

FORMULATION AND EVALUATION OF GUMMY BEARS MADE FROM SPINACH AND TOMATO EXTRACT: AN INNOVATIVE NUTRITIONAL SUPPLEMENT FOR HAIR AND SKIN

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ABSTRACT:

Background:The creation of gummy bear supplements infused with Biotin from Spinach (*Spinacia oleracea*) and hydrolyzed collagen from Tomatoes (*Lycopersicon esculentum*) offers consumers the choice of vegan, organic, and vitamin-rich gummies. This innovation makes it's simpler than ever to include these supplements into daily routines without compromising health principles.

Objective:The research highlights the importance of Biotin (Vitamin B7) in promoting keratin production, which in turn strengthens and thickens hair, supports a healthy skin barrier, and alleviates dryness or flakiness. Furthermore, the study discusses vegan collagen boosters that supply all the essential nutrients needed for the body to produce its own collagen.

Methods:Both the control and experimental gummy jelly samples were tested and statistically analysed to ensure product quality. Sensory assessments were conducted using sugars as natural sweeteners to attain the best flavour and customer preference. A 9-point hedonic sensory evaluation and physicochemical assessments were also performed.

Result and Discussion:The investigation produced three diverse formulations; notably, the second batch had inadequate texture quality during the preliminary assessment but showed superior cohesion, chewiness, and gumminess in its fresh condition. Surprisingly, the second batch had the highest auction increase, even in the 9-point hedonic sensory rating, which indicated the merlot/deep burgundy hue. Furthermore, the second batch passed the physicochemical assessment tests, which included moisture content, ash value, pH observation, and stability testing, and obtained the highest rating for being incredibly popular.

Conclusion:This study aimed at enhancing beauty and wellness. This has garnered significant attention, leading to a surge in the development of dietary supplements that cater to these interconnected domains.

KEY WORDS: Gummies, Biotin, Hydrolyzed Collagen, Hydrocolloid and vegan collagen builders.

1. INTRODUCTION:

In the past few years, the convergence of nutrition, beauty and wellness has attracted considerable attention, leading to a surge in the development of dietary supplements that cater to these interconnected domains. Among these innovations, vegan and organic gummy supplements have emerged as a popular choice for consumers seeking effective, convenient, and ethically produced products. ⁽¹⁾ Nowadays, consumers are increasingly aware of the necessity of maintaining a healthy diet, and there is a growing demand for natural and nutritious food products, especially for children. Veganism and organic products reflect a broader societal trend towards conscious living. Consumers are becoming more discerning about the products they choose, seeking those that align with their values and lifestyle choices. ^(1,2) Vitamin gummies have also acquired popularity due to their ease of ingesting, attractive look, and delicious flavour. Gummy vitamins are intended to be more palatable (read: sweeter) than ordinary vitamins in the expectation that people will be more likely to take them. Many individuals prefer gummy vitamins to capsules because of their chewy texture and delicious flavour. ⁽²⁾ The formulation of vegan and organic gummy supplements for beauty and wellness involves the careful selection of ingredients known for their beneficial properties. Key vitamins such as vitamin E, vitamin C and Biotin, along with botanical extracts like collagen-boosting herbs and antioxidants, play a crucial role in promoting skin elasticity, hydration, and overall radiance. Additionally, the use of organic and sustainably sourced ingredients ensures that these products are free from harmful additives and align with conscious living. Consumers are becoming more discerning about the products they choose, seeking those that align with their values and lifestyle choices. ⁽³⁾ Gummy supplements come in various shapes, like gummy bears, jelly bottles, jelly beans, fruit jellies, leg gummies, worm gummies, gummy sharks, and jelly rings. These gummies are made by boiling gelling agents with sugars (or other sweetener) at high temperatures (over 90-95°C). Then, after boiling, active ingredients such as vitamins, flavors and colorants are added to the mixture at 80-90°C (before it is molded and dried). Gummies are popular among a wide range of individuals. They are typically composed of a protein derived from collagen, gelatin which imparts a firm and uniquely elastic texture to the candy. They are gentler on the stomach than tablets, because their binding agents are harder to digest. Gummies can provide the vitamins, minerals, or nutrients that might be missing from one's diet. This study investigates the possibility of replacing gelatin in gummies with plant-based hydrocolloids such as agar-agar and guar gum. Gummies are a type of confectionery that contains a hydrocolloid that acts as a stabilizer, forming a network to retain a high-moisture sugar syrup. Hydrocolloids play an important role in shaping the visual appeal, flavour release, and texture of the gel network.

2. OBJECTIVE:

1. Identify vegan ingredients that enhance beauty benefits.
2. Develop gummy formulations with optimal texture and taste.
3. Assess the efficacy of gummies on beauty-related outcomes.
4. Evaluate the safety of the gummies through toxicity studies.
5. Gauge consumer acceptance through surveys and focus groups.
6. Conduct nutritional analysis to verify dietary claims.
7. Test shelf-life and stability under various conditions.
8. Analyze market trends for vegan beauty supplements.
9. Ensure compliance with food safety and labeling regulations.

Table 01- List of Ingredients and its daily requirement

Sr.no	Ingredients	Organic Drug	Percentage	Daily Requirement	Roles
1	Biotin	Spinach	0.0007%	0.1 mg	Supports healthy skin,
2	Vitamin C	Lemon	5.90%	820 mg	Antioxidants that's helps to protect cell, support the immune system
3	Vitamin E	capsule	0.11%	15 mg	Antioxidant that protects cells damage
4	Hydrolyzed collagen	Tomato	16.55%	2500 mg	Supports skin elasticity a hydration beneficial for joint health
5	Vitamin A	sweet potatoes	0.0006%	0.8 mg	Essential for vision& skin health
6	Vitamin D3	orange juice	0.11%	15 mg	Support bone health by aiding calcium absorption
7	Zinc	green pea	14.39%	2000 mg	Important for immune system function
8	Folic acid	Spinach	2.88%	0.4 mg	Vital for DNA synthesis
9	Omega 3 fatty acid	spinach	9.71%	1350 mg	Support heart health reduces inflammation
10	Flaxseed	Flaxseed oil	50.35%	7000 mg	Moisturizing, skin elasticity

Table 02- Nutritional value of spinach per 100 g (3.5 oz) (Adapted after <http://ndb.nal.usda.gov/ndb/foods>)

Nutrient	Amount per 100 g
Energy	23 kcal
Water	91.4 g
Protein	2.9 g
Total Fat	0.4 g
Carbohydrates	3.6 g
Dietary Fiber	2.2 g
Sugars	0.4 g
Calcium	99 mg
Iron	2.7 mg
Magnesium	79 mg
Phosphorus	49 mg

Potassium	558 mg
Sodium	79 mg
Zinc	0.53 mg
Vitamin C (Ascorbic acid)	28.1 mg
Thiamin (B1)	0.08 mg
Riboflavin (B2)	0.19 mg
Niacin (B3)	0.72 mg
Vitamin B6	0.20 mg
Folate (B9)	194 µg
Vitamin A (RAE)	469 µg
Beta-Carotene	5,624 µg
Vitamin E (Alpha-tocopherol)	2.0 µg
Vitamin K	482.9 µg

Table 03- Nutritional value of tomato per 100 g (3.5 oz) (Adapted after <http://ndb.nal.usda.gov/ndb/foods>)

Nutrient	Amount per 100 g
Energy	18 kcal
Water	95.0 g
Protein	0.9 g
Total Fat	0.2 g
Carbohydrates	3.9 g
Sugars	2.6 g
Dietary Fiber	1.2 g
Calcium	10 mg
Iron	0.27 mg
Magnesium	11 mg
Phosphorus	24 mg
Potassium	237 mg
Sodium	5 mg
Zinc	0.17 mg
Vitamin C (ascorbic acid)	13.7 mg
Thiamin (Vitamin B1)	0.037 mg
Riboflavin (Vitamin B2)	0.019 mg
Niacin (Vitamin B3)	0.594 mg
Vitamin B6	0.08 mg
Folate (Vitamin B9)	15 µg
Vitamin A (RAE)	42 µg
Alpha-tocopherol (Vitamin E)	0.54 µg
Phylloquinone (Vitamin K)	7.9 µg

3. MATERIALS AND METHOD:

The experimental research on the creation of Gummies jelly from a combination of spinach and tomato extract was carried out in a chemical lab of SPJCOP&R, Palaskheda, Jamner M.H., where the control and experimental Gummies jelly samples were evaluated and statistically analysed.

Table 04- List of Ingredients, Preparation and Extraction Method

Ingredient	Preparation	Extraction Method	Solvent/Medium	Solvent System used (1:10)
Tomato	Pulverize-Wash, Chop, Dry and Blend	Maceration	Water or ethanol	Water
Spinach	Pulverize –Wash thoroughly, chop finely, Dry and Blend	Maceration	Water or ethanol	Water
Amla	Deseed, chop or crush, Dry and Grind	Decoction	Water or ethanol	Water
Beetroot	Wash, Peel, Slice, Dry and Grind	Cold pressing	Water	Water
Flaxseed Oil	Clean and dry seeds, grind and react with solvent system as 1:10 ratio	Solvent Extraction	Alcohol	Methanol

4. FORMULATION AND PREPARATION:

Table 05- Formulation (Selection of Ingredients Batch wise)

Sr. No.	Ingredients	B1	B2	B3	B4
A) Extraction of Active ingredients from crude					
1	Sugar (sweetener)	2gm	2gm	2gm	2gm
2	Tomato powder	5.5gm	2.5gm	2.5gm	2.5gm
3	Spinach powder	8gm	1gm	1gm	1gm
4	Amla powder	1gm	0.25gm	0.25gm	0.25gm
5	Beat root powder	1.10gm	1gm	1gm	1gm
6	Flaxseed oil	7.5gm	1ml	1ml	1ml
7	Orange oil	3-4ml	3-4ml	5ml	5ml
8	Sodium Benzoate	0.5gm	0.5gm	0.5gm	0.5 gm
9	Vit E	0.4gm	0.4gm	0.4gm	0.4gm
10	Flavoring agent (Orange oil)	Q.S.	Q.S.	-	-
11	Green tea extract	0.5gm	-	-	-
B) Base Preparation:					
1	Glycerin/ Glycerol	-	-	7ml	7ml
2	Gelatin (Gelling Agent)	3.54gm	06gm	1.4gm	1.4gm

3	Agar-Agar (Hydrocolloid)	-	-	-	0.6gm
4	water	35ml	12ml	10ml	10ml

Step- I**• Prepare the Gelling Agent (Gelatin) for Batch I and II**

Weight the required amount of gelatin and soak it in enough cold water until thoroughly softened. (Allow it to absorb the water for 5-10 minutes and heat it if needed till it become transparent, 5-8min at low flame or ($<70^{\circ}\text{C}$)).

• Prepare the Glycerogelatin Agent (Gelatin) for Batch III and IV

Heat Glycerol or Glycerin with cold water according to given ratio in Table no.03 for 5min at $60-70^{\circ}\text{C}$.

Put the soaked gelatin (as per gelatin gelling agent preparation procedure) on the calculated amount of glycerin and heat it 40-50 min at same temperature.

During evaporation the liquid mass should be only gently stirred, rapid stirring produced air bubbles which may appear in the finish product.

Step- II**Mix the Multivitamin Blend (Active ingredients)**

In a separate beaker, combine the powdered multivitamins, minerals or active ingredients according to given ratio in a Table no.03. Don't provide heat which produce degradation of active ingredients.

Step- III**Heat the Liquid**

In a double boiler or a heatproof bowl over simmering water, heat the mixture of water base and sweeteners until it becomes smooth.

Add Flavor and Color

Add flavoring extracts to the warm mixture. Stir to combine thoroughly. This is the time to also add any coloring agents if you want vibrant gummies.

Step- IV**Incorporate the Multivitamins**

Once the liquid mixture is smooth and well combined, remove it from heat. Let it cool slightly before carefully stirring in the powdered multivitamins and minerals. This ensures that the vitamins don't degrade due to high temperatures.

Step- V**Mold the Gummies**

Remove any skin formed on the surface before pouring.

Pour the mass into silicone molds while still hot, use a dropper or syringe for precision.

Keep it at room temperature for air dry 30min. and refrigerate it 8-10 hr.

Step- VI**Remove from Molds**

Once the gummies have fully set and firmed up, carefully remove them from the molds.

Step- VII**Store the Gummies**

Store the gummies in an airtight container to maintain freshness. (It made with gelatin, so they may be refrigerated.

Store in a cool, dry place. Below 25 °C)



Figure 01 Gelatin and Glycerogelatin base

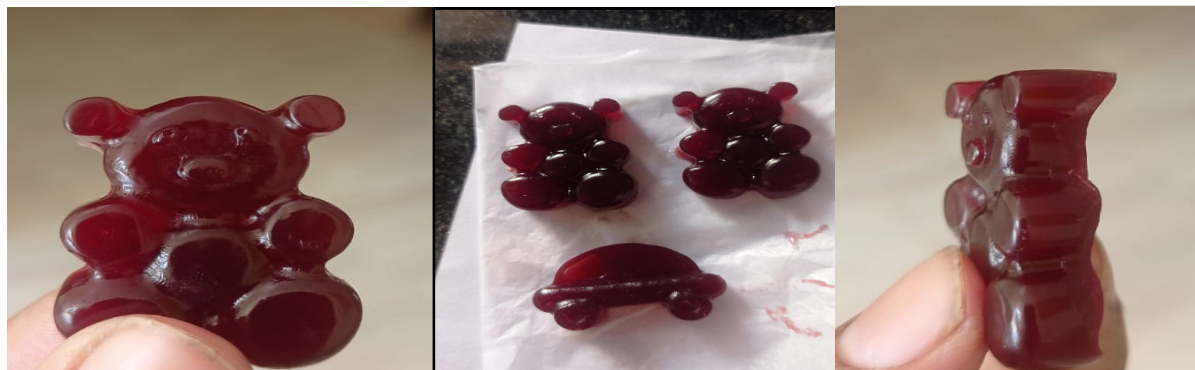
Batch I-**Batch II-****Batch III-****Batch IV-**

Figure 02 formulation of Gummies (Batch I, II, III and IV)

5. RESULT AND DISCUSSION:**5.1 Hedonic Scale Evaluation:****Table 06-** Hedonic Scale Evaluation Table

Attribute	Batch I	Batch I	Batch I	Avg Score	Batch II	Batch II	Batch II	Avg Score
	Panelist 1	Panelist 2	Panelist 3		Panelist 1	Panelist 2	Panelist3	
Appearance clarity, color, and surface finish	4	3	3	4	7	8	7	8
Aroma	3	3	2	3	8	7	7	8
Taste/Flavor	3	3	2	3	7	7	6	7
Texture/Mouth feel	2	2	2	2	8	8	8	8
Hardness or firmness (Texture Analyzer can be used)	2	2	3	3	7	8	7	8
Elasticity (springiness) – bounce-back after compression	2	2	3	3	7	7	8	8
Overall Accept.	Not Accepted	Not Accepted	Not Accepted	-	Accepted	Accepted	Accepted	-

Attribute	Batch III	Batch III	Batch III	Avg Score	Batch IV	Batch IV	Batch IV	Avg Score
	Panelist 1	Panelist 2	Panelist 3		Panelist 1	Panelist 2	Panelist 3	
Appearance clarity, color, and surface finish	2	2	2	2	3	2	3	3
Aroma	6	5	6	6	6	5	6	6
Taste/Flavor	6	5	6	6	4	5	4	5
Texture/Mouth feel	3	3	2	3	4	4	5	5
Hardness or firmness (Texture Analyzer can be used)	3	2	2	3	2	2	3	3
Elasticity (springiness) – bounce-back after	2	2	2	2	3	3	2	3

compression								
Overall Accept.	Not Accepted	Not Accepted	Not Accepted	-	Not Accepted	Not Accepted	Not Accepted	-

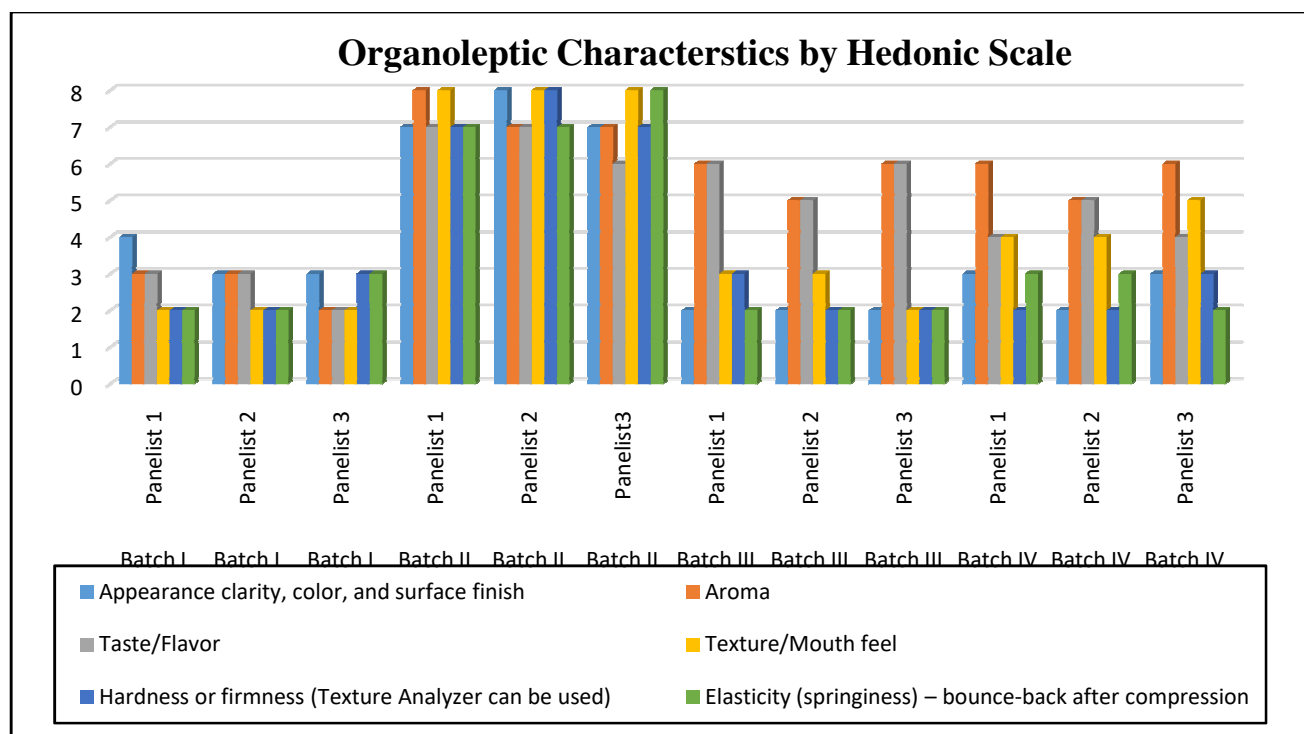


Figure 03 Organoleptic Character

5.2 Physicochemical Evaluation:

Table 08- Physicochemical Evaluation:

Parameters	Batch I	Batch II	Batch III	Batch IV
pH measurement (Affects taste, texture, and stability)	4.9	4.8	5.2	5.3
Moisture content (Affects shelf-life and microbial growth)	12.71 %	09.82 %	25.72 %	10.98 %
Ash Value (Especially for nutraceuticals/Pharma gummies)	10.83%	09.82 %	11.06%	10.40%

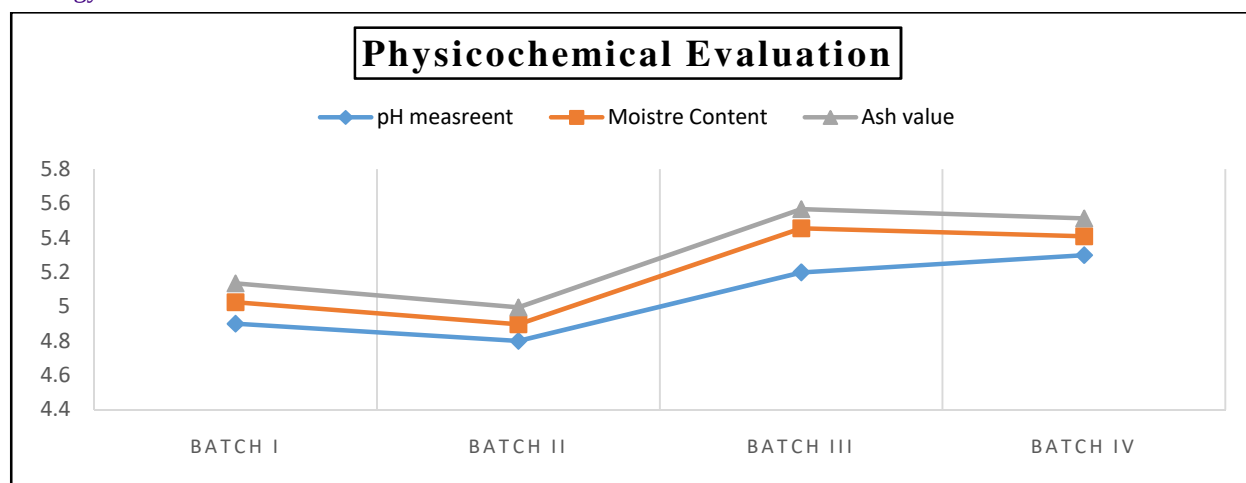


Figure 04 Physicochemical Character

5.3.Stability Testing:

Table 07- Store at various conditions (e.g., 3-5 °C/30-40% RH, 25°C/60% RH)

Monitor for changes in	Batch I 3-5 °C & 25°C		Batch II 3-5 °C & 25°C		Batch III 3-5 °C & 25°C		Batch IV 3-5 °C & 25°C	
	Accepted	Unaccepted	Accepted	Accepted	Accepted	Unaccepted	Accepted	Unaccepted
Texture	Accepted	Unaccepted	Accepted	Accepted	Accepted	Unaccepted	Accepted	Unaccepted
Color	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted
Odour	Accepted	unaccepted	Accepted	Accepted	Accepted	unaccepted	Accepted	Unaccepted

6. CONCLUSION:

This study focusses on gummies creative potential as a novel vehicle for delivering nutraceuticals to adults with the goal of improving beauty and wellbeing. This has garnered significant attention, leading to a surge in the development of dietary supplements catering to these interconnected domains. Based on the findings, incorporating beneficial compounds like spinach and tomato extract, along with essential vitamins such as Vitamin A, C, E, Omega-3, and Zinc, can be effectively used to create gummy candy. Gummy bear supplements containing Biotin and Collagen boosters will be both tasty and nutraceutically active. The ingredients were selected for their efficacy in promoting beauty from within, including plant-based sources of vitamins, antioxidants, and other beneficial compounds. Increasing the quantity of the gelling agent and encapsulating the extract enhances its stability and reduces its rate of degradation. The hydrocolloids and additives used in gummy jelly provide minimal calories and serve as a visually appealing encasing matrix to augment the nutritional content. The study's organoleptic analysis found that consumers are pleased about the texture profile of gelatin-based gummies, as seen by the sensory rating. Further study into other formulations and sensory qualities might potentially improve the attractiveness and efficacy of these gummies.

AUTHORS CONTRIBUTION:

TRS: Conceptualization, Methodology and Validation.

SSC: Software, Formal analysis and Resources.

FUNDING:

This research received no external funding.

DECLARATION OF COMPETING INTEREST:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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