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Research Article

Formulation Of Fenugreek Based Nutritional Jelly for Enhancing Paediatric Appetite

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ABSTRACT

The present study focuses on the formulation and evaluation of a fenugreek-watermelon-based jelly designed to serve as a natural appetite stimulant for pediatric use. Recognizing the nutritional and therapeutic potential of fenugreek (Trigonella foenum-graecum) and watermelon (Citrullus lanatus), the jelly was developed to combine palatability with functional benefits. Fenugreek seeds are known for their appetite-stimulating properties due to their saponin and alkaloid content, while watermelon offers hydration and a pleasant flavor profile appealing to children. The formulation process involved optimizing the concentrations of fenugreek extract and watermelon juice to ensure acceptable sensory attributes, stability, and efficacy. Evaluation parameters included physicochemical properties, sensory acceptability, microbial stability, and in vivo assessment of appetite stimulation in children. Results indicated that the developed jelly had favorable organoleptic characteristics, was microbiologically safe, and demonstrated a potential increase in appetite among pediatric subjects. The study concludes that fenugreek-watermelon-based jelly may serve as an effective, natural, and child-friendly formulation to address appetite-related issues in children.

INTRODUCTION

Appetite stimulation in paediatric populations is a growing area of interest within both clinical and nutritional sciences. Inadequate appetite among children is a significant concern as it can lead to insufficient nutrient intake, compromised growth, weakened immune function, and delayed developmental milestones. The causes of poor appetite in children are multifactorial, ranging from underlying illnesses and emotional stress to medication side effects and dietary preferences. Consequently, there is a pressing need for child-friendly, effective, and safe formulations that not only address nutritional gaps but also enhance appetite naturally. Jelly, owing to its smooth

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texture, sweet flavor, and vibrant appearance, stands out as an appealing food vehicle for paediatric use. Its ease of swallowing and digestion makes it suitable for children with feeding difficulties. Furthermore, jelly offers excellent formulation flexibility, allowing the incorporation of functional and therapeutic ingredients such as herbal extracts and bioactive compounds. Fenugreek (Trigonella foenum-graecum), a traditional medicinal herb, is renowned for its diverse health benefits and, notably, its appetite-stimulating properties. Its bioactive constituents, including saponins and alkaloids, are known to enhance digestive secretions and promote hunger. Additionally, fenugreek is a rich source of protein, dietary fiber, iron, and essential micronutrients, positioning it as a valuable component in paediatric nutrition. To improve acceptability among children, especially considering the bitterness of fenugreek, complementary fruit flavors such as watermelon or mango can be used to mask unpleasant tastes. The development of a fenugreek-based nutritional jelly seeks to merge the therapeutic potential of fenugreek with the sensory appeal of jelly, resulting in a product that is both health-promoting and palatable. This research focuses on the formulation and evaluation of a fenugreek-based jelly designed to stimulate appetite in children. The study encompasses ingredient selection, optimization of the jelly matrix, sensory acceptability, nutritional profiling, and potential health implications. Through this innovative approach, the work aims to offer a functional food solution for addressing paediatric appetite-related issues and improving overall nutritional health.

❖ Appetite:

Appetite is the natural desire to eat food, typically regulated by a complex interaction of physiological, psychological, and environmental factors. It plays a crucial role in maintaining energy balance, supporting growth, and ensuring overall health. In children, a healthy appetite is especially important, as it directly influences nutrient intake, physical development, cognitive performance, and immune function. Appetite is primarily controlled by the central nervous system, particularly the hypothalamus, which responds to signals from hormones, neurotransmitters, and nutrients. Hormones such as ghrelin (which stimulates appetite) and leptin (which signals satiety) work together to regulate hunger and fullness. Additionally, external factors such as taste, smell, emotional state, cultural practices, and mealtime environment also significantly influence appetite [7] [8]. In Paediatric populations, loss of appetite or poor eating behaviours can arise due to a variety of causes, including illness, infections, emotional stress, medication side effects, or unappealing food textures and flavours. Persistent poor appetite in children can lead to undernutrition, weight loss, stunted growth, and delayed development. Therefore, addressing appetite-related issues is a vital aspect of Paediatric healthcare and nutrition [9]. Conventional approaches to improving appetite in children often involve dietary modifications, improved mealtime practices, and in some cases, the use of pharmacological appetite stimulants. However, these methods may have limited effectiveness or carry potential side effects. This has led to increased interest in natural and food-based solutions, such as the use of functional foods and herbal ingredients with appetite-enhancing properties [10]. In recent years, the development of palatable, nutrient-rich food products like functional jellies has emerged as a promising strategy to stimulate appetite in children. Such products can be fortified with natural ingredients known for their therapeutic benefits, offering a safer and more acceptable alternative to synthetic appetite stimulants [11].

❖ **Types of Appetite:**

1. **Physical Appetite (Physiological Hunger):**

This type of appetite arises from the body's biological need for energy and nutrients. It is regulated by internal signals such as hormone levels (e.g., ghrelin, insulin) and nutrient status. Signs include stomach growling, fatigue, or a general feeling of emptiness [12].

2. **Psychological Appetite (Emotional or Mental Hunger):**

Triggered by emotions, moods, or environmental cues rather than a physical need for food. Examples include eating due to stress, boredom, sadness, or even happiness. This type often leads to cravings for specific "comfort foods" rather than balanced meals [13].

3. **Habitual Appetite:** Related to routine and habit, this type of appetite develops over time based on meal patterns. A person might feel hungry at specific times of the day simply because they're used to eating then, even if the body doesn't physiologically need food [14].

4. **Sensory Appetite:** Stimulated by sensory cues such as the sight, smell, or taste of food. For example, the aroma of freshly baked bread or a visually appealing dish can trigger the desire to eat even if the person is not truly hungry [15].

5. **Selective Appetite:** Characterized by a craving or preference for a specific type of food, such as sweets, salty snacks, or spicy dishes. This can be driven by physiological needs (e.g., sodium deficiency) or emotional triggers [16].

❖ **Jelly:**



Fig No. 1: Jelly

Jelly is a semi-solid, gel-like food product that is commonly consumed as a dessert or a sweet spread. It is typically made by combining fruit juice or puree with a gelling agent such as pectin, gelatine, or agar-agar, along with sugar and sometimes citric acid or other preservatives. The gelling agent is what gives jelly its characteristic firm yet elastic texture, allowing it to hold its shape while remaining soft enough to spread or eat with a spoon [17]. Jelly products are appreciated for their palatable texture, vibrant colours, and sweet taste, making them popular among people of all age groups, especially children. In addition to their sensory appeal, jellies can also serve as an effective medium for the incorporation of functional ingredients, such as vitamins, minerals, herbal extracts, or other bioactive compounds. This makes them suitable for use in health-focused or nutraceutical formulations [18]. Traditionally, jelly has been made using fruits such as apples, grapes, and berries, which are naturally rich in pectin. However, modern food technology allows the creation of jelly from a wide variety of fruits and vegetables, even those with low natural pectin content, through the addition of commercial gelling agents. The balance of acidity, sugar, and pectin is critical to achieving the desired gel consistency and ensuring the stability and shelf-life of the product [19]. Jelly not only serves as a convenient and attractive vehicle for nutrition

delivery but also offers opportunities for innovation in terms of flavour combinations, texture modifications, and functional ingredient incorporation. In recent years, research has expanded into the development of jellies with medicinal or therapeutic benefits, particularly for Paediatric, geriatric, and clinical nutrition applications. Such functional jellies are designed not only for sensory satisfaction but also to address specific health needs, such as appetite stimulation, immune support, or gastrointestinal health [20]. In the context of Paediatric nutrition, jelly serves as an ideal medium for delivering beneficial ingredients to children due to its easy-to-swallow consistency, pleasant taste, and appealing appearance. These features make it especially suitable for children with feeding difficulties or poor appetite. Therefore, exploring the formulation of jelly using natural and therapeutic ingredients, such as fenugreek and watermelon, holds significant potential for the development of child-friendly appetite stimulants [21].

Merits of fenugreek based jelly:

1. **High sensory appeal:** Jelly's sweet taste, smooth texture, and bright colours make it attractive and enjoyable, especially for children and elderly individuals.
2. **Easy to swallow and digest:** The soft, gel-like consistency is ideal for individuals with chewing or swallowing difficulties, making it suitable for Paediatric and geriatric use.
3. **Effective carrier of nutrients and bioactive compounds:** Jelly can be fortified with functional ingredients such as vitamins, minerals, herbal extracts (e.g., fenugreek), and other health-promoting substances [22].
4. **Versatile and customizable:** Jelly formulations can be tailored using various fruits, natural sweeteners, and gelling agents to achieve desired flavour, texture, and nutritional profiles.
5. **Promotes appetite:** Its palatable nature can help stimulate appetite in children, making it beneficial in addressing poor eating habits or undernutrition.
6. **Cost-effective production:** Jelly is inexpensive to produce and can be made using locally available or seasonal ingredients, making it accessible and affordable.
7. **Long shelf life:** The high sugar content and low water activity help preserve the product by inhibiting microbial growth, ensuring good shelf stability.
8. **Convenient and ready-to-eat:** Jellies require no preparation and are easy to serve, making them suitable for use in homes, schools, hospitals, and on-the-go consumption.
9. **Child-friendly dosage form:** For Paediatric use, jelly can be used as a medium to administer medications or supplements in a form that is more acceptable to children.
10. **Encourages innovation in functional foods:** Jelly serves as a platform for developing new functional or therapeutic food products targeting specific health needs, such as appetite stimulation or immune support [23] [24]. ing to control their caloric intake [28].

❖ **Effect of fenugreek:**

Fenugreek (*Trigonella foenum-graecum*) is a versatile medicinal herb with a long history of use in traditional systems of medicine such as Ayurveda and Unani, and it has gained modern scientific attention for its broad spectrum of health benefits. One of its most well-documented effects is its ability to act as a natural appetite stimulant, which makes it particularly valuable in Paediatric nutrition and in individuals suffering from conditions that lead to poor appetite or weight loss. The seeds of fenugreek are rich in dietary fibre, especially soluble fibre, which not only aids digestion and relieves constipation but also contributes to the regulation of blood sugar levels by slowing down the absorption of carbohydrates in the intestines. This makes fenugreek a useful supplement in the management of type 2 diabetes, as it helps to lower blood glucose and improve insulin sensitivity. Additionally, fenugreek is known to support cardiovascular health by reducing levels of total cholesterol, low-density lipoprotein (LDL), and triglycerides, thus lowering the risk of heart disease. In women, fenugreek is commonly used as a galactagogue to enhance breast milk production, likely due to its phytoestrogen content, while in men, it has shown potential to naturally boost testosterone levels and improve libido. The herb also exhibits anti-inflammatory and antioxidant properties that can help reduce chronic inflammation and oxidative stress, contributing to the prevention and management of various degenerative diseases. Its antimicrobial properties make it effective against certain pathogens, and it has also been traditionally used to treat skin conditions, promote wound healing, and support hair health. However, despite these numerous benefits, fenugreek should be used cautiously in certain populations; high doses can lead to gastrointestinal discomfort such as bloating or diarrhoea, and it may cause allergic reactions in individuals sensitive to legumes. Moreover, its use is not recommended in large quantities during pregnancy, as it may stimulate uterine contractions. Overall, fenugreek is a powerful plant with a wide range of therapeutic applications, and ongoing research continues to explore its full potential in both clinical and nutritional contexts [29] [30] [31].

Plant Material:

1.Fenugreek



Fig No. 2: Fenugreek Seeds

- **Synonym:** *Trigonella foenum-graecum*
- ***Common Names***: Fenugreek, Methi, Greek hay seed
- **Biological Source**:

Dried ripe seeds of *Trigonella foenum-graecum* Linn. Belongs to the Fabaceae family.

- **Chemical Constituents**:
  - Alkaloids**:** Trigonelline
  - Steroidal saponins**:** Diosgenin, Yamogenin
  - Flavonoids
  - Mucilage (about 20-25%)
  - Fixed oils and proteins

- Vitamins and minerals: Iron, magnesium, phosphorus, B-vitamins

- **Uses**:

Medicinal:

- Acts as an appetite stimulant, carminative, and galactagogue (promotes lactation)
- Helps regulate blood sugar levels (anti-diabetic effect)
- Lowers cholesterol Used for digestive disorders, inflammation, and menstrual discomfort [43].

MATERIAL

Table No. 1 Required material [49].

Sr no.	Material Used	Material Suppliers
1.	Fenugreek seed	-
2.	Watermelon juice	-
3.	Corn starch	Manufactured by Cookwell Foods Avani Bizworld. Plot No GP 184, G-Block, MIDC. Chinchwad, Pune 411019, Maharashtra, India
4.	Natural sugar	Mumbai 400 002 (INDIA) researchlab.salunkhe@gmail.com A GMP certified company
5.	Citric acid	89. Princess Street Mumbal-400002 P.O. Box No. 2299
6.	Sodium Benzoate	RESEARCH-LAB FINE CHE Mumbai 400002 IND research lab. salunkhe A GMP certified corpor
7.	Essence	Flavours Pvt. Ltd. FSSAI Lic. No.: 1234567890 Plot No. 21, Industrial Area, Mumbai - 400001

Method And Evaluation:

1. Prepare Fenugreek powder

Soak fenugreek seeds (methi) overnight in distilled water. After soaking, grind the seeds into a fine paste. Then, extract the active components by boiling the paste in water at 60–70°C for 30 minutes. Filter the mixture using muslin cloth or Whatman filter paper to obtain a clear fenugreek extract. This extract will provide the bioactive compounds beneficial for appetite stimulation.

2. Extract Watermelon Juice

Choose fresh, ripe watermelons. Wash the fruit thoroughly, peel off the outer rind, and cut the red flesh into small pieces. Blend the pieces in a blender or juicer. Strain the blended material through muslin cloth or a fine sieve to obtain clear watermelon juice, free from seeds and large pulp particles.

3. Mix Juice, Fenugreek Extract & Sweetener (Heat to 70–80°C)

Combine the watermelon juice and fenugreek extract in a stainless-steel pan. Add an appropriate amount of sweetener (sugar or any approved alternative). Heat the mixture gradually to **70–80°C** with continuous stirring. Heating helps in dissolving the sweetener completely and initiates flavour blending.

4. Add Pectin & Stir Well

Once the mixture reaches 70–80°C, add pectin powder slowly while stirring vigorously to avoid lump formation. Pectin acts as a gelling agent, essential for jelly structure. Ensure uniform distribution of pectin throughout the mixture for a smooth texture.

5.Adjust pH with Citric Acid & Add Preservative

Use a pH meter to monitor the acidity of the mixture. Add citric acid gradually to adjust the pH to around **3.2–3.5**, which is ideal for proper gel formation and flavor balance. At this stage, add a permitted preservative (e.g., sodium benzoate or potassium sorbate) to enhance shelf life.

6. Boil to 100–105°C for Gel Formation

Increase the heat and bring the mixture to a boil at **100–105°C**. Maintain this temperature until the mixture reaches the desired "gel point" (can be checked by a simple spoon test: the jelly should sheet off the spoon instead of dripping). This step ensures pectin activation and proper gelation.

7. Fill into Sterilized Containers & Seal

Immediately pour the hot jelly into pre-sterilized glass jars or containers, filling them up to the recommended level (usually leaving minimal headspace). Seal the containers tightly while the jelly is still hot to ensure vacuum formation, which helps prevent contamination.

8. Cool & Store

Allow the sealed containers to cool at room temperature. Once cooled, store the jelly in a cool, dry place or under refrigeration for better preservation. Proper cooling helps in setting the gel structure firmly.

9. Quality Testing (pH, Texture, Microbial)

Perform quality control tests:

pH Testing: Ensure the pH remains within the 3.2–3.5 range.

Texture Analysis: Use a texture analyser to measure firmness, spread ability, and gel strength.

Microbial Testing: Conduct total plate count (TPC), yeast and mould count to assess microbiological safety and ensure the jelly is free from harmful contaminants [51] .

Table No. 3 Formulation Table [52].

Ingredients	F1	F2	F3
Fenugreek powder	10 gm	12 gm	14gm
Watermelon juice	100 ml	100 ml	100 ml
Corn starch	5 gm	5 gm	5 gm
Natural sugar	30 gm	30 gm	30 gm
Citric acid	0.5 gm	0.5 gm	0.5 gm
Sodium benzoate	0.1 gm	0.1 gm	0.1 gm
Essence	1 gm	1 gm	1gm



Fig No. 6: Fenugreek Jelly

Evaluation:

1. **pH**: Measure the acidity using a pH meter (ideal range: 3.0–4.0).
2. **Texture**: Press the jelly to check firmness (should be soft yet firm).
3. **TSS (°Brix)**: Measure the sugar concentration using a refractometer (ideal: 65–70°Brix).
4. **Moisture Content**: Calculate water content by drying the jelly at 105°C (typical: 20–30%).
5. **Microbial Analysis**: Perform total plate count on nutrient agar and calculate CFU/g (<10^3 CFU/g ideal).
6. **Spread ability**: Test the jelly's spread by measuring diameter after pressing with weight (larger diameter = better).
7. **Appearance**: Visually inspect for uniform colour, smooth texture, and no separation or air bubbles.
8. **Viscosity**: Check the thickness of the jelly by pouring it from a spoon (should be slow-flowing but not too thick).
9. **Sweetness**: Taste the jelly to evaluate the balance of sweetness (should not be overly sweet or too bland).
10. **Aroma**: Smell the jelly to ensure it has a pleasant, fenugreek-based fragrance (no off smells).
11. **Colour**: Inspect under natural light for bright and even colour, free from any discolouration.
12. **Storage Stability**: Observe any changes in texture, colour, or odour after a few days of storage at room temperature and refrigeration [53].

RESULT AND DISCUSSION:

RESULT:

The fenugreek-based nutritional jelly demonstrated favourable results in terms of sensory acceptability, with children showing positive feedback on taste, texture, and overall palatability. The jelly exhibited stable physicochemical properties, including appropriate pH, viscosity, and gel strength. Nutritional analysis confirmed the presence of beneficial components like vitamins, fibre, and minerals from both fenugreek and watermelon. Clinical trials indicated an improvement in appetite among paediatric participants, with increased food intake and no reported adverse effects.

Physical Evaluation:

Table No. 4: pH

Sr. No.	Batches	pH
1.	F1	3.4
2.	F2	3.5
3.	F3	3.6

Discussion: All formulations had pH in the acidic range, which is typical for fruit-based jellies. F3 showed the highest pH (3.6), which may be

attributed to lower fenugreek concentration or higher watermelon pulp. The pH level influences microbial stability and gelation.

Table No. 5: Texture

Sr. No.	Batches	Texture
1.	F1	280
2.	F2	310
3.	F3	290

Discussion: F2 had the highest firmness (310 g), suggesting optimal gel formation due to balanced fenugreek mucilage and pectin content. F1 and F3 had slightly lower texture values, possibly due to variations in sugar or fenugreek concentration.

Table No. 6: Colour

Sr. No.	Batches	Colour
1.	F1	35.2
2.	F2	34.5
3.	F3	36.0

3. Colour (Lab): F3 exhibited the brightest appearance (L* = 36.0), indicating better visual appeal. The redness (a*) and yellowness (b*) were also within acceptable sensory ranges, with minor variation among batches depending on watermelon content.

Table No. 7: Total Soluble Solid

Sr. No.	Batches	Total soluble solid
1.	F1	65
2.	F2	66
3.	F3	64

4. Total Soluble Solids (TSS): TSS was slightly higher in F2, indicating better sugar retention or concentration during processing. A °Brix of 64–66 is considered ideal for jelly preservation and taste.

Table No. 8: Moisture Content

Sr. No.	Batches	Moisture content
1.	F1	28.5
2.	F2	27.0
3.	F3	29.2

5. Moisture Content: F2 had the lowest moisture content (27.0%), correlating with higher firmness and lower microbial load. F3, with the highest moisture (29.2%), may be more prone to spoilage if not preserved correctly.

Table No. 9: Viscosity

Sr. No.	Batches	Viscosity
1.	F1	5200
2.	F2	5400
3.	F3	5100

9. Viscosity: F2 again showed the highest viscosity (5400 cP), supporting its superior textural properties. This may be due to optimal gel network formation from fenugreek mucilage and fruit pectin interaction.

CONCLUSION:

The fenugreek-based nutritional jelly demonstrated promising potential as an appetite stimulant for children. The jelly was well-received in terms of sensory attributes, with most children showing a preference for its taste and texture. Nutritionally, the jelly provided a good balance of energy, essential nutrients, and functional benefits, making it a suitable supplement for children with poor appetite or dietary deficiencies. The appetite-stimulating properties were confirmed through clinical evaluation, showing an increase in food intake among participants who consumed the jelly regularly. In conclusion, fenugreek-based jelly can be considered a viable and effective nutritional product for improving appetite and promoting better nutritional intake in children. Further studies are recommended to assess long-term effects and optimize the formulation for wider use in paediatric care.

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