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Development of Nutraceutical Jelly Using Tulsi, Honey and Lemon

Kotla Venkat[1*], A. Swaroopa Rani[1], D. Jagadeesh[2]
[1]*Department of Food Technology, JNTU Oil Technological & Pharmaceutical Research Institute, Ananthapuramu, India*
[2]*Department of Quality, Mayora India Pvt. Ltd., Hyderabad, India*

***Abstract*: This study focuses on the development of a functional herbal jelly using Tulsi (Ocimum sanctum), honey, and lemon juice. Tulsi is known for its antioxidant, antimicrobial, and anti-inflammatory properties, while honey acts as a natural sweetener with added nutritional benefits. Lemon juice provides acidity, enhances flavor, and supports gel formation. The jelly was prepared using tulsi extract, honey, sugar, pectin, and citric acid in different proportions to obtain an optimized formulation. The preparation involved extraction, mixing, heating, and gel formation. The developed samples were analyzed for physicochemical properties such as pH, total soluble solids, acidity, and moisture content. Sensory evaluation was conducted to assess color, taste, aroma, texture, and overall acceptability. The results showed that the optimized jelly had good texture, balanced sweetness and acidity, and high acceptability. The addition of tulsi and honey improved the functional and nutritional properties without affecting product quality. The study concludes that Tulsi–Honey–Lemon jelly can be successfully developed as a value-added functional food with good sensory qualities and potential for commercial production.**

***Keywords*: Tulsi (Ocimum sanctum), Herbal jelly, Functional food, Honey, Lemon juice, Pectin, Physicochemical analysis, Sensory evaluation, Antioxidant properties, Value-added product.**

1. Introduction

Food plays a vital role in human health by providing essential nutrients required for growth, development, and maintenance of the body. In recent years, there has been increasing interest in functional foods, which not only supply basic nutrition but also offer additional health benefits beyond their nutritional value. Functional foods are known to reduce the risk of chronic diseases and promote overall well-being (Roberfroid, 2002; Granato et al., 2010). Among these, herbal-based food products have gained considerable attention due to their natural origin and therapeutic potential (Gupta & Prakash, 2014).

Tulsi (Ocimum sanctum), commonly known as holy basil, is a well-recognized medicinal plant widely used in traditional systems of medicine such as Ayurveda. It is reported to possess various pharmacological properties including antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory effects (Prakash & Gupta, 2005; Cohen, 2014). The incorporation of tulsi into food products enhances their functional and therapeutic value, making them beneficial for human health.

Honey is a natural sweetener rich in enzymes, vitamins, minerals, and phenolic compounds, which contribute to its antioxidant and antimicrobial properties. It has been widely used not only for its nutritional value but also for improving the sensory characteristics of food products (Bogdanov et al., 2008; Al-Waili et al., 2011). Additionally, fructo-oligosaccharides (FOS) are important prebiotic compounds that stimulate the growth of beneficial intestinal microflora such as Bifidobacteria and Lactobacilli, thereby improving gut health and digestion (Gibson & Roberfroid, 1995; Roberfroid, 2007).

Jelly is a semi-solid product prepared by cooking fruit or plant extracts with sugar, pectin, and acid to form a gel-like structure. It is widely accepted due to its appealing texture, taste, and ease of consumption (Desrosier & Desrosier, 1977). The incorporation of functional ingredients such as tulsi extract, honey, and FOS into jelly formulation not only enhances its nutritional profile but also results in a novel functional product with added health benefits.

Therefore, the present study focuses on the development of Tulsi–Honey–FOS jelly as a value-added functional food product with improved nutritional quality, desirable sensory attributes, and good storage stability.

2. Materials

Tulsi leaves, Honey, Sugar, Lemon, Pectin, Glucose syrup/FOS, Water, Potassium sorbate or sodium benzoate.

Fig. 1. Pectin

*Corresponding author: venkatkotla0805@gmail.com

Fig. 2. Honey

Fig. 3. Sugar

Fig. 4. Potassium sorbate

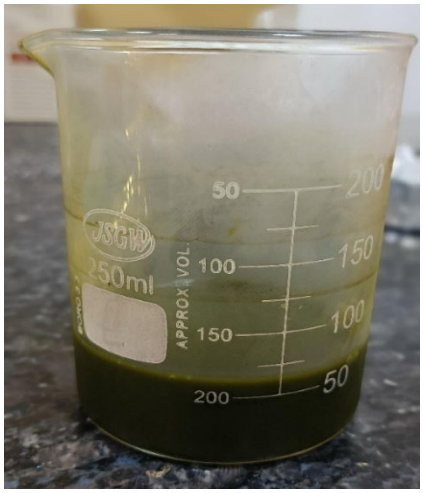

Fig. 5. Tulsi extract

Fig. 6. FOS

3. Methodology

A. Preparation of Tulsi Extract

Fresh tulsi (Ocimum sanctum) leaves were selected and sorted to remove damaged and diseased materials. The leaves were washed thoroughly with potable water to remove adhering dust and impurities, followed by air drying to remove excess surface moisture.

The cleaned leaves were crushed using a mortar and pestle to obtain a fine paste. Distilled water was added in a ratio of 1:10 (leaf:water), and the mixture was heated at 60–80°C for 10–15 minutes to facilitate the extraction of bioactive compounds. The extract was then cooled to room temperature and filtered through muslin cloth to obtain a clear extract. Filtration was repeated to ensure clarity and removal of suspended particles (Prakash & Gupta, 2005; AOAC International, 2019).

B. Preparation of Jelly

The prepared tulsi extract was used as the base material for jelly preparation. Sugar was added and heated to form a uniform syrup at 80–90°C.

Pectin was pre-mixed with a small quantity of sugar to avoid lump formation and then gradually incorporated into the syrup with continuous stirring until completely dissolved. Water was

added as required to maintain proper consistency.

Fructo-oligosaccharides (FOS) were then added and mixed thoroughly. The mixture was boiled and concentrated until the total soluble solids reached 65–68°Brix, as determined using a refractometer. This range is essential for proper gel formation and product stability (Desrosier & Desrosier, 1977; Ranganna, 2010).

C. Addition of Functional Ingredients

After achieving the desired concentration, the mixture was allowed to cool to 50–60°C. Honey was then added to retain its nutritional and functional properties, as excessive heat may degrade its bioactive compounds (Bogdanov et al., 2008).

Potassium sorbate (0.05–0.1%) was added as a preservative to inhibit microbial growth. Citric acid solution was incorporated to adjust the pH to 3.0–3.3, which is critical for gel formation and preservation of jelly (Ranganna, 2010).

D. Final Processing

The mixture was stirred thoroughly to ensure uniform distribution of all ingredients. The hot jelly was poured into clean, dry, and sterilized glass containers or molds.

The filled containers were allowed to cool and set at room temperature. After complete gel formation, the containers were sealed properly to prevent contamination and ensure product safety.

E. Storage

The prepared Tulsi–Honey–FOS jelly was stored in a cool and dry place for further physicochemical, microbial, and sensory evaluation, as well as shelf-life studies (Ranganna, 2010).

4. Methods

A. Energy Value

The energy value of the sample was calculated based on the proximate composition, namely protein, fat, and carbohydrate content, expressed on a 100 g basis. The metabolizable energy was estimated using Atwater general factors, where protein and carbohydrates contribute 4 kcal/g each, and fat contributes 9 kcal/g. The total energy value was obtained by summing the individual contributions, and expressed as kcal per 100 g of the sample (Merrill & Watt, 1973; AOAC International, 2019).

$$Energy\ (\frac{kcal}{100gm}) = (Protein \times 4) + (Fat \times 9) + (Carbohydrate \times 4)$$

B. Moisture Content

Moisture content was determined using the hot air oven method, which is based on the principle of weight loss upon drying. A known weight of the sample was taken in a pre-weighed moisture dish and dried in a hot air oven at 105 ± 2°C until a constant weight was achieved. The dish was cooled in a desiccator and reweighed. The loss in weight represented the moisture content of the sample (Ranganna, 2010).

$$Moisture\ (\%) = \frac{(W2 - W3)}{(W2 - W1)} \times 100$$

Where:
W1= Weight of empty dish
W2= Weight of dish + sample before drying
W3 = Weight of dish + sample after drying

C. pH Value

The pH of the sample was determined using a digital pH meter based on electrometric principles. The instrument was calibrated using standard buffer solutions (pH 4.0, 7.0, and 9.2) prior to measurement. The electrode was immersed in the sample solution, and the stabilized reading was recorded. The electrode was rinsed with distilled water after each measurement to prevent contamination (Ranganna, 2010; AOAC, 2019).

D. Reducing Sugar

Reducing sugar content was estimated using the Lane and Eynon titrimetric method, which is based on the reduction of Fehling's solution by reducing sugars. A known volume of Fehling's solution was boiled, and the sample solution was added from a burette until the endpoint was reached, indicated by the formation of a brick-red precipitate of cuprous oxide. Methylene blue was used as an internal indicator for accurate endpoint detection. The reducing sugar content was calculated using standard factors (Ranganna, 2010).

$$Reducing\ sugar\ (\%) = \frac{Factor \times Dilution \times 100}{(Titre\ value) \times Weight\ of\ sample}$$

Where:
Factor = Amount of sugar (in grams) required to completely reduce the Fehling's solution (obtained from standardization)
Dilution = Total volume to which the sample solution is made
Titre Value = Volume of sample solution used during titration (mL)
Weight of Sample = Weight of the sample taken (g)

E. Ash Content

Ash content was determined using the muffle furnace method. A known quantity of the sample was taken in a pre-weighed crucible and initially charred to avoid spattering. The sample was then incinerated in a muffle furnace at 550 ± 25°C until a light grey or white ash was obtained. The crucible was cooled in a desiccator and weighed. The residue obtained represents the total mineral content of the sample (Ranganna, 2010; AOAC, 2019).

$$Ash(\%) = \frac{(W2 - W1)}{W} \times 100$$

Where:
W1= Weight of empty dish
W2 = Weight of crucible + ash
W= Weight of sample taken (g)

F. Microbial Analysis of Jelly

Microbial analysis of the developed jelly samples was carried out to evaluate their microbiological safety and quality, following standard procedures described by AOAC International (2019). The analysis included determination of total viable bacterial count, yeast and mould count, and coliform count using established microbiological techniques.

1) Total Plate Count (TPC)

The total viable bacterial population was determined using Plate Count Agar (PCA) as described by American Public Health Association (2015). Serial dilutions of the jelly sample were prepared under aseptic conditions, and appropriate dilutions were pour-plated onto sterile PCA plates. The plates were incubated at 37°C for 24–48 hours, after which colonies were counted and expressed as colony forming units per gram (CFU/g) of sample.

$$Cfu/ml = \frac{Number\ of\ colonies \times Dilution\ factor}{Volume\ of\ the\ sample}$$

2) Yeast and Mould Count

Yeast and mould counts were estimated using Rose Bengal Chloramphenicol Agar according to the method suggested by International Organization for Standardization (ISO 21527, 2008). The serially diluted samples were spread onto the agar plates and incubated at 25–28°C for 3–5 days. The developed colonies were counted and expressed as CFU/g.

$$Cfu/ml = \frac{Number\ of\ colonies \times Dilution\ factor}{Volume\ of\ the\ sample}$$

3) Coliform Count

Coliform bacteria were analyzed using Violet Red Bile Agar (VRBA) following the procedure outlined by Food and Agriculture Organization (1992). The pour plate technique was employed, and plates were incubated at 37°C for 24 hours. Typical dark red colonies with a surrounding bile precipitation zone were counted as coliforms and expressed as CFU/g.

All analyses were performed in triplicate, and the mean values were reported. The microbial counts obtained were compared with standard permissible limits to assess the safety and acceptability of the jelly samples, as recommended by Food Safety and Standards Authority of India.

$$Cfu/ml = \frac{Number\ of\ colonies \times Dilution\ factor}{Volume\ of\ the\ sample}$$

Table 1
Sample formulations

Ingredients	Trail 1	Trail 2	Trail 3	Trail 4
Tulsi	15.22%	19.60%	20.29%	24.14%
honey	20.30%	19.60%	20.29%	19.31%
FOS	5.07%	4.90%	5.07%	4.82%
Sugar	40.60%	39.21%	40.58%	38.63%
Water	10.15%	9.80%	10.45%	9.66%
Pectin	5.58%	3.92%	0.51%	0.48%
Citric acid	3.04%	2.94%	3.04%	2.90%
Potassium sorbate	0.05%	0.05%	0.05%	0.05%

5. Results and Discussion

The results demonstrated significant variation among the different formulations in terms of physicochemical and sensory properties. Among all trials, exhibited optimal pH, total soluble solids (TSS), and acidity, which are critical parameters for proper gel formation, texture development, and product stability (Ranganna, 2010; Desrosier & Desrosier, 1977). The formulation also showed desirable texture, gel strength, and consistency, with no evidence of syneresis or sugar crystallization, indicating a stable gel network.

Sensory evaluation reveals the highest scores for color, flavor, aroma, taste, and overall acceptability, suggesting greater consumer preference. The balanced incorporation of tulsi extract, honey, and lemon contributed to improved sensory characteristics, as well as enhanced functional properties. Tulsi is known for its antioxidant and antimicrobial activity, while honey provides natural sweetness along with bioactive compounds that improve both flavor and preservation (Prakash & Gupta, 2005; Bogdanov et al., 2008).

Fig. 7. Tulsi jelly

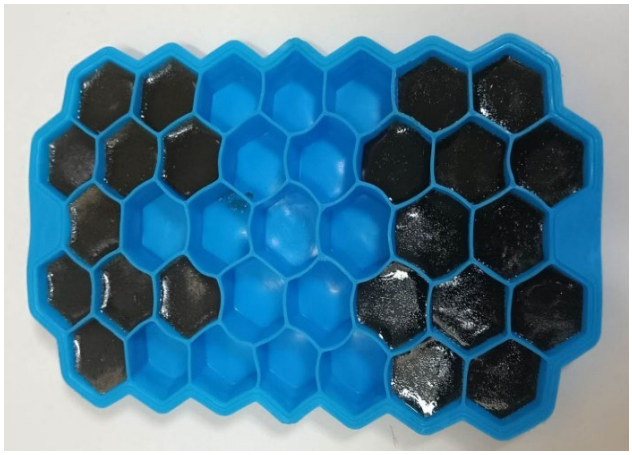

Fig. 8. Jelly moulding

Table 3
Microbial analysis

Parameters	Trail 1	Trail 2	Trail 3	Trail 4
Total plate count	$3.5 \times 10^2\ CFU/g$	$2.6 \times 10^2\ CFU/g$	$1.8 \times 10^2\ CFU/g$	$1.5 \times 10^2\ CFU/g$
Coliform	Absent	Absent	Absent	Absent
Yeast and Mould	$1.8 \times 10^2\ CFU/g$	$1.2 \times 10^2\ CFU/g$	$0.9 \times 10^2\ CFU/g$	$1.5 \times 10^2\ CFU/g$

Table 2
Physio-chemical analysis

Parameters	Trail1	Trail 2	Trail 3	Trail 4
Moisture	20	25.81	25	30
pH	3.40	3.51	3.50	3.5
Ash	0.280	0.272	0.270	0.290
Reducing Sugar	20.39	14.92	15	14.80
Titratable acidity	0.7	0.8	0.8	0.8

Fig. 9. Sensory evaluation

The selection of the best trial was primarily based on sensory evaluation, which assessed key attributes such as color, flavor, aroma, taste, texture, and overall acceptability. Sensory analysis is a widely accepted method for determining consumer preference and product quality (Stone & Sidel, 2004; Lawless & Heymann, 2010). Among all the formulations, Trial 3 received the highest scores from the panel members, indicating superior acceptability.

The balanced incorporation of tulsi extract, honey, lemon, sugar, and pectin contributed to a pleasant flavor profile without excessive bitterness, along with an appealing appearance and desirable consistency. The proper balance of sweetness, acidity, and gel structure plays a crucial role in enhancing sensory quality and consumer acceptance of jelly products (Ranganna, 2010).

Therefore, based on sensory attributes, Trial 3 was selected as the most acceptable formulation for further study.

Microbial analysis of the Tulsi–lemon–honey jelly formulations revealed that all trials were within acceptable safety limits as per standard food quality guidelines. The total plate count, yeast, and mould counts were observed to be comparatively lower in Trial 3, while coliforms were absent in all samples, indicating good hygienic practices during processing and handling (FSSAI, 2012; AOAC International, 2019).

The reduced microbial load in Trial 3 may be attributed to the synergistic antimicrobial effects of tulsi, honey, and lemon. Tulsi possesses strong antimicrobial properties due to its bioactive compounds, while honey contributes through its osmotic effect and natural inhibitors. Lemon juice enhances microbial stability by lowering pH, creating an unfavorable environment for microbial growth (Prakash & Gupta, 2005; Bogdanov et al., 2008).

Therefore, Trial 3 was found to be microbiologically safer and more stable compared to the other formulations, making it suitable for further application and storage studies.

6. Conclusion

The study successfully developed a functional Tulsi (Ocimum sanctum)–Honey–Lemon jelly with good quality and acceptability. The optimized formulation showed suitable physicochemical properties, ensuring proper gel formation and stability. Sensory evaluation indicated good color, flavor, texture, and overall acceptability. The addition of tulsi and honey enhanced the nutritional and functional properties, while lemon improved pH and gel formation. Overall, the product can be considered a value-added functional food with potential for commercial production.

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