | |

| | | | |
|---------------|------------------|------------------|--|
| | Calcium | 289 mg | |
| Dried fruits | Moisture content | 18.8 g | (Verma and Gupta, 2015) |
| | Carbohydrates | 68.33 g | |
| | Proteins | 8.48 g | |
| | Fats | 0.143 g | |
| | Dietary fiber | 69.43 g | |
| | Ash content | 4.44 g | |
| | Calcium | 848 mg | |
| | Iron | 6 mg | |
| Leaves | Moisture content | 50.50 g | (Wangkheirakpam and Laitonjam, 2012) (Azim <i>et al.</i> , 2011) (Ruby <i>et al.</i> , 2000) |
| | Carbohydrates | 19.20 g | |
| | Proteins | 13.55 g | |
| | Fats | 2.5 g | |
| | Crude fiber | 26.1g | |
| | Ash content | 12.9 g | |
| | Calcium | 1.67 mg | |
| | Iron | 0.18mg | |
| | Copper | 0.105 mg | |
| | Manganese | 0.355 mg | |
| | Zinc | 0.09 mg | |
| | Bark | Moisture content | |
| Carbohydrates | | 15.4 g | |
| Proteins | | 2.5 g | |
| Fat | | 1.7 g | |
| Crude fiber | | 9.9 g | |
| Ash content | | 13.1 g | |
| Calcium | | 16.1 mg | |
| Iron | | 623 mg | |

3.2 Bioactive compounds in *Ficus religiosa* and related animal studies

F. religiosa has been reported to have medicinal properties like antibacterial, anti-diabetic, anti-amnesic, anti-ulcer and anti-oxidant properties in the presence of chemical compounds (Gautam *et al.*, 2014). The bark of this tree contains lanosterol, β -sitosteryl-D glucoside, bergaptol, bergapten, steroids, flavonoids, alkaloids and phenol content. The presence of these chemical compounds makes it effective against bacteria like *Azobacter chroococcum*, *Bacillus cereus*, β -*megaterium*, *Streptococcusfacealis* (Al-Snafi, 2017). The leaves have been reported to have bioactive compounds (campesterol, stigmasterol, isofucoesterol, tannins, arginine, serine, aspartic acid, glycine, threonine, alanine, proline, tryptophan, tyrosine, methionine, valine, isoleucine) which help in preventing gastric problems. The methanolic, ethanolic and aqueous extracts can be made from bark, leaves and fruits (Rutuja *et al.*, 2015). The fruits have been reported with bioactive compounds such as asparagine, tyrosine, undecane, tridecane, tetradecane, ocimene, limonene, dendrolasine, flavonoids (kaempeferol, quercetin, myricetin) and other phenolic components (Rutuja *et al.*, 2015). All these phytochemicals have been reported to exert medicinal properties such as anti-bacterial, anti-diabetic, anti-convulsant, anti-amnesic etc. The extracts of *F. religiosa* are used to prepare traditional medicines by *Hakims or Vaidis* (Traditional doctors). Many animal studies have been reported by researchers or scientists which strengthen the claims made regarding the medicinal and curative properties of different parts of the tree. Anti-diabetic property of bark of *F. religiosa* has been reported in streptozotocin induced type 2 diabetic rats with the usage of aqueous extracts of bark (Al-snafi, 2017 and Kaur *et al.*, 2011).

Table 3.2: Bioactive compounds of *Ficus religiosa* and reported animal studies

| Part used | Bioactive compounds | Medicinal property | Animal study | Reference |
|-----------|--|------------------------------|---|---|
| Fruits | Terpenoids, glycosides, flavonoids, serotonergic | Bronchoconstriction activity | Methanolic extract of fruits (0.5, 1 and 2 mg/kg of body weight) showed significant | (Ahuja <i>et al.</i> , 2011) (Chandrasekar <i>et al.</i> , 2010) |

| | | | | |
|-------------|--|----------------------------|---|---|
| | content. | | effects in guinea pig. | |
| | | Anti-fertility activity | Methanolic extract of fruits (1%) showed anti-fertility effects on uterus of goats. | (Goyal <i>et al.</i> , 2013) |
| Bark | Steroids, flavonoids, alkaloids, phenol content, glycosides, tannins, saponins, polyphenolic compounds, sterols. | Anti-diabetic | Aqueous extract of bark (50 and 100 mg/kg of body weight) showed hypoglycemic effects in streptozotocin induced type 2 diabetic rats. | (Pandit <i>et al.</i> , 2010) (Verma <i>et al.</i> , 2012) |
| | | Anti-inflammatory activity | Ethanollic extract of bark (100 mg/kg of body weight) showed anti-inflammatory effects in carrageen induced golden syrian hamsters. | (Murugesan <i>et al.</i> , 2012) |
| | | Anti-ulcer activity | Ethanollic extract of bark (200 and 400 mg/kg of body weight) showed antiulcer effects in male albino wistar rats. | (Khan <i>et al.</i> , 2011) |

| | | | | |
|---------------|--|-------------------------|--|---------------------------------|
| Leaves | Flavonoids, terpenoids, tannins, phenols, sterols. | Wound healing activity | Ethanollic extract of leaves (300 mg/kg of body weight) showed wound healing activity in wistar albino strain rat. | (Charde <i>et al.</i> , 2017) |
| | | Anti-parkinson activity | Petroleum ether extract of leaves (400 mg/kg of body weight) showed anti-parkinson effects in induced experimental rats. | (Bhangale <i>et al.</i> , 2016) |
| | | Anti-ulcer activity | Ethanollic extract of leaves (2000 mg/kg of body weight) showed anti-ulcer property in albino mice. | (Gregory <i>et al.</i> , 2013) |

3.3 Ayurvedic formulations of *Ficus religiosa*

F. religiosa is consumed as herbal medicine in Ayurvedic medicinal system as a treatment for several ailments. Parts of *F. religiosa* can be consumed in the form of oil, as ointments, capsules, tablets or in raw form. Each formulation has its own function and can be effective in particular kind of disease. *Nalpamradi thailam* oil is effective in conditions like dermatitis, scabies, eczema, acne, urticarial, blemishes etc. In this formulation 15 g of bark of *F. religiosa* in 100 ml of oil has been used (Singh *et al.*, 2017). Medicinal properties reported for this oil were anti-oxidant, anti-fungal etc (Sahasra yoga and Tailayoga prakarana, 2012). *F. religiosa* also being consumed in the powder form by drying it and grind in traditional grinders. Powder form is also very effective for some conditions like diabetes mellitus, urinary disorders etc. Powder of stem bark of *F. religiosa* can be proved more effective if taken with honey, before or

after meal (Anupama, 2014). Similarly, there are various products or formulations available in market which is known for treating specific diseases.

Table 3.3: Some Ayurvedic formulations of *Ficus religiosa*

| Name/product(manufacturer) | Part of <i>F. religiosa</i> / Dosage | Effective in conditions | Reported medicinal properties | References |
|---|--|--|---|--|
| Nalpamardi thailam/Nalpam aradi oil(Kerala ayurveda, Nagarjuna) | Bark of <i>F. religiosa</i> /Few drops apply on skin and twice in day. | Dermatitis, scabies, eczema, acne, urticaria and blemishes | Anti-oxidant, anti-fungal, demulcent, anti-pruritic | (Singh <i>et al.</i> , 2017) (Sahasra yoga and Tailayoga prakarana, 2012) |
| Nyagrodhadi churna/Auyurvedic medicine in powder form(GMP guidelines and Vhca Ayurveda) | Stem bark of <i>F. religiosa</i> is used/1-3gm with honey | Diabetes, urinary disorders like dysuria | - | (Anupama, 2014) |
| Sarivadyasava/ Kerala ayurveda saribadyasavam, kottakkal saribadyasavam | Bark of <i>F. religiosa</i> /Twice a day with equal amount of water | Urinary diseases, renal diseases | Anti-gout, diuretic, anti-syphilis, detoxifying, purifies blood | (Singh, 2017) |

3.4 Herbal food products available in market

Ayurvedic products are manufactured with natural and vegetarian ingredients. *F. religiosa* has been used as ingredient in some products such as arjun tea, neotea arasa and candies. Arjun tea acts as antioxidant, contains micro nutrient CoenzymeQ10 and is effective for heart and cholesterol. Neotea arasa contains flavonoids and sterols which are effective against jaundice

and heart disease. The dry fruit powder is being used in candies for treatment of asthma, alternatively it can be consumed after mixing with water. All commercial ayurvedic supplements undergo quality check at various levels and are considered good for health and with negligible or minimum side effects on body (Verma and Gupta, 2015). Some food products of *F. religiosa* have been discussed in Table. 3.4.

Table 3.4: Some food products of *Ficus religiosa*

| Products/Dosage | Part used | Bioactive compounds | Health Benefits | Reference/Source |
|--|------------------|--|--|-------------------------|
| Arjun tea/One cup twice a day | Bark | Flavonoids, Anti-oxidant, micro nutrient CoEnzyme-Q10. | Helps to maintain heart function, levels of triglycerides, LDL, VLDL, and pumping capacity of heart. | Amazon, 2017 |
| Neotea arasa ilai/1-2 teaspoon | Leaf powder | Flavonoid, sterols | Laxative, remove jaundice, heal from heart disorders like cardiac weakness. | Neotericindia, 2017 |
| Neotea arasam pattai powder/mix 5gm of powder in water | Bark | Steroids, flavonoids, alkaloids | Helpful for teeth, stretch in ankles, remove stammer, eye pain. | Amazon, 2017 |
| Neotea arasam pala powder/as prescribed by doctor | Fruits | Terpenoids, glycosides, flavonoids, serotonergic content | Helpful in fever, relief from nosebleed and, stretch in ankles. | Amazon, 2017 |

| | | | | |
|--|---------------------|---|--|-----------------|
| Jeevan ras peepal juice\40- 60ml twice per day | Bark and Leaves | Tannins, saponins, flavonoids, sterols | Effective in urticaria acidity, colitis fungus, skin diseases, psoriasis and leucorrhea. | Amazon, 2017 |
| Slim honey/1-2 tablespoon twice a day | <i>F. religiosa</i> | Tannins, saponins, flavonoids, sterols | Improve body efficiency; reduce weight; natural glow, clear skin, instant energy, increase immunity, better digestion. | Indiamart, 2017 |
| Oil pulling Concentrate /1 tablespoon | <i>F. religiosa</i> | Steroids, flavonoids, alkaloids | Prevent bad breath, whiter teeth, and healthier gums, alleviated allergies and improved lymphatic system. | Amazon, 2017 |

4: Proposed Research Objectives:

1. To evaluate the quality of raw materials.
2. To develop value added products from the fruits of *Ficus religiosa*.
3. To evaluate the quality of developed products.
4. To study the storage life of the prepared products.

5: Proposed Research Methodology

Experiment 1: Quality evaluation of the raw materials

1. Raw materials

Fruit of *Ficus religiosa*

2. Tests to be performed

Proximate analysis

- a. Moisture (Elezabeth and Subramnian, 2013)
- b. Total sugars and reducing sugars (AOAC, 2000)
- c. Protein (Lowry *et al.*, 2009)
- d. Fats (AOAC, 2000)
- e. Ash (Elezabeth and Subramnian, 2013)
- f. Crude fibre (AOAC, 2000)
- g. Dietary fibre (AOAC, 2000)

Bioactive compounds analysis

- a. Total phenols (Blainski *et al.*, 2003)
- b. Tannins (Durai *et al.*, 2016)
- c. Flavonoids (Majaw and Moirangthem, 2009)

FTIR analysis of raw material.

Experiment 2: Development of value added product

Treatment will be selected on the basis of bases of RSM design and the best treatment will be selected for development of value added products like Jelly, Squash, RTS (ready to serve) will be prepared.

Experiment 3: Quality evaluation of prepared product

Proximate analysis

- a. Moisture (Elezabeth and Subramanian, 2013)
- b. Total sugars and reducing sugars (AOAC, 2000)
- c. Protein (Lowry *et al.*, 2009)
- d. Fats (AOAC, 2000)
- e. Ash (Elezabeth and Subramanian, 2013)
- f. Crude fibre (AOAC, 2000)
- g. Dietary fibre (AOAC, 2000)

Bioactive compound analysis

- a. Total phenols (Blainski *et al.*, 2003)
- b. Tannins (Durai *et al.*, 2016)
- c. Flavonoids (Majaw and Moirangthem, 2009)

FTIR analysis of product.

Sensory Evaluation

Final product will be evaluated for the sensory characteristics on the basis of 9 Point hedonic scale and composite sensory scale.

A. Sensory analysis:

A 9 point hedonic scale will be used to evaluate the experimental samples using 100 semi trained panelists. Healthy male and female of suitable age will be selected for the evaluation.

- a. Color and appearance
- b. Flavor and sweetness
- c. Body and texture
- d. Mouth feel
- e. Overall acceptability

| Expression | Points to be assigned |
|----------------------------|-----------------------|
| Liked extremely | 9 |
| Liked very much | 8 |
| Liked moderately | 7 |
| Liked slightly | 6 |
| Neither liked nor disliked | 5 |
| Disliked slightly | 4 |
| Disliked moderately | 3 |
| Disliked very much | 2 |
| Disliked extremely | 1 |

| Sample code | Color and appearance | Flavor and sweetness | Body and texture | Mouth feel | Overall acceptability | Remarks (if any) |
|-------------|----------------------|----------------------|------------------|------------|-----------------------|------------------|
| | | | | | | |
| | | | | | | |
| | | | | | | |

Optimized product will be obtained using the above experimental setup.

A. Mean Sensory score on composite sensory scale for the Development of value added product :

| Sensory attributes | Possible score | Mean Score \pm SD | Number of Judges |
|---------------------------|-----------------------|---------------------------------------|-------------------------|
| Appearance | | | |
| Consistency | | | |
| Flavor | | | |
| Absence of defects | | | |
| Total Score | | | |

Experiment 4: Microbiological Study

- a. Total plate count
- b. Yeast Count
- c. Mould Count

6. Expected Research Outcomes

The development of value added products made from fruits of *F. religiosa* are expected to be high in phyto-chemicals like flavonoids, alkaloids, terpenoids, glycosides etc. which can help to cure diseases such as respiratory problems (like asthma), fever, paralysis etc. Development of such products will boost the current market demand of functional foods in India.

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