"FORMULATION & CHARACTERIZATION OF ENERGY BOOSTING CANDY (JELLY) USING MORINGA OLEIFERA AS NUTRITIONAL APPROACH"

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ABSTRACT

The increasing prevalence of physical fatigue, nutritional deficiencies, reduced dietary quality, and dependence on synthetic energy supplements has created a growing demand for natural, nutrient-rich, and consumer-friendly functional foods. Conventional energy products available in the market frequently contain high sugar levels, artificial additives, preservatives, and stimulants, which may limit their long-term health benefits. Therefore, the development of herbal nutraceutical formulations has gained significant interest in recent years.

Moringa oleifera, commonly referred to as the "miracle tree," possesses exceptional nutritional and therapeutic value due to the presence of proteins, essential amino acids, vitamins, minerals, polyphenols, flavonoids, antioxidants, and bioactive phytoconstituents. The leaves of Moringa oleifera are particularly rich in iron, calcium, potassium, vitamin A, vitamin C, and phenolic compounds, making them a promising candidate for the development of natural energy-enhancing products.

The present review focuses on the formulation and characterization of an energy-boosting jelly candy incorporating Moringa oleifera as a functional ingredient. The proposed jelly formulation may include suitable gelling agents such as gelatin, pectin, or agar along with sweetening and flavor-masking components to improve stability, palatability, and consumer acceptance. Characterization parameters considered for evaluation include organoleptic properties, pH, moisture content, texture profile, viscosity, total solids, nutritional composition, antioxidant activity, microbial quality, and stability assessment.

Furthermore, the study highlights the nutraceutical significance of Moringa oleifera and its potential role in supporting energy metabolism, reducing oxidative stress, and improving nutritional intake. The incorporation of Moringa oleifera into a jelly-based dosage form may provide a convenient, acceptable, and innovative functional food product suitable for children, adults, athletes, and nutritionally vulnerable populations.

Overall, the review suggests that Moringa oleifera-based energy jelly candy possesses promising potential as a herbal nutraceutical formulation and may serve as a foundation for future product development, clinical evaluation, commercialization, and functional food research.

Keywords:

Moringa oleifera, Energy boosting candy, Herbal jelly, Nutraceutical formulation, Functional food, Antioxidant activity, Characterization, Nutritional supplement.

INTRODUCTION

Moringa oleifera, commonly known as the "drumstick tree" or "miracle tree," is one of the most nutritionally rich medicinal plants widely cultivated in tropical and subtropical regions. Due to its exceptional nutritional composition and therapeutic potential, Moringa has gained significant scientific attention in the fields of nutraceuticals, pharmaceuticals, and functional food development. The leaves of Moringa are particularly rich in proteins, vitamins (A, C, and E), minerals (calcium, potassium, and iron), essential amino acids, polyphenols, flavonoids, carotenoids, and other bioactive phytochemicals that exhibit antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and immunomodulatory properties. [1,2]

In recent years, consumers have shown increasing interest in functional confectionery products that not only provide taste and convenience but also deliver health-promoting benefits. Among these products, jelly candies have emerged as an attractive dosage form because of their palatability, chewable texture, ease of consumption, and suitability for incorporation of nutraceutical ingredients. Conventional candies are generally high in sugar and provide minimal nutritional benefits; therefore, the incorporation of plant-based bioactive compounds into jelly formulations offers an innovative strategy to transform confectionery products into value-added functional foods. [3]

The formulation of energy-boosting jelly candy using Moringa oleifera is scientifically promising because Moringa contains a wide spectrum of nutrients involved in energy metabolism and physiological functioning. The high levels of iron and vitamin C may help reduce fatigue and improve hemoglobin synthesis, while amino acids and minerals support metabolic activities and muscle function. Additionally, the antioxidant compounds such as quercetin, kaempferol, chlorogenic acid, and phenolic acids present in Moringa help combat oxidative stress generated during physical and mental exertion. These phytochemicals may contribute to improved stamina, enhanced immunity, and better overall health.[4,5]

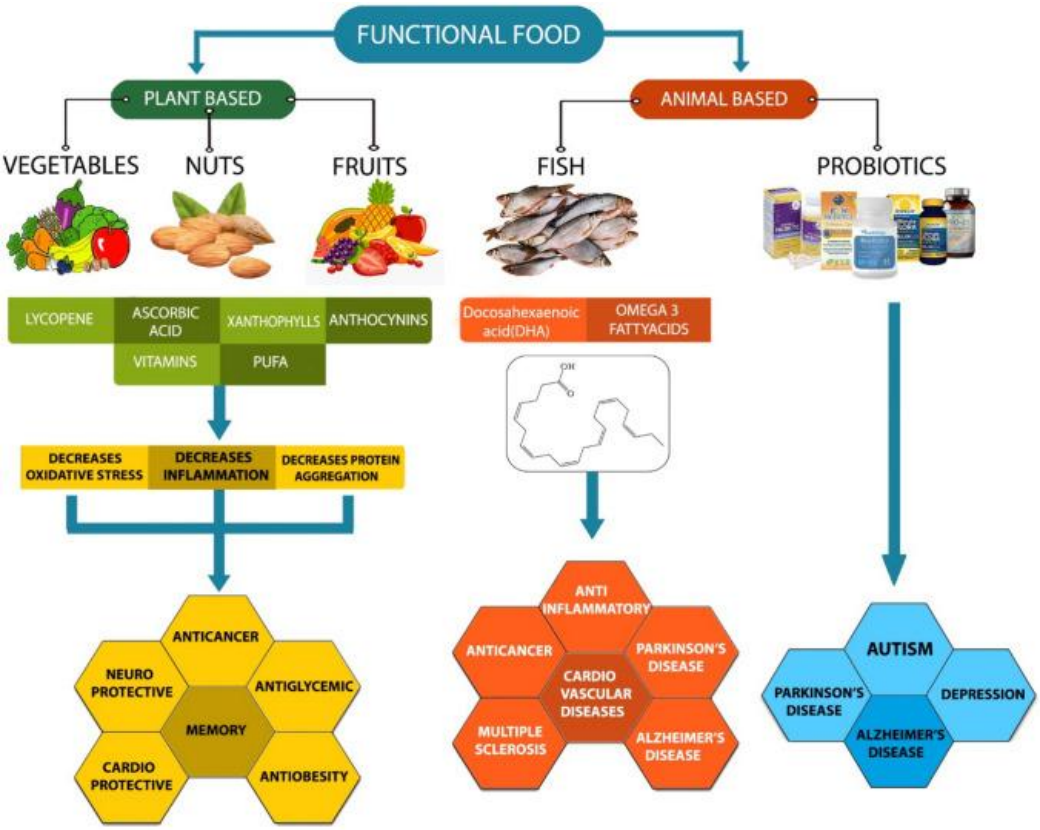
From a pharmaceutical and food technology perspective, jelly candy serves as an effective delivery system for herbal and nutraceutical ingredients. The gelatin or pectin-based matrix can protect sensitive bioactive compounds and improve consumer acceptability compared to traditional herbal preparations that often possess undesirable taste and odor. However, the development of Moringa-based jelly candy requires careful optimization of formulation parameters such as concentration of Moringa powder or extract, gelling agent ratio, sugar concentration, acidity, texture profile, moisture content, color stability, and sensory acceptability. Excessive addition of Moringa may impart bitterness, dark green coloration, and reduced consumer preference due to the presence of chlorophyll and certain phytochemicals. Therefore, scientific formulation strategies such as flavor masking, encapsulation, or balancing sweeteners and acids are essential for achieving an acceptable product. Several research studies on functional foods have highlighted the successful incorporation of plant extracts and antioxidants into confectionery systems to enhance nutritional value and shelf stability. Nutraceutical jelly candies enriched with antioxidant-rich ingredients have demonstrated potential as convenient health supplements with improved consumer compliance. In this context, Moringa oleifera-based jelly candy can be considered a novel functional confectionery product capable of delivering nutritional supplementation alongside sensory satisfaction. Scientifically, the characterization of such jelly candy involves multiple evaluation parameters including physicochemical properties (pH, viscosity, moisture content, total soluble solids), nutritional analysis, phytochemical screening, antioxidant activity assays, microbial stability, texture analysis, and sensory evaluation. Stability studies are also important to determine the retention of bioactive compounds during storage. Moreover, the growing global demand for plant-based energy supplements and natural functional foods supports the commercial relevance of Moringa-enriched confectionery products. [6]

Thus, the formulation and characterization of energy-boosting candy (jelly) using Moringa oleifera represents an innovative approach in functional food research aimed at developing a nutritionally enriched, consumer-friendly, and health-promoting confectionery product with potential applications in nutraceutical and pharmaceutical industries.

FUNCTIONAL FOODS AND ENERGY SUPPLEMENTS

Functional foods are regarded as foods that have potential beneficial effect on health beyond their basic nutritional value. They promote good health and lower the risk of diseases. Functional foods have received widespread popularity across the globe, and they are commonly known as “nutraceuticals” and “designer food”. The concept of functional food was started and regulated by the Ministry of Health and Welfare, Japan, in the year 1980s and then progressed to North America and other markets (Mellentin et al. 2014). Amount of biologically active compounds are very less in the food items and their beneficial effect have been studied in rodent models and clinical studies. Results from epidemiological studies have shown that consumption of specific fruits, animal

products and vegetables that are rich in bioactive compounds reduced the risk of various metabolic disorders and cancer (Karasawa and Mohan 2018) [7,8,9]



Role of Energy Supplement

Protein supports muscle repair, recovery, and growth after training. Endurance and strength athletes need higher protein, especially during intense or new training phases. Adequate intake is easily met through varied diets including meat, eggs, and dairy, but athletes with restricted or poorly planned diets (e.g., low-fat or vegetarian) risk deficiency. Regular strenuous exercise mayincrease the need for certain vitamins and minerals, but supplementation is unnecessary if a nutrient-rich diet is maintained. Supplements are recommended only during energy restriction, travel, or limited food availability. Protein requirements rise with intense training (1.4–2.0 g/kg/day), and supplements help meet these needs, although excess intake offers no added benefits. Essential amino acids (EAAs) and branched-chain amino acids (BCAAs), especially leucine, promote protein synthesis, recovery, and fatigue delay. Creatine monohydrate (0.3 g/kg/day loading, then 3–5 g/day) effectively enhances high-intensity performance and muscle mass with proven safety. Caffeine, a natural stimulant found in coffee, tea, and energy drinks, improves endurance,

power, and fat metabolism at doses of 3–6 mg/kg taken before exercise, though excessive intake may cause side effects such as palpitations or insomnia. (Kreider et al.,2010; Antonio et al., 2008; Paddon-Jones et al., 2004).Electrolytes such as potassium, sodium, magnesium, calcium, and phosphorus are vital for muscle, heart, andnervous system function. A well-balanced diet rich in vitamins, minerals, functional compounds, and sufficient water serves as a safe and effective means to support optimal athletic performance. During periods of intense physical activity, such a diet ensures adequate energy, macronutrients, protein for tissue repair, glycogen replenishment, essential fatty acids, and fat-soluble vitamins (Gammone et al., 2014). Key micronutrients include B vitamins, vitamins D, C, and E, iron, calcium, magnesium, zinc, selenium, and beta-carotene, many of which mitigate exercise-induced oxidative stress (Iannello and Belfiore, 2001; Nielsen, 2006).Deficiencies, especially in vegetarian or vegan athletes, can impair performance, oxygen delivery, and bone integrity (Ogan and Pritchett, 2013; Peeling et al., 2009; Brownlie et al., 2004). Energy gels, containing carbohydrates, electrolytes, and sometimes caffeine, provide rapid energy, support hydration delay fatigue, and enhance endurance when used strategically during prolonged exercise. [10,11,12]

Table 1. Dietary supplements content and examples

Dietary Supplements	Content	Examples
Energy gel	Carbohydrate with or without minerals, amino acids, vitamins	Carb-BOOM gel, GU carbohydrate gel, Power gel etc.
Energy drink	Carbohydrate or protein	Ocean energy drink or water; Sting, Red bull and Hell energy drink etc.
Energy bar	Carbohydrate or protein	Phab, Rite bite, Max protein and On the run energy bar etc.
Powder	Electrolytes eg. Na, K etc.	Fast and up, Hydralyte, E- Hydration etc.
Capsule/ Tablets	Vitamins, minerals, amino acids etc.	Nature life, Fast and up, H and C capsules etc.
Effervescent Tablet	Vitamin C, caffeine etc.	L-Glutathione, Effervescent tablet-
Gummies	Biotin, multivitamin, omega-3 etc.	Man matters (omega-3), True vitals (multivitamin), Bodywise (biotin) etc.
Transdermal Patch	Scopolamine, nitrogrigycerin, clonidine, estradiol etc.	Pure science (Vit. B12), Nutripacth (Antioioidant, Cipla (Nicotex) etc.

NEED FOR NATURAL ENERGY BOOSTER

The growing incidence of physical fatigue, reduced stamina, nutritional deficiencies, sedentary lifestyles, mental stress, irregular dietary habits, and increased dependence on processed foods has led to a rising demand for effective energy-supporting products. Modern lifestyles frequently involve inadequate nutrient intake, disturbed sleep patterns, prolonged working hours, academic pressure, and decreased physical activity, all of which may contribute to reduced energy levels and impaired physiological performance. Consequently, consumers increasingly seek nutritional interventions capable of supporting energy metabolism and overall wellness.

Conventional energy products available in the market, including energy drinks, synthetic supplements, and stimulant-based formulations, are commonly formulated with high concentrations of sugar, caffeine, artificial

flavors, preservatives, and synthetic additives. Although these products may provide temporary stimulation or rapid energy release, excessive consumption has raised concerns regarding metabolic imbalance, elevated caloric intake, sugar overload, oxidative stress, and limited nutritional benefits. Therefore, there is growing scientific interest in developing safer, nutritionally enriched, and naturally derived alternatives. [4]

Natural energy boosters derived from medicinal plants, functional foods, and nutraceutical ingredients have gained considerable importance due to their ability to provide nutritional support along with additional biological benefits. Plant-based ingredients are rich sources of vitamins, minerals, amino acids, polyphenols, flavonoids, antioxidants, and bioactive compounds that may contribute to improved energy metabolism, reduction of oxidative damage, enhancement of physical performance, and maintenance of physiological homeostasis.

Among various botanical candidates, Moringa oleifera has emerged as a promising natural ingredient because of its exceptional nutritional profile and diverse pharmacological properties. The leaves of Moringa oleifera contain proteins, essential amino acids, iron, calcium, potassium, vitamin A, vitamin C, phenolic compounds, and antioxidant constituents. These components may support nutritional status and contribute indirectly to fatigue reduction and improved metabolic function. Experimental investigations have also reported anti-fatigue activity associated with Moringa oleifera, indicating its potential role in the development of energy-support formulations.

In addition to ingredient selection, the dosage form plays a critical role in consumer acceptance and compliance. Traditional herbal preparations often suffer from poor palatability, difficult administration, and limited acceptance among pediatric and general populations. Jelly-based nutraceutical systems provide advantages such as improved taste, ease of consumption, convenient dosing, attractive appearance, and enhanced acceptability. Therefore, incorporation of Moringa oleifera into an energy-boosting jelly candy formulation represents an innovative approach for developing a functional nutraceutical product with potential health benefits.

Hence, the development of natural energy boosters based on Moringa oleifera may provide a safer, nutritionally enriched, consumer-friendly, and commercially feasible alternative to conventional synthetic energy products while supporting future research in herbal functional foods and nutraceutical formulations.[7,8]

Nutritional Importance Of Moringa Olefira

Every part of M. oleifera is a storehouse of important nutrients and antinutrients. The leaves of M. oleifera are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper . Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in M. oleifera. Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar present along with anti-cancerous agents like glucosinolates, isothiocyanates, glycoside

compounds and glycerol-1-9-octadecanoate. Moringa leaves also have a low calorific value and can be used in the diet of the obese. The pods are fibrous and are valuable to treat digestive problems and thwart colon cancer . A research shows that immature pods contain around 46.78% fiber and around 20.66% protein content. Pods have 30% of amino acid content, the leaves have 44% and flowers have 31%. The immature pods and flowers showed similar amounts of palmitic, linolenic, linoleic and oleic acids.

Moringa has lot of minerals that are essential for growth and development among which, calcium is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300–400 mg, moringa leaves can provide 1000 mg and moringa powder can provide more than 4000 mg. Moringa powder can be used as a substitute for iron tablets, hence as a treatment for anemia. Beef has only 2 mg of iron while moringa leaf powder has 28 mg of iron. It has been reported that moringa contains more iron than spinach . A good dietary intake of zinc is essential for proper growth of sperm cells and is also necessary for the synthesis of DNA and RNA. M. oleifera leaves show around 25.5–31.03 mg of zinc/kg, which is the daily requirement of zinc in the diet

PUFAs are linoleic acid, linolenic acid and oleic acid; these PUFAs have the ability to control cholesterol. Research show that moringa seed oil contains around 76% PUFA, making it ideal for use as a substitute for olive oil [14]. A point to note is that the nutrient composition varies depending on the location. Fuglie [12] revealed that seasons influence the nutrient content. It was shown that vitamin A was found abundantly in the hot-wet season, while vitamin C and iron were more in the cool-dry season [15]. The difference in results can be attributed to the fact that the location, climate and the environmental factors significantly influence nutrient content of the tree. [13,14]

ENERGY DEFICIENCY AND FATIGUE

Energy deficiency and fatigue are common physiological conditions characterized by reduced physical performance, diminished endurance, decreased mental alertness, weakness, and impaired ability to perform daily activities. Fatigue is generally defined as a state of physical and/or mental exhaustion resulting from inadequate energy availability, increased metabolic demand, nutritional imbalance, oxidative stress, disease conditions, or prolonged workload. It may be acute or chronic and can significantly affect quality of life, productivity, and overall health.

Energy production within the human body primarily depends on the metabolism of carbohydrates, proteins, and lipids through cellular pathways that generate adenosine triphosphate (ATP), which serves as the principal energy currency of cells. ATP synthesis mainly occurs within mitochondria through oxidative phosphorylation. Any disturbance in nutrient availability, mitochondrial function, oxygen utilization, or metabolic efficiency may contribute to decreased energy production and the development of fatigue. [15]

Nutritional deficiency is considered one of the major contributing factors associated with energy deficiency. Insufficient intake of essential nutrients such as iron, vitamin B-complex, vitamin C, magnesium, proteins, and amino acids may impair metabolic reactions involved in ATP synthesis and oxygen transport. Iron deficiency can reduce hemoglobin formation and oxygen delivery to tissues, resulting in weakness, reduced exercise tolerance, and physical exhaustion. Similarly, deficiency of B vitamins may interfere with carbohydrate metabolism and energy generation processes.

Oxidative stress also plays an important role in the pathophysiology of fatigue. Increased production of reactive oxygen species (ROS) during prolonged physical activity, metabolic imbalance, and environmental stress may lead to cellular damage, mitochondrial dysfunction, and reduced energy efficiency. Antioxidant-rich dietary interventions have therefore attracted scientific interest due to their ability to minimize oxidative damage and support physiological energy balance.

Modern lifestyle factors further contribute to the increasing prevalence of fatigue. Irregular dietary patterns, processed food consumption, academic pressure, inadequate sleep, sedentary behavior, psychological stress, excessive workload, and limited physical activity may reduce nutritional quality and metabolic efficiency. These factors have increased demand for functional foods and nutraceutical products capable of supporting natural energy metabolism.

Natural plant-derived ingredients are increasingly investigated as alternatives to synthetic stimulants because they provide nutritional support along with antioxidant and health-promoting properties. Among these, Moringa oleifera has gained attention due to its rich nutritional composition and potential anti-fatigue activity. The leaves of Moringa oleifera contain proteins, essential amino acids, calcium, iron, potassium, vitamin A, vitamin C, phenolic compounds, flavonoids, and antioxidants. Experimental studies have suggested that Moringa oleifera may improve antioxidant defense systems, reduce oxidative stress, and contribute to fatigue reduction.

Considering these nutritional and functional characteristics, incorporation of Moringa oleifera into an energy-boosting jelly candy formulation may represent an innovative nutraceutical approach. The jelly dosage form may improve palatability, convenience, consumer compliance, and acceptance while delivering nutrients in an easily consumable format. Therefore, the development of Moringa oleifera-based energy jelly products may provide a natural strategy for supporting energy balance and reducing nutrition-related fatigue. [16]

ROLE OF HERBAL JELLIES

In recent advances in drug delivery, the oral route continues to be the most convenient and preferred route for drug administration to attain maximal therapeutic benefits-leading to patient compliance. Nowadays, jelly candies are readily accepted by children with a full set of teeth as they enjoy the taste and chewability of the jelly candies due to the frequent addition of fruit juice and fruit extracts. Most patients with dysphagia would choke on water while administering highly viscous liquid formulations that should be avoided, thus the enhancement of pharmaceutical preparations of this sort. Modern development of oral medicated jelly is, in fact, one of the novel approaches that target the improvement of safety and efficacy. The formulations are more patient compliant when it comes to administering, especially for dysphagic patients, who constitute a significant proportion of the population in this modern world.

In simplest words, jelly consists of semisolid preparations that may be transparent or translucent without greasiness, meant for topical and internal uses. Jellies refer to water-soluble bases derived from natural materials like tragacanth, pectin, boroglycerin, and alginates or the synthetic derivatives of those natural substances by means of cellulose, sodium carboxymethylcellulose, methylcellulose, and sodium carboxymethyl cellulose. An ideal dosage regimen for any drug treatment of a disease is usually one that achieves the desired therapeutic concentration of the drug in plasma (or at the site of action) as quickly as possible and keeps it generally constant for the entire duration of the treatment. Drugs are very often administered orally, which is somewhat contradictory to the idea. Drug administration is for the most part a very natural, simple, convenient, and safe option, allowing considerations of great flexibility in design of dosage form, ease of manufacture, and small cost, with user-appropriateness, aggregation, and ease of production. [17,18,19]

Oral Mucosa

The term is used to refer to the soft tissue lining of the oral cavity, which comprises the - mucosa, epithelium, lamina propria, and submucosa. The total area of the oral cavity comes to about 100 cm2, and the oral mucosal surfaces are constantly bathed by saliva (0.5-2 L per day turnover). The pH of saliva ranges from 5.6 to 7.9 based on the flow rate. [20]

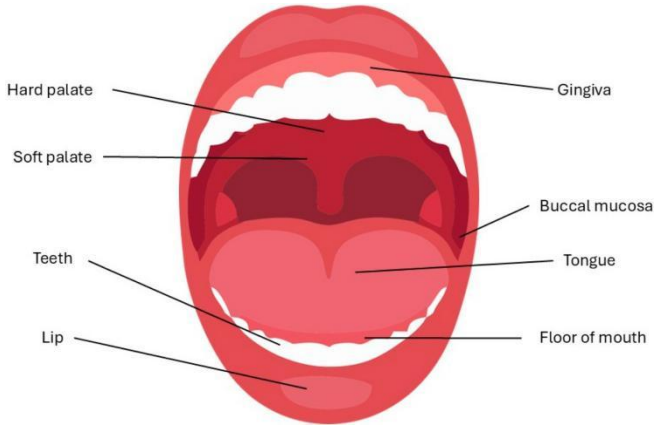
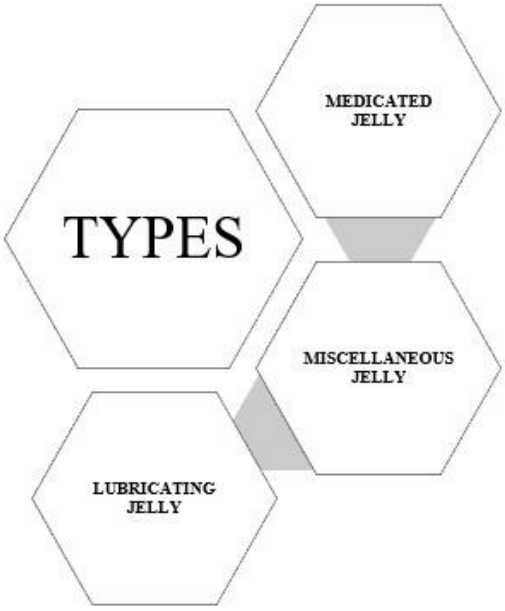


Figure:- Oral Mucosa

TYPES OF JELLY



1. Medicated Jelly

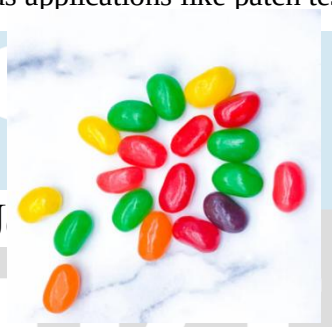
These mainly act in the mucous membranes and skin due to their spermicidal, local anaesthetic, and antiseptic properties. These jellies contain adequate water content. Upon evaporation of the water, the jellies provide a local cooling effect and protect through a residual film. For example, ephedrine sulphate jelly acts as a vasoconstrictor in stopping nosebleeds.

2. Lubricating Jelly

The jellies are intended to act as lubricants for diagnostic equipment, such as cystoscopes, catheters, surgical gloves.

3. Miscellaneous jelly

The miscellaneous jelly are used for various applications like patch testing, electrocardiogram.



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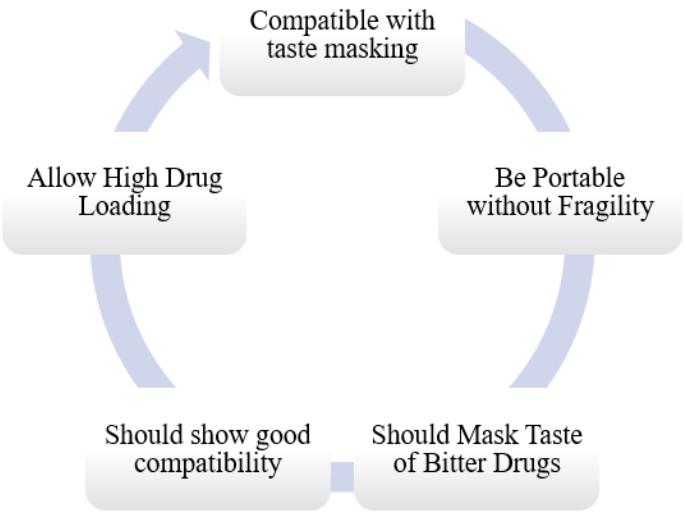


Advantages Of Jelly

1. Can give anywhere and anytime without water.
2. It can prevent synthesis difficulty due to short drug action and variation in drug release and retention time through the oral mucosa.
3. Less frequent dose when compared to other drug administering systems.
4. Termination of treatment is comparatively easy at will.
5. Drugs should either dissolve or suspend in saliva and be in a freely bioavailable form, so that after the initial jelly release, they are swallowed into the gastro-tract.
6. Design flexibility.
7. Improved patient compliance.
8. Medicated jellies are practical for localized treatment against the diseases affecting systemic conditions or the oral cavity.
9. High acceptance by children, geriatrics and patients with dysphagia.
10. Good for immediate or emergency treatment.

Disadvantages Of Jelly

1. Because it is an aqueous formulation, proper packaging is necessary to preserve the stability of the medications in a variety of environments.
2. If not properly prepared, it could result in a disagreeable flavour.
3. It also exhibits the quality of effervescent, fragile granules.
4. Standard blister packets lack physical resistance.
5. Because oral medicated jelly is hygroscopic, it needs to be stored in a dry location.
6. Special packaging is necessary for the stable product to be appropriately stabilized and safe.

Limitations Of Jelly

1. An expensive production method
2. Standard blister packets lack physical resistance.
3. For the stable product to be adequately stabilized and safe, OMJ needs appropriate packaging.
4. It also exhibits the quality of fragile, effervescent granules.
5. Limited capacity to add more active medication concentrations.
6. ODT must be stored in a dry location due to its hygroscopic nature.

Key Ingredients Used in Preparation of Jelly

Table No. 1 Key Ingredients

Sr no	Ingredients	Uses
1)	Gelling agent	Gellan gum, Gelatin, xanthan gum, sodium alginate, pectin, carrageneen, mcc and dvts etc
2)	Stabilizers	Propylene glycol, sorbitol
3)	Preservatives	Methyl paraben, propyl paraben, sodium benzoate

Table No. 2 Gelling Agents [21]

Sr no	Gelling agents	Description
1	Sodium Benzoate	In a variety of topical and oral medicinal formulations, including pastes, creams, and gels, as well as in cosmetics and food items, it is frequently utilized as a thickening and suspending agent.
2	Gelatin	In an implanted delivery system, it serves as a biodegradable matrix material. Additionally, gelatin is frequently used in culinary items and emulsions for photography.
3	Agar	It has been experimentally employed in gel formulation for oral sustained drug administration and is utilized as an adsorbent and bulk forming agent.
4	Tragacanth	It serves as an emulsifying and suspending ingredient in a number of medicinal compositions. Creams, gels, and emulsion formulas all employ it.
5	Xanthan gum	It is primarily utilized as a thickening, emulsifying, stabilizing, and suspending ingredient in food, cosmetics, and topical and medicinal formulations. Additionally, it is utilized as a hydrocolloid in the food sector and as a thickening ingredient in shampoo in cosmetics.
6	Cellulose derivatives	It is employed in the production of thermoplastic polymers and functions as a hydrophilic bulking agent. For instance, sodium carboxymethyl methyl cellulose.

Nutritional Content of Fresh Moringa Leaves and Dried Moringa Leaves (per 100g) [22,23,24]

Nutrient content	Fresh Moringa Leaves	Dried Moringa Leaves	Reference
Water content (%)	75.9	6	
Ash content	-	7.95	Shiriki, et al. (2015)
Calories (cal)	92	205	
Proteins (%)	6.7	23.78	Augustyn, et al. (2017)
Fat (%)	4.65	2.74	
Carbohydrates (%)	12.5	51.66	Tekle, et al. (2015)
Fiber (%)	7.92	12.63	Aminah, et al. (2015)
Calcium (mg)	440	2003	
Iron (mg)	0.85	28.2	
Magnesium (mg)	42	368	
Zinc (mg)	0.16	3.29	USFDA National Nutrient Databas e (2015)
Phosphorus (mg)	70	204	
Copper (mg)	0.07	0.57	
Vitamin A (mg)	6.78	18.9	
Niacin (B3) (mg)	0.8	8.2	
Riboflavin (B2) (mg)	0.05	20.5	
Thiamine (B1) (mg)	0.06	2.64	
Vitamin C (mg)	220	17.3	

Pharmacognosy of Moringa (Moringa oleifera)

Botanical Description:

- Family: Moringaceae
- Common names: Drumstick tree, Miracle tree, Ben oil tree.
- Origin: Native to the Indian subcontinent but cultivated in tropical and subtropical regions worldwide.

Synonyms

The plant Moringa oleifera is known by several names throughout the world. The synonyms are given below.

- Latin – Moringa oleifera
- Sanskrit – Subhanjana,
- Hindi – Saguna, Sainjna
- Unani – Sahajan
- Ayurvedic – Haritashaaka, Raktaka, Akshiva
- Arabian – Rawag,
- French – Morungue
- Spanish – Angela, Ben, Moringa
- Chinese – La ken
- English - Drumstick tree, Horseradish tree

Phytochemical Constituents

- Alkaloids: Moringa contains alkaloids such as morphine, niazimicin, and other bioactive compounds that exhibit various pharmacological properties.

- Flavonoids: Includes quercetin, kaempferol, and others which are known for their antioxidant and anti-inflammatory properties.

- Vitamins: Rich in vitamins A, C, and E; these act as antioxidants and are crucial for immune function.

- Minerals: High in calcium, potassium, and iron, contributing to its nutritional value.

- Phenolic Compounds: Exhibit antioxidant activity and potential health benefits.

- Glucosinolates: Present in the leaves and seeds, which have been studied for their anti-cancer properties.

Taxonomical Classification

- Kingdom – Plantae
- Sub kingdom – Tracheobionta
- Super Division – Spermatophyta
- Division – Magnoliophyta
- Class – Magnoliopsida
- Sub class – Dilleniidae
- Order – Capparales
- Family – Moringceae
- Genus – Moringa
- Species – oleifera

Morphology

Moringa oleifera is a small fast – growing evergreen or deciduous tree usually grows up to 10 or 12 m in height. It has spreading, fragile branches, feathery foliage of tripinnate leaves, and whitish gray bark [13,22]

A] Leaves

The leaves are bipinnate or commonly tripinnate up to 45 cm long the leaflets are hairy, green and almost hairless on the upper surface. The twigs are hairy and green, these are compound leaves with leaflets of 1–2 cm long.

B] Flowers

The fragrant, bisexual, yellowish white flowers are hairy stalks in spreading or drooping axillary panicles 10 – 25 cm long. Individual flowers are approximately 0.7 to 1 cm long and 2 cm broad and five unequal yellowish –

white, thinly veined, spathulate petals, five stamens with five smaller sterile stamens and pistil composed of a 1-celled ovary and slender style.

C] Fruits

Fruits are tri – lobed capsules and are referred to pods it is pendulous, brown triangular, and splits into three parts lengthwise when dry 30 – 120 cm long, 1.8 cm wide fruits production mostly occurs in march and april. Fruit contain around 26 seeds during their development stage. Immature pods are green in color they turn brown on maturity.

D] Seeds

Seeds are round 1cm in diameter with brownish semi – permeable seed hull with 3 papery wings hulls of seed are brown to black but can be white if kernels are of low viability. Viable seed germinate within 2 weeks, each tree can produce around 15,000 to 25,000 seeds/year. Average weight is 0.3 gm/seed.

Pharmacological Activity

The plant Moringa oleifera possess broad pharmacological activities. Some of them are discussed below.

Antioxidant activity

Aqueous and alcoholic extracts (methanolic & ethanolic) of leaves and roots of Moringa oleifera exhibit strong in-vitro anti-oxidant and radical scavenging activity. Its leaves are rich source of antioxidant compounds; they could protect the animals against diseases induced by oxidative stress. Administration of Moringa oleifera leaves extract seems to prevent oxidative damage caused by high-fat diet [27].

Antiepileptic activity

Methanolic extract of Moringa oleifera leaves exhibit potent anti-convulsant activity against pentylenetetrazole and maximal electroshock induced convulsions at the dose levels of 200 mg/kg and 400 mg/kg administered intraperitonially. Diazepam and phenytoin were used as reference standard. Methanolic extract significantly delayed the onset of seizures in Ptz induced convulsions and significantly reduced duration of hind limb extension in MES test at both the dose levels. This may be because of the presence of alkaloids, flavonoids and tannins present in the extract [27].

Studies were performed to determine the in-vivo anti-convulsant effect of ethanolic extract of Moringa concanensis leaves (200 mg/kg, i.p) on MES and PTZ-induced seizures in Swiss albino mice. Observation revealed MES seizures, suppression of tonic hind limb extension. In PTZ seizures, abolition of the convulsions was noted. The ethanolic extract of Moringa concanensis leaves may produce its anti-convulsant effects via

multiple mechanisms since it abolished the hind limb extension induced by MES as well as abolished seizures produced by PTZ [28].

Anti-diabetic activity

Aqueous extract of Moringa oleifera leaves shows anti-diabetic activity and controls diabetes and thus exhibit glycemic control [28].

The investigation of in-vitro antioxidant and in-vivo antidiabetic effects of methanol extracts of Moringa oleifera pods in streptozotocin (STZ)-induced diabetic albino rats was performed. Diabetic rats were treated with 150 or 300 mg/kg of extract for 21 days and the antidiabetic effects were evaluated by measuring changes in biochemical parameters in serum and pancreatic tissue. The progression of diabetes was significantly reduced after treatment with the extract. In treated rats, both doses of extract induced a significant reduction in serum glucose and nitric oxide, with concomitant increases in serum insulin and protein levels [28].

The antidiabetic activity of two doses of Moringa seed powder 50 and 100 mg/kg on STZ induced diabetes male rats was investigated. The diabetic positive control group showed increased IL-6, increased lipid peroxide, and decreased antioxidant enzyme in the serum and kidney tissue homogenate compared with that of the negative control group

Cardiovascular activity

Ethanolic extract of Moringa oleifera leaves showed prominent anti-hypertensive or hypotensive activity. The in-vivo activity was done in animal's heart and it was found that thiocarbamate and isothiocyanate glycosides were responsible for this powerful hypotensive activity [29].

Anti-fertility activity

Aqueous extract of Moringa oleifera roots was found to be effective as anti-fertility in presence or absence of estradiol dipropionate and progesterone. The in-vivo antifertility activity and histopathology study was done using aqueous extract to investigate the effect on histoarchitecture of the uterus during pre and post–implantation stages.

Antiurolithiatic activity

The in-vitro anti-urolithiatic activity was performed in aqueous and alcoholic extract of bark of Moringa oleifera. It showed reduction in weight of stone produced using ethylene glycol induced urothiasis. It also possesses both preventive and curative property

Anti-asthmatic activity

A study was carried out to investigate the usefulness of Moringa oleifera seed kernel in patients of bronchial asthma. The patients of either sex with mild-to-moderate asthma were treated with finely powdered dried seed kernels in dose of 3 g for 3 weeks. The clinical efficacy was assessed using a spirometer prior to and at the end of the treatment. The majority of patients showed increase in hemoglobin (Hb) values and reduction in Erythrocyte sedimentation rate (ESR). Improvement was also observed in symptom score and severity of asthmatic attacks. After 3 weeks treatment in asthmatic subjects the drug produced significant improvement in forced vital capacity, forced expiratory volume in one second, and peak expiratory flow rate values by 32.97 ± 6.03%, 30.05 ± 8.12%, and 32.09 ± 11.75% respectively

Alcoholic extracts of Moringa oleifera seed kernels were found spasmolytic in acetylcholine, histamine, $Bacl_2$ and 5HT, induced bronchospasm

Hepatoprotective activity

In-vivo hepatoprotective activity of ethanolic extract of leaves and alcoholic extract of seed of Moringa oleifera was estimated against isoniazid, rifampicin, and pyrizinamide induced liver damage. Haematological along with hepatorenal functions of methanolic extract of Moringa oleifera roots, doses of the crude extract (CE) on liver and kidney functions were also reported

Anti–cancer activiy

Ethanolic extracts of leaves and seeds of Moringa oleifera shows potent anti–tumor activity. Thiocarbamate and isothiocyanate related compounds were isolated and which act as inhibitor of tumor promoter. The in-vivo antitumor potential was due the presence of three known thiocarbamate and isothiocynate related compounds which act as inhibitors of tumor promoter teleocidin B-4-induced Epstein–barr virus, interestingly [30].

Anti-inflammatory activity

Methanolic and aqueous extract of root and bark, methanolic extract of leaves and flowers and ethanolic extract of seeds of Moringa oleifera posses anti-inflammatory activity. In-vitro anti-inflammatory activity from the hot water infusions of flowers, leaves, roots, seeds and stalks or bark of Moringa oleifera using carrageenan-induced and the extract was pharmacologically evaluated [30].

Anti-microbial activity

Leaves, roots, bark and seeds of Moringa oleifera show anti-microbial activity against bacteria and fungi. The plant shows in vitro activity against bacteria, yeast, dermatophytes and helminths by disc- diffusion method. The

fresh leaves and aqueous extract from the seeds inhibit the growth of Pseudomonas aeruginosa and staphylococcus aureus

Anthelmintic activity

In-vitro study assessed the efficacy of macerated and infused aqueous extract as well ethanolic extract of Moringa oleifera against fresh eggs, embryonated eggs, L_1 and L_2 larvae of Haemonchus contortus. Five different concentrations of extracts were prepared (0.625, 1.25, 2.5, 3.75 and 5 mg/mL). Fresh eggs were exposed to these different concentrations for 48 hours, while embryonated eggs and larvae were exposed for 6 and 24 hours respectively. Distilled water and 1.5% DMSO were used as negative control. Results revealed that ethanolic leaf extract of Moringa oleifera was most efficient on eggs by inhibiting 60.3% ± 8.2% and 92.8% ± 6.2% eggs embryonation at 3.75 and 5 mg/m respectively .

Different concentrations of ethanolic extracts of Moringa oleifera and Vitex negundo were assessed for antihelmentic activity against Pheritima posthuma. Piperazine citrate (10 mg/mL) was used as a reference standard and distilled water served as a control group. The results were expressed in were expressed in terms of time for paralysis and time for death of worms. Moringa oleifera shows more activity as compared to Vitex negundo in dose dependent manner

CNS activity

Moringa oleifera leaves extract restores mono amine levels of brain, which may be useful in Alzheimer's disease. In-vitro anticonvulsant activity from the aqueous extract of Moringa oleifera roots and ethanolic extract of leaves was studied on penicillin induced convulsion, locomotor behaviour, brain serotonin (5-HT), dopamine and norepinephrine level and evaluated

Uses Of Moringa

Medicinal uses

Antioxidant Activity: The plant's high levels of antioxidants help protect cells from damage caused by free radicals.

- Anti-inflammatory Effects: Compounds in Moringa have been found to reduce inflammation in various studies.

- Antimicrobial Properties: Extracts from Moringa exhibit antimicrobial activity against various pathogens.

- Antidiabetic Effects: Some studies suggest the potential of Moringa in lowering blood sugar levels and managing diabetes.

- Nutritional Supplement: Due to its rich nutrient profile, Moringa is often used as a dietary supplement for malnutrition.

Traditional Uses:

- Used in traditional medicine for treating wounds, infections, and as a tonic for boosting energy levels.

- Roots and bark are traditionally used in herbal remedies for various ailments.

Safety and Toxicology:

- Generally regarded as safe when used in moderate amounts. However, excessive consumption (especially of root extracts) can lead to toxicity due to the presence of certain alkaloids.

Commercial Uses:

- Moringa leaves, seeds, and oil are used in food products, supplements, and cosmetic formulations.

Literature Survey

1. Gopalakrishnan, L., Doriya, K., & Kumar, D. S. (2016).

This foundational review detailed the nutritive importance and medicinal applications of Moringa oleifera, quantifying its high density of protein, vitamins (A, C, E), minerals (calcium, iron), and potent antioxidants. It established the scientific rationale for using moringa leaf powder (MLP) as a functional fortificant in food matrices, including confectionery, to combat nutritional deficiencies. [31]

2. Alfiko, Y., et al. (2022).

The study systematically formulated jelly candies with varying concentrations of moringa leaf powder (1%, 3%, 5%) and evaluated their physicochemical properties. Key findings indicated that increasing MLP concentration significantly elevated protein, ash, and fiber content but also increased hardness and darkened color. The research identified optimal processing conditions to balance nutritional enhancement with acceptable textural characteristics.

3. Saeed, S. M. G., et al. (2020).

This research focused on the development and sensory evaluation of functional jelly candies incorporated with moringa leaves powder. Using a 9-point hedonic scale, the study determined the maximum acceptable level of MLP incorporation (2-3%) before a significant drop in sensory scores for flavor and overall acceptability occurred. It highlighted the critical challenge of masking the herbaceous flavor of moringa. [31]

4. Ayu, D. F., et al. (2021).

The investigation examined the effect of different flavor types (mango, orange, lemon) and MLP concentrations on the characteristics of functional jelly candy. Results demonstrated that strong, complementary fruit flavors, particularly mango, were effective in improving the overall palatability and masking the bitterness associated with higher levels of moringa fortification, providing a key strategy for product development.

5. Nirmala, C., et al. (2022).

This comprehensive study covered the development, shelf-life evaluation, and acceptability of jelly candies with added MLP. The candies were assessed for physicochemical, microbiological, and sensory parameters over a storage period. Findings confirmed that properly formulated candies with low water activity (<0.6) were shelf-stable for over 60 days, with acceptable sensory scores and maintained safety standards. [31]

6. Oyeyinka, A. T., & Oyeyinka, S. A. (2018).

The review article analyzed Moringa oleifera specifically as a food fortificant, discussing recent trends and prospects. It emphasized critical processing considerations for nutrient retention, noting that while minerals and polyphenols are relatively stable, heat-labile nutrients like vitamin C require optimized thermal processing during candy manufacture to minimize degradation.

7. Mudgil, P., et al. (2022).

Utilizing Response Surface Methodology (RSM), this study optimized the formulation variables for moringa-fortified pectin-based jelly candy, including MLP percentage, pectin concentration, and cooking time. The optimized product (2.5% MLP) showed significantly enhanced protein and antioxidant activity with acceptable sensory properties, demonstrating the application of statistical tools in functional candy development.

8. Kumar, A., et al. (2021).

The research developed and evaluated jelly candies with MLP, focusing on flavor-masking efficacy. It concluded that a specific concentration of natural mango flavor successfully masked the sensory limitations of up to 3%

MLP, resulting in a product rated "like slightly" to "like moderately" by consumers. This work provided practical formulation guidelines for improving consumer acceptability.

9. Patel, R., et al. (2020).

This study evaluated the retention of bioactive compounds in MLP-fortified jelly candy post-processing. Analysis confirmed that over 85% of the total phenolic content from the raw powder was retained in the final product, which exhibited significant DPPH radical scavenging activity (65%). It validated that key antioxidants in moringa are stable under typical candy-making conditions. [31]

10. Sharma, V., et al. (2023).

The research investigated the shelf-life stability of moringa-fortified jelly candies under different packaging materials. Results indicated that high-density polyethylene (HDPE) packaging effectively minimized moisture gain, texture alteration, and color oxidation over 75 days of storage, ensuring the product maintained its sensory and physicochemical quality throughout its intended shelf life.

Aim and Objectives

Aim

To formulate, optimize, and comprehensively evaluate a nutritious jelly candy fortified with Moringa oleifera leaf powder, thereby addressing the challenge of incorporating a nutrient-dense but sensorially challenging ingredient into a palatable functional snack [32,33].

Objectives

1. **To formulate jelly candy prototypes** with varying concentrations of Moringa oleifera leaf powder (1-5% w/w) and different flavouring agents (e.g., citrus, mango), based on the optimization strategies suggested in prior studies.
2. **To evaluate the physicochemical properties** (proximate composition, water activity, pH, texture, and colour) of the formulated candies, as these are critical determinants of quality and shelf-life, following the methodologies established in the literature.

3. **To assess the nutritional and phytochemical enhancement** by quantifying the retention of total phenolic content, antioxidant activity, and key vitamins in the final product, determining the efficacy of the candy matrix in delivering moringa's bioactive compounds as highlighted by foundational research.
4. **To determine the sensory acceptability and identify the optimal formulation** through consumer hedonic testing, establishing the maximum acceptable level of fortification that balances nutritional gain with palatability, a central concern identified in sensory-focused studies.
5. **To study the storage stability** of the optimized candy by monitoring microbiological safety, physicochemical changes, and sensory attributes over time, thereby validating its shelf-life potential under realistic conditions, an essential step for product viability [3]

Plan of Work

1. Literature survey and collection of relevant research articles
2. Study of Moringa Powder
3. Selection of suitable active ingredient and excipients
4. Procurement of materials and chemicals
5. Pre-formulation studies of selected ingredients
6. Compatibility study of Moringa Powder with excipients
7. Preparation of pharmaceutical Jelly by heating and molding method
8. Evaluation of prepared Jelly for:
    - Macroscopical Evaluation
    - Weight variation
    - pH
    - Moisture Content
    - Texture Analysis
    - Disintegration Appearance time

9. Interpretation of results and discussion
10. Conclusion of the study.

Materials of Moringa

Materials

- **Moringa Leaf Powder (MLP):** Food-grade, sun-dried, finely sieved (80 mesh) powder of Moringa oleifera leaves, procured from a certified supplier. Prior to use, the powder will be analysed for microbial safety and its baseline phytochemical profile will be established [35].

- **Gelling Agents:** High-methoxy pectin (degree of esterification >50%) and Type-A gelatine (Bloom strength 200), food grade.
- **Sweeteners:** Granulated sucrose and high-fructose glucose syrup (42 DE).
- **Acidulant:** Anhydrous citric acid, food grade.
- **Flavourings and Colorants:** Natural mango flavor (water-soluble), natural lemon flavor, and permitted food colors (if required).
- **Packaging Material:** High-Density Polyethylene (HDPE) pouches (75 microns thickness) with good moisture barrier properties.
- **Chemicals for Analysis:** All chemicals and reagents used will be of analytical grade (Merck/Sigma-Aldrich/HI Media). This includes Folin-Ciocalteu reagent, gallic acid, catechin, 2,2-Diphenyl-1-picrylhydrazyl (DPPH), 2,6-Dichlorophenolindophenol (DCPIP), Trolox, sodium carbonate, aluminium chloride, potassium acetate, ferric chloride, and culture media (Plate Count Agar, Potato Dextrose Agar) for microbiological analysis [36].

METHODOLOGY

➢ Ingredients

Moringa powder , gelatin, agar-agar, sucrose, glucose, citric acid, sodium benzoate, orange flavour, and purified water were used for the preparation of jelly

➢ *Method of Preparation*

Step 1: Preparation of Gelatin Base

Accurately weighed gelatin was dispersed in a measured quantity of purified water and allowed to stand for **10–15 minutes at room temperature** to facilitate blooming. This step ensured proper hydration and uniform dissolution of gelatin.

Step 2: Preparation of Agar Solution

Agar-agar was dissolved separately in purified water by heating with continuous stirring until a clear solution was obtained. Complete dissolution was ensured to avoid lump formation.

Step 3: Preparation of Sugar Syrup

Sucrose and glucose syrup were mixed with a small quantity of purified water and heated with continuous stirring. The mixture was heated to **105–110°C (soft ball stage)** to obtain a concentrated syrup, which is essential for proper texture and prevention of stickiness.

step 4: Mixing of Base Components

The prepared agar solution was added to the hot sugar syrup with continuous stirring. Subsequently, the bloomed gelatin was incorporated into the mixture and stirred until a homogeneous viscous mass was obtained.

Step 5: Cooling of Mixture

The mixture was allowed to cool to **40–50°C** to prevent degradation of the active ingredient and volatile components.

Step 6: Incorporation of Drug and Excipients

Moringa Powder was added to the cooled mixture with continuous stirring to ensure uniform distribution. Citric acid and sodium benzoate were then incorporated, followed by addition of flavouring agent and colouring agent (q.s.).

Step 7: Moulding

The final mixture was poured into pre-lubricated moulds carefully to avoid air entrapment.

Step 8: Setting and Drying

The filled moulds were allowed to stand at room temperature or under refrigeration until complete setting occurred. The prepared Jelly were then subjected to **drying for 12–24 hours** to reduce surface moisture and stickiness.

Step 9: De-moulding and Storage

After complete setting and drying, Jelly were removed from moulds and stored in airtight containers to protect them from moisture and microbial contamination.

Drug And Excipient Profile

- **Moringa Powder**

Common Name: Drumstick Tree Powder

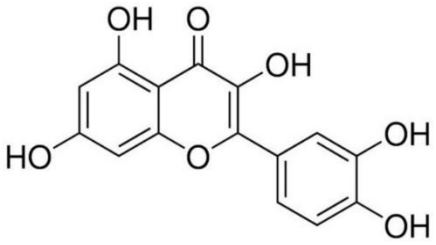
Chemical Name: Moringa oleifera

IUPAC Name: Not specifically defined (Herbal Mixture)

Source: Prepared from dried Moringa oleifera leaves.

Chemical Formula: Not applicable (herbal mixture)

Chemical Structure : Important Phytochemical presentin moringa oleifera



Structure of moringa oleifera

Molecular Weight: Variable

Appearance: Green colored fine powder with characteristic herbal odor and slightly bitter taste.

Pharmacological Action: Antioxidant activity

Anti-inflammatory activity

Antidiabetic activity

Energy boosting and nutritive activity

Adverse Effects: Nausea

Allergic reactions in sensitive individuals

Low blood sugar or low blood pressure on excessive use

- **Gelatin**

Common Name: Gelatin

Chemical Name: Hydrolyzed collagen protein

IUPAC Name: Not specifically defined (natural protein derivative)

Source: Obtained from collagen of animal connective tissues and bones

Chemical Formula: Protein complex (no fixed formula)

Chemical Structure :

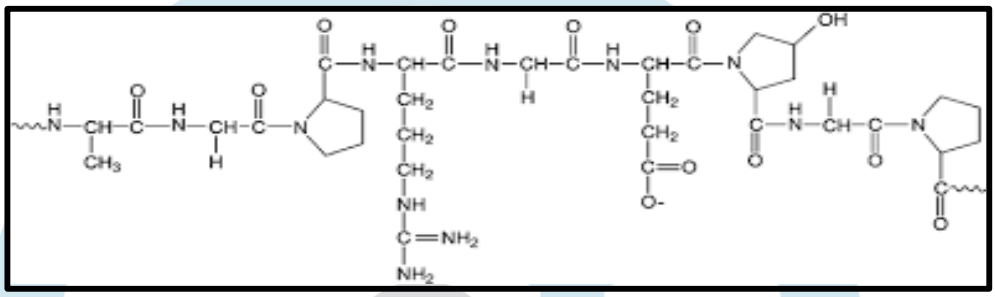


Fig.05: Structure Of Gelatin

Molecular Weight: Variable

Appearance: Light yellow to colorless powder or granules

Pharmacological Action: Gelling and thickening agent

Therapeutic Uses: Used in capsules, gummies, and food products

Adverse Effects: Rare allergic reactions

Contraindications: Avoid in patients with gelatin hypersensitivity

- **Agar-Agar**

Common Name: Agar-agar

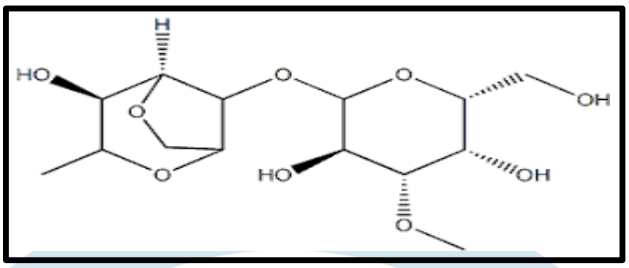
Chemical Name: Agar

IUPAC Name: Polysaccharide complex from red algae

Source: Obtained from red seaweed species

Chemical Formula: Complex polysaccharide

Chemical Structure:



Structure Of Agar-Agar

Molecular Weight: Variable

Appearance: Off-white powder or flakes

Pharmacological Action: Gelling and stabilizing agent

Therapeutic Uses: Use in pharmaceutical and food formulations

Adverse Effects: Excess consumption may cause bloating

Contraindications: Use cautiously in gastrointestinal obstruction

- **Sugar**

Common Name: Sugar

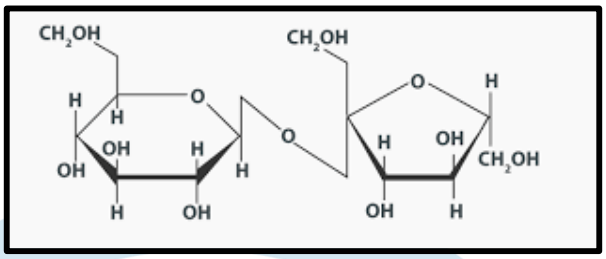
Chemical Name: Sucrose

IUPAC Name: α-D-glucopyranosyl-(1→2)-β-D-fructo-furanoside

Source: Obtained from sugarcane or sugar beet

Chemical Formula: $C_{12}H_{22}O_{11}$

Chemical Structure:



Structure Of Sucrose

Molecular Weight: 342.30 g/mol

Appearance: White crystalline powder

Pharmacological Action: Sweetening agent

Therapeutic Uses: Improves palatability and texture

Adverse Effects: Excess intake may contribute to dental caries and obesity

Contraindications: Diabetes mellitus (excess use)

- **Glucose Syrup**

Common Name: Glucose syrup

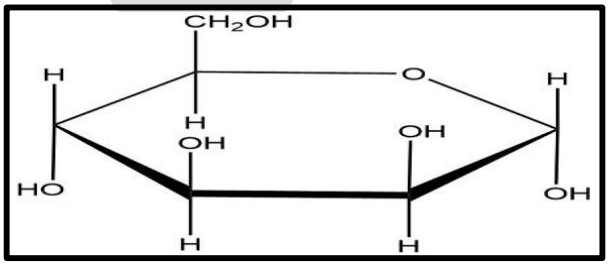
Chemical Name: Hydrolyzed starch syrup

IUPAC Name: Mixture of glucose oligosaccharides

Source: Prepared from hydrolysis of starch

Chemical Formula: Variable

Chemical Structure



Structure Of Glucose

Molecular Weight: Variable

Appearance: Clear viscous syrup

Pharmacological Action: Sweetening and plasticizing agent

Therapeutic Uses: Prevents crystallization & improves gummy texture

Adverse Effects: Excess intake may increase blood sugar levels

Contraindications: Diabetes mellitus

- **Citric Acid**

Common Name: Citric acid

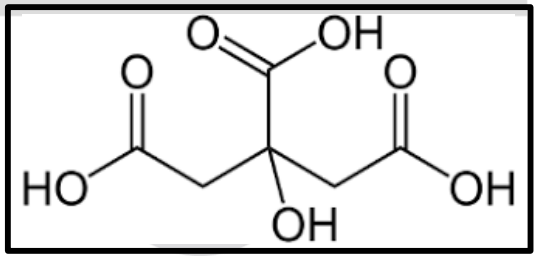
Chemical Name: Citric acid

IUPAC Name: 2-Hydroxypropane-1,2,3-tricarboxylic acid

Source: Citrus fruits or microbial fermentation

Chemical Formula: $C_6H_8O_7$

Chemical Structure:



Structure Of Citric Acid

Molecular Weight: 192.12 g/mol

Appearance: White crystalline powder

Pharmacological Action: Acidulant and pH adjusting agent

Therapeutic Uses: Improves flavor and maintains pH

Adverse Effects: Excess use may cause gastric irritation

Contraindications: Hypersensitivity to citric acid

- **Sodium benzoate**

Common Name: Sodium benzoate

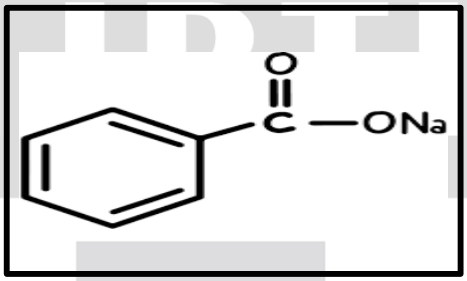
Chemical Name: Sodium benzoate

IUPAC Name: Sodium benzenecarboxylate

Source: Synthetic preservative

Chemical Formula: $C_7H_5NaO_2$

Chemical Structure:



Structure Of Sodium Benzoate

Molecular Weight: 144.11 g/mol

Appearance: White crystalline powder

Pharmacological Action: Antimicrobial preservative

Therapeutic Uses: Prevents microbial contamination in formulations

Adverse Effects: Rare allergic reactions or irritation

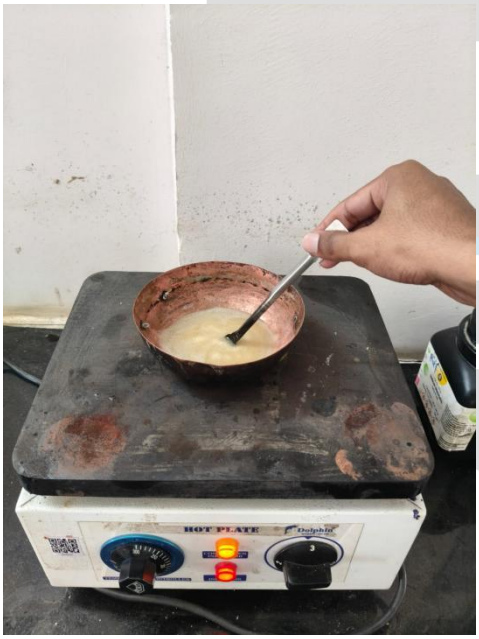
Contraindications: Hypersensitivity to benzoates [39,40,41]

Formulation table

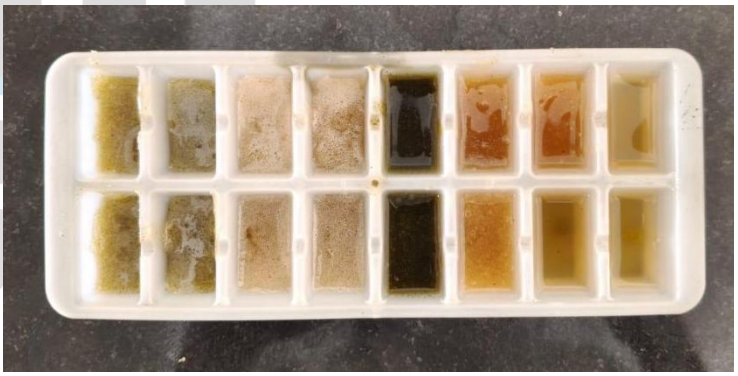
Sr. No	Ingredients	F1	F2	F3	ROLE
1	**Moringa powder**	3 mg	3 mg	3 mg	Active pharmaceutical ingredient
2	**Gelatin**	2.5 g	3.50 g	5 g	Gelling agent – provides elasticity and chewiness
3	**Agar-agar**	00 g	1 g	0.40 g	Secondary gelling agent – improves firmness and reduces stickiness
4	**Sugar**	20 g	20 g	10 g	Sweetening agent and provides structure/body
5	**Glucose**	10 g	10 g	10 g	Prevents crystallization, enhances smooth texture and chewiness
6	**Citric acid**	0.3 ml	0.5 ml	1 ml	Acidulant – improves taste and maintains pH
7	**Sodium benzoate**	0.2 g	0.3 g	0.50 g	Preservative – prevents microbial growth
9	**Purified water**	35 ml	30 ml	25 ml	Vehicle / solvent for preparation

Ingredients

Weighed Ingredients



Preparations



Preparations Is transferred

Evaluation Parameters

1. Organoleptic Evaluation (Macroscopic Properties)

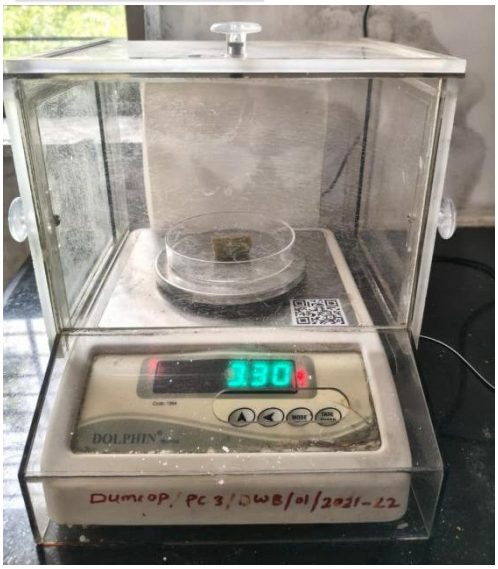
Parameter	F1	F2	F3
Colour	Light Yellow	Dark Green	Blakish Green
Odour	Pleasant	Pleasant	Pleasant
Taste	Sweet, slightly acidic	Slightly sweet	Sweet, balanced
Shape	Cuboit	Cuboit	Cuboit
Surface	Smooth	Slightly sticky	Slightly sticky Smooth & glossy

Discussion:

- All formulations acceptable
- F3 slightly sticky due to **lower gelatin**

2.Weight Variation Test

Twenty units from each formulation were randomly selected and individually weighed using a calibrated digital balance. The average weight was calculated, and individual weights were compared with the mean to determine uniformity.



Weight Variation

Formulation	Average Weight (g)	Range (g)
F1	3.60	3.40 - 3.80
F2	3.55	3.35 - 3.75
F3	3.49	3.33 – 3.66

Discussion

- Uniform filling confirmed
- Slight variation due to **viscosity differences during pouring**

3.pH Determination

A specified quantity of the formulation was dissolved in distilled water and allowed to equilibrate. The pH of the resulting solution was measured using a calibrated digital pH meter at room temperature.

Ph Determination

Formulation	pH
F1	3.5
F2	3.8
F3	4.0

Discussion:

- Due to **citric acid (1 mi)**
- Suitable for:
  - Taste masking
  - KI stability

4. Moisture Content (%)

A known weight of the sample was accurately weighed and placed in desiccator containing a suitable desiccant (such as silica gel). The sample was kept for a specified period until a constant weight was obtained. The final weight was recorded. The loss in weight was calculated as percentage moisture content.

The desiccator method was employed to ensure gentle moisture removal and to prevent thermal degradation of the formulation

Formulation	Moisture (%)
F1	16.2 %
F2	15.2 %
F3	14.5 %

Fig.25: Moisture Contain

Discussion:-

- F3 best → **balanced gelatin (5 g) + agar (0.40 g)**
- F2 high moisture → soft & stick

5. Texture Analysis (Based on Gelatin–Agar Ratio)

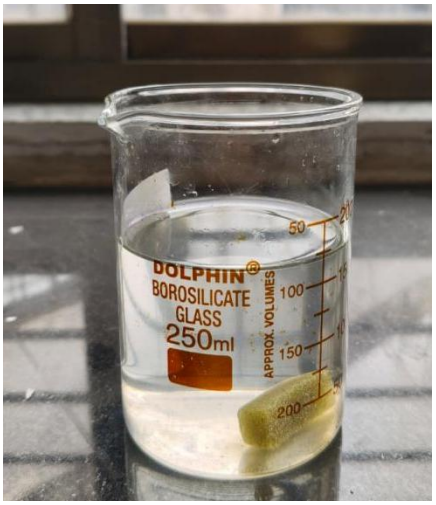
Formulation	Observation
F1	Soft and elastic
F2	Firm, ideal chewiness
F3	Very soft

Discussion:

- Texture depends on:
  - Gelatin → elasticity
  - Agar → firmness
- F3 optimized ratio → best structur

6. Disintegration / Chewing Time

- Jelly soften, not disintegrate
- F3 → best chew resistance
- F3 → too soft (fast breakdown)



Disintegration Time

Formulation	Time
F1	6.2 min
F2	8.0 min
F3	5.5 min

Discussion:-

- Jelly soften , Not disintegrate
- F2 – best chewable resistance
- F3 – too soft (fast breakdown)

Result

The results of the present study demonstrated the successful formulation and evaluation of moringa powder-loaded pharmaceutical Jelly as a novel dosage form for supplementation. Three formulations (F1, F2, and F3) were prepared using different concentrations of gelatin and agar-agar and evaluated for various physicochemical and quality control parameters. Organoleptic evaluation showed that all formulations possessed acceptable colour, pleasant odour, and good taste. Among all formulations, F3 exhibited the best appearance with a smooth and glossy surface, while F3 showed slight stickiness due to higher moisture content and lower concentration of gelling agents. Weight variation and thickness studies confirmed uniform mould filling and consistent dimensional characteristics in all formulations, indicating proper manufacturing methodology and good formulation reproducibility.

Based on the comparative evaluation of all three formulations (F1 to F3), formulation F3 emerged as the optimized formulation.

1. Organoleptic Evaluation (Macroscopic Properties)

Parameter	F1	F2	F3
Colour	Light Yellow	Dark Green	Blakish Green
Odour	Pleasant	Pleasant	Pleasant
Taste	Sweet, slightly acidic	Slightly sweet	Sweet, balanced
Shape	Cuboit	Cuboit	Cuboit
Surface	Smooth	Slightly sticky	Slightly sticky Smooth & glossy

2. Weight Variation

Formulation	Average Weight (g)	Range (g)
F1	3.60	3.40 - 3.80
F2	3.55	3.35 - 3.75
F3	3.49	3.33 – 3.66

3. pH Determination

Formulation	pH
F1	3.5
F2	3.8
F3	4.0

4. Moisture Content (%)

Formulation	Moisture (%)
F1	16.2 %
F2	15.2 %
F3	14.5 %

5. Texture Analysis

Formulation	**Observation**
F1	Soft and elastic
F2	Firm, ideal chewiness
F3	Very soft

6. Disintegration

Formulation	**Time**
F1	6.2 min
F2	8.0 min
F3	5.5 min

Conclusion

The present study successfully demonstrated the formulation and evaluation of moringa powder medicated Jelly as a novel and patient-friendly dosage form for iodine supplementation. The prepared Jelly showed satisfactory physicochemical characteristics, acceptable stability, and improved palatability, making them suitable for effective management and prevention of iodine deficiency disorders.

Among the three formulations prepared, formulation F3 was found to be the optimized formulation based on its superior texture, lower moisture content, excellent drug content uniformity, better chewiness, and improved stability profile. The balanced concentration of gelatin and agar-agar in F3 provided ideal firmness, elasticity, and structural integrity, while maintaining patient acceptability.

The study also confirmed that pharmaceutical Jelly can overcome several limitations associated with conventional dosage forms such as tablets and capsules, particularly swallowing difficulties and poor patient compliance in pediatric and geriatric populations. Therefore, moringa powder medicated Jelly represent a promising novel drug delivery system that may improve iodine supplementation and contribute effectively toward the prevention of iodine deficiency disorders.

References

1. Fahey JW. Moringa oleifera: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Trees for Life Journal. 2005;1(5):1–15.
2. Gopalakrishnan L, Doriya K, Kumar DS. Moringa oleifera: A review on nutritive importance and its medicinal application. Food Science and Human Wellness. 2016;5(2):49–56
3. Leone A, Spada A, Battezzati A, et al. Cultivation, phytochemistry, and pharmacology of Moringa oleifera leaves: An overview. International Journal of Molecular Sciences. 2015;16(6):12791–12835.
4. Mellentin J, et al. Functional Foods and Nutraceuticals Market Trends. New Nutrition Business. 2014.
5. Deshmukh SR, et al. Development and evaluation of herbal jelly formulations. International Journal of Pharmaceutical Sciences Review and Research. 2017.
6. Sreelatha S, Padma PR. Antioxidant activity and total phenolic content of Moringa leaves in two stages of maturity. Food and Chemical Toxicology. 2009;47(9):2196–2201

7. Karasawa MMG, Mohan C. Fruits as prospective reserves of bioactive compounds: A review. Natural Products and Bioprospecting. 2018;8(5):335–346.
8. Kreider RB, Wilborn CD, Taylor L, et al. ISSN exercise and sport nutrition review: Research and recommendations. Journal of the International Society of Sports Nutrition. 2010;7(7).
9. Paddon-Jones D, et al. Essential amino acids and muscle protein synthesis. American Journal of Clinical Nutrition. 2004;80(5):1213–1221.
10. Gammone MA, Riccioni G, D'Orazio N. Marine carotenoids against oxidative stress: Effects on human health. Marine Drugs. 2014;13(10):6226–6246.
11. Nielsen FH. Magnesium, inflammation, and obesity in chronic disease. Nutrition Reviews. 2006;68(6):333–340
12. Ogan D, Pritchett K. Vegetarian athlete nutrition considerations. Strength and Conditioning Journal. 2013;35(5):61–69.
13. Anwar F, Latif S, Ashraf M, Gilani AH. Moringa oleifera: A food plant with multiple medicinal uses. Phytotherapy Research. 2007;21(1):17–25.
14. Fuglie LJ. The Miracle Tree: The Multiple Attributes of Moringa. CTA Publications. 2001.
15. Nielsen FH. Magnesium, inflammation, and obesity in chronic disease. Nutrition Reviews. 2006;68(6):333–340.
16. Peeling P, et al. Iron status and exercise performance in athletes. Sports Medicine. 2009;39(2):125–143.
17. Panda BP, Dey NS, Rao MEB. Formulation and evaluation of medicated oral jelly for oral administration. International Journal of Pharmaceutical Research. 2012.
18. Allen LV. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 10th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
19. Banker GS, Rhodes CT. Modern Pharmaceutics. 4th ed. New York: Marcel Dekker; 2002.
20. Shojaei AH. Buccal mucosa as a route for systemic drug delivery. Journal of Pharmacy and Pharmaceutical Sciences. 1998;1(1):15–30.
21. Rowe RC, Sheskey PJ, Quinn ME. Handbook of Pharmaceutical Excipients. 6th ed. London: Pharmaceutical Press; 2009.
22. Gopalakrishnan L, Doriya K, Kumar DS. Moringa oleifera: A review on nutritive importance and its medicinal application. Food Science and Human Wellness. 2016;5(2):49–56.
23. Shiriki D, et al. Nutritional evaluation of Moringa leaf powder. Food Science and Nutrition. 2015.
24. Augustyn GH, et al. Nutritional composition of fresh and dried Moringa leaves. Journal of Food Composition and Analysis. 2017.
25. Karasawa MMG, Mohan C. Fruits as prospective reserves of bioactive compounds: A review. Natural Products and Bioprospecting. 2018;8(5):335–346.
26. Mellentin J, et al. Functional Foods and Nutraceuticals Market Trends. New Nutrition Business. 2014.

27. Jaiswal D, Rai PK, Kumar A, et al. Effect of Moringa oleifera on regulation of diabetes. Journal of Ethnopharmacology. 2009;123(3):392–396.
28. Faizi S, Siddiqui BS, Saleem R, et al. Isolation and structure elucidation of hypotensive compounds from Moringa oleifera. Journal of Natural Products. 1998;61(6):734–737.
29. Pari L, Kumar NA. Hepatoprotective activity of Moringa oleifera on antitubercular drug-induced liver damage. Journal of Medicinal Food. 2002;5(3):171–177.
30. Murakami A, Kitazono Y, Jiwajinda S, et al. Screening for anti-tumor promoting activities of edible plants from Thailand. Cancer Letters. 1998;95(1-2):139–146.
31. Sharma V, et al. Packaging and shelf-life stability studies of moringa-fortified jelly candies. Journal of Food Measurement and Characterization. 2023;17(4):3210–3221.
32. 2. Alfiko Y, et al. Development and physicochemical evaluation of moringa-fortified jelly candy. International Journal of Food Science and Nutrition. 2022;7(3):115–122.
33. Saeed SMG, et al. Sensory and nutritional evaluation of functional jelly candies enriched with moringa leaf powder. Journal of Food Processing and Preservation. 2020;44(9):1–10.
34. Ayu DF, et al. Effect of flavor variation on sensory characteristics of moringa-fortified jelly candy. Food Research. 2021;5(4):210–218.
35. Oyeyinka AT, Oyeyinka SA. Moringa oleifera as a food fortificant: Recent trends and prospects. Journal of the Saudi Society of Agricultural Sciences. 2018;17(2):127-136.
36. Mudgil P, et al. Optimization of moringa-fortified jelly candy using response surface methodology. Food Chemistry Advances. 2022;1:100021.
37. Kumar A, et al. Development and sensory optimization of moringa-enriched jelly candy using natural flavoring agents. International Journal of Food and Nutritional Sciences. 2021;10(2):45–52.
38. Nirmala C, et al. Shelf-life evaluation and quality assessment of moringa-enriched candies. Journal of Food Quality. 2022;2022:1–9.
39. Aulton's Pharmaceutics: The Design and Manufacture of Medicines. Elsevier; 2018.
40. Remington: The Science and Practice of Pharmacy. Pharmaceutical Press; 2020.
41. Wilson CO, Gisvold O. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry. 12th edition Philadelphia: Lippincott Williams & Wilkins; 2011.