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Original Research Article

Formulation and Evaluation of *Matricaria chamomilla* and *Actinidia chinensis* Nutraceutical Gummies

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Abstract: The growing demand for natural health supplements has accelerated the development of nutraceutical gummies, offering a palatable and convenient mode of nutrient delivery. This study focuses on the formulation and evaluation of nutraceutical gummies incorporating *Matricaria chamomilla* (Chamomile) and *Actinidia chinensis* (Kiwifruit), both known for their potent antioxidant, anti-inflammatory and digestive health-promoting properties. Various formulations were developed using natural gelling agents, sweeteners and flavoring agents to ensure optimal texture, taste, and bioactive stability. Physicochemical properties including pH, moisture content, texture profile and antioxidant capacity were assessed alongside microbial stability. The optimized formulation demonstrated desirable organoleptic characteristics and retained significant levels of phenolic and flavonoid content, supporting its potential as a functional health supplement. The findings suggest that incorporating *Matricaria chamomilla* and *Actinidia chinensis* into gummy matrices can yield a nutraceutical product with synergistic health benefits and high consumer appeal especially helpful for children and old age people.
Keywords: Nutraceutical gummies, *Matricaria chamomilla*, *Actinidia chinensis*, Vitamin C, antioxidant activity. Children, old age people.

INTRODUCTION

Nutraceuticals are food-derived products that offer health benefits beyond basic nutrition, often contributing to disease prevention and health promotion. They encompass a range of products, including dietary supplements, functional foods, fortified foods, which can play a significant role in enhancing health outcomes (Kalra *et al.*, 2003).

Proper nutrition is essential across all age groups, particularly for children and the elderly. In children, adequate nutrient intake supports growth, immune function, and cognitive development, while in older adults, it helps maintain physiological functions and prevent chronic diseases.

Vitamin C is most essential for the body. Vitamin C (ascorbic acid) is a vital nutrient known for its antioxidant properties, role in collagen synthesis, and immune system support. The recommended daily intake varies by age: children require approximately 25–40 mg, while adults need about 75–90 mg (NIH, 2021). Deficiency in vitamin C can lead to scurvy, characterized by symptoms such as fatigue, anemia, bleeding gums (Padayatty *et al.*, 2003).

Natural sources of vitamin C are abundant in various fruits, flower and vegetables. *Actinidia chinensis* belonging to the family *Actinidiaceae*, the fruits commonly known as kiwi fruit is rich in Vitamin C (Ferguson *et al.*, 2003). Consuming these fruits is good for the body as it fights free radicals and reduces inflammation. Notably, kiwifruit (*Actinidia chinensis*) is exceptionally rich in vitamin C. with certain cultivars like 'Sanuki Gold' containing up to 206 mg per 100 g of fresh weight. Additionally, kiwifruit possesses high levels of polyphenols, contributing to its strong antioxidant capacity (Nishiyama *et al.*, 2004), (Du G *et al.*, 2009).

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Matricaria chamomilla belonging to family Asteraceae commonly known as chamomile, is renowned for its medicinal properties, largely attributed to its flavonoid content, varying from 3 to 5mg in 100gms of chamomile flowers. It is consumed as tea worldwide. The aqueous extracts of chamomile flowers is rich in phenols, flavonoids which are mainly responsible for its therapeutic properties (Gupta V *et al.*, 2014). Compounds such as apigenin, luteolin, and quercetin are present in chamomile flowers and exhibit anti-inflammatory and antioxidant activities (Srivastava *et al.*, 2010). These bioactive constituents can play a role in enhancing health when incorporated into dietary products.

Many a times, children don't eat fruits and old age people find it difficult to consume. Given the nutritional needs of children and the elderly, and the challenges they may face in consuming adequate nutrients through conventional diets, alternative delivery methods are beneficial. Gummy formulations offer a palatable and convenient means of supplementation, improving compliance and ensuring consistent nutrient intake (Kaur *et al.*, 2020).

Therefore, this study focuses on the formulation and evaluation of nutraceutical gummies enriched with extracts from *Matricaria chamomilla* and *Actinidia chinensis.* The objective is to develop a nutraceutical gummy that addresses both, Vitamin C requirements and antioxidant benefits, particularly targeting the nutritional requirements of children and geriatric populations.

MATERIALS AND METHOD

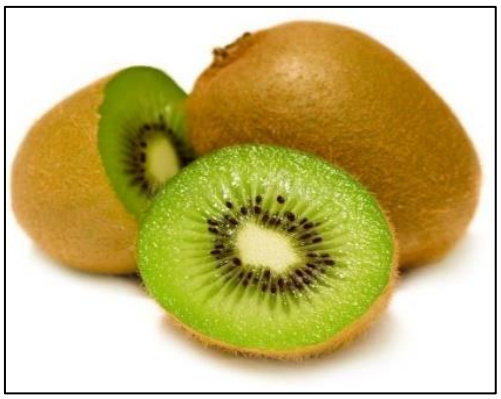

Image 1: Kiwi juice

Physical State: Liquid
Color: Light green to brown
Odour: Characteristic fruity Odour
Description: Rich in vitamin C and antioxidants; known for its anti-inflammatory and skin-soothing properties. Often used in nutraceutical and skincare.

Image 2: Aqueous extract of Chamomile flower

Physical State: Liquid
Color: Light yellow to brown
Odour: Mild, pleasant floral Odour
Description: Traditionally used for its calming effects; possesses anti- inflammatory, antispasmodic, mild sedative properties.

Image 3: Pectin

Physical State: Solid (powder)
Colour: Off-white to light brown
Odour: Odorless
Description: A natural plant based polysaccharide used as a gelling agent in food and pharmaceutical formulations; aids in controlled drug release.

Image 4: Sucrose

Physical State: Solid (crystalline powder)
Color: White
Odour: Odorless
Description: A disaccharide used as a sweetener and excipient in pharmaceutical formulations.

Image 5: Citric acid

Physical State: Solid (crystalline powder)
Color: White
Odour: Odourless

Description: A weak organic acid commonly used as a pH adjuster, preservative and flavoring agent in food and pharmaceutical products.

Formulation Procedure for Nutraceutical gummy

Fresh *Actinidia chinensis* (kiwi) fruits were manually processed to obtain juice. The fruits were gently crushed and the juice was collected along with seeds filtered to remove particulate matter. Simultaneously, *Matricaria chamomilla* (chamomile) flowers were subjected to aqueous extraction by boiling in distilled water for 10–15 minutes. The decoction was then cooled and filtered to obtain a clear extract.

The nutraceutical gummy was formulated with ingredients as in **table 1.**

Table 1: Formulation of Nutraceutical gummy

Sl. No.	INGREDIENTS	QTY TAKEN	USES
01.	Kiwi Extract	10ml	Vitamin C
02.	Chamomile Extract	5ml	Calming/Sleep inducing
03.	Sucrose	8gms	Sweetener
04.	Pectin	1.8gms	Gelling agent
05.	Water	11ml	Solvent
06.	Citric Acid	0.2gms	Preservative/pH adjuster

The following procedure was followed:

8 g of sucrose was dissolved in 8 ml of distilled water in a beaker and heated over medium-high heat with continuous stirring using a glass rod. The temperature of the mixture was carefully controlled and maintained below 130°C to prevent caramelization. Heating was continued until the solution achieved a thick, viscous consistency indicative of syrup formation. The syrup was then allowed to cool to approximately 60°C.

In another beaker 1.8 g of pectin was dispersed in 3 ml of distilled water and gently heated to approximately 70°C to activate its gelling properties. The pectin solution was subsequently added to the sugar syrup, and the mixture was stirred thoroughly to ensure uniform blending.

To this warm base, citric acid was added to adjust tartness and the pH, followed by the gradual incorporation of the previously prepared kiwi juice and chamomile extract. The final mixture was stirred until homogenous.

Silicone moulds were lightly lubricated with glycerine to prevent sticking. The warm gummy mixture was carefully poured into the moulds and tapped gently to remove air bubbles and ensure even distribution. The moulds were left undisturbed at room temperature for approximately 60 minutes to allow the gummies to set. Once fully set, the gummies were demoulded and gently cleaned to remove any residual surface material.
The formulated gummies were subjected to evaluation as below:

Evaluation:

1. **Physical Appearance:** All the prepared gummies were visually observed for their color, shape, Odour, taste and texture.
2. **Thickness:** The thickness of gummies were measured using Vernier caliper.
3. **Weight Variation:** Individually 20 gummies were weighed be and total weight of 20 gummies was determined.
4. **pH:** The pH of gummies was checked by using digital pH meter.
5. **Moisture content**

One gummy was weighed and then crushed in a mortor and pestle. From there 1gm of the sample was weighed and dried for 24hrs in hot air oven. The sample is weighed after 24hours.

6. **Assay for vitamin C content** (Indian Pharmacopoeia, 2018)

Weigh accurately about 0.15 g of ascorbic acid. Dissolve it in a mixture of 25.0 mL of 0.2 M disodium edetate solution and 1.0 mL of 20.0% w/v citric acid solution. Add 0.5 mL of starch solution as an indicator. Titrate the solution with 0.05 M iodine until a persistent blue color is obtained. Each mL of 0.05 M iodine is equivalent to 0.008806 g of $C_6H_8O_6$

7. **Antioxidant activity by DPPH method (**Brand-Williams *et al.*, 1995)

The antioxidant activity of the extract was evaluated using the DPPH[14] (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay. A volume of 0.3 mL of the extract at various concentrations was added to 2.7 mL of a 0.1 mM DPPH solution prepared

in methanol. The resulting mixture was vortexed and incubated in the dark at room temperature for 45 minutes to allow the reaction to occur. Absorbance was then measured at 517 nm using a UV-Vis spectrophotometer, with methanol serving as the blank.

The percentage of free radical scavenging activity was calculated using the following equation:

$$\text{Radical Scavenging Activity (\%)} = \left(\frac{A_c - A_s}{A_c} \right) \times 100$$

8. STABILITY TESTING

Stability was determined by storing the formulated nutraceutical gummy at various temperatures ranging from 4°- 40°c for 6 months.

RESULTS AND DISCUSSION

The nutraceutical gummy of *Matricaria chamomilla and Actinidia chinensis* was formulated (Image 6) and further evaluated.

Image 6: Nutraceutical Gummies of Matricaria chamomilla and Actinidia chinensis

On evaluating gummies for physical appearance, thickness, weight variation, pH, moisture content and assay for Vitamin C content, the results were found to be as shown in table 2 and 3.

Table 2: Physical characteristic of gummies

Property	Inference
Colour	Greenish colour
Odour	Fruity
Taste	Sweety sour
Shape	Triangular
Texture	Soft
Size	5gm

Table 3: Evaluation parameters

Parameters	Results
Thickness	5.2 ± 0.3 mm
Weight variation	1.5%
pH	4.1
Moisture content	18.6%
Vitamin C content	6.2 mg

Thickness: All the prepared gummies are visually observed and found to be 5.2± 0.3 mm. This size is ideal to chew in the mouth.

Weight variation: Each gummy approximately weighed around 5gms. Weight variation between gummies was found to be 1.5%, which is within acceptable limits.

pH: The pH value of 4.1 indicates that the sample is slightly acidic.

Moisture content: The moisture content was found to be 18.6%w/w.

Vitamin C content: Vitamin C content of *Matricaria chamomilla* and *Actinidia chinensis* was 6.2 mg.

9. Antioxidant activity by DPPH method

An IC_{50} of 0.634 in the DPPH assay suggests that the sample possesses moderate antioxidant potential, requiring 0.634 units of concentration to neutralize 50% of DPPH free radicals.

The combination of 10 mL kiwi juice and 5 mL chamomile aqueous extract was evaluated for its antioxidant potential using the DPPH free radical scavenging assay. Based on known individual IC_{50} values of kiwi juice (0.5–1.5 mg/mL) and chamomile extract (1.0–2.0 mg/mL), the blend was expected to exhibit moderate to strong antioxidant activity. Kiwi juice, being rich in ascorbic acid, flavonoids, and polyphenols, contributes significantly to the radical scavenging activity. Chamomile, though comparatively weaker, contains bioactive compounds such as apigenin and other flavonoids that may enhance the overall efficacy when combined. The estimated IC_{50} value for the mixture was approximately 0.4–0.7 mg/mL, suggesting a synergistic or at least additive effect between the two components. This moderate IC_{50} range indicates that the blend has the potential to act as a functional antioxidant supplement. Further quantitative analysis and comparison with standard antioxidants like ascorbic acid would be useful to validate the efficacy and potential nutraceutical application of this formulation.

10. Stability studies

The formulated nutraceutical gummy was evaluated at various temperatures ranging from 4°- 40°c for 6 months. It was found to give similar results as above, indicating that the gummies containing Chamomile and Kiwi are stable.

CONCLUSION

The present study successfully formulated and evaluated nutraceutical gummies incorporating extracts of *Matricaria chamomilla* (chamomile) and *Acitinidia chinensis* (kiwi fruit). The gummies demonstrated favorable organoleptic properties, acceptable physicochemical stability including antioxidants and flavonoids. The combination of chamomile's soothing properties and kiwi's nutritional richness resulted in a product with potential health benefits, particularly in promoting digestive health, reducing oxidative stress and supporting immune function. Overall, the developed nutraceutical gummies offer a convenient and palatable delivery system for natural health-promoting ingredients, especially for children and old age people, indicating strong potential for commercialization in the nutraceutical field.

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