*Available in online @ www.iaraindia.com*
*SCIENCE EXPLORE-An International Journal on Science and Knowledge in General*
*ISSN: 3139-2997 (Online)*
*Volume I, Issue 2*
*July - December 2026*

# FORMULATION AND DEVELOPMENT OF A VEGAN COLLAGEN-BOOSTING INSTANT JUICE MIX USING TAMARIND SEED POWDER

**S. MERSHINI**
Department of Nutrition and dietetics
KSR College of Arts and Science, Tiruchengodu

## ABSTRACT

***Background:*** *Collagen is a vital protein that provides structural support to skin, connective tissues, and bones. Declining collagen synthesis with age accelerates skin aging, joint stiffness, and reduced tissue strength (Shukla et al., 2019). Commercial collagen supplements are costly and mainly animal-derived, restricting their use among vegetarian and vegan populations (Proksch et al., 2014).* ***Aim:*** *This study aimed to formulate a low-cost, plant-based instant juice mix with collagen-boosting potential using tamarind seed powder along with vitamin C-rich fruits and vegetables including amla, carrot, beetroot, and strawberry, and to evaluate its nutritional, microbial, sensory, cost, and consumer acceptance.* ***Materials and Methods:*** *Three formulations were prepared with varying proportions of amla and strawberry powder, while tamarind seed, carrot, beetroot, and tamarind shell powders were kept constant. The powders were blended into a ready-to-drink instant juice mix. Nutritional composition was analyzed using AOAC methods. Microbial safety tests, sensory evaluation by a 30-member semi-trained panel, cost analysis, and shelf-life studies were carried out. A consumer survey (n=75) was conducted to assess awareness and willingness to adopt plant-based collagen alternative.* ***Results:*** *The juice mix exhibited high vitamin C content (210–230 mg/100 g) and strong antioxidant activity. Protein content from tamarind seed contributed 7–8 g/100 g. Microbial counts were within safe permissible limits up to 45 days of storage. Sensory evaluation showed high acceptability for variation 2 (mean score 8.7/9). Cost analysis indicated that one serving cost ₹8–10, compared to ₹60–100 for market collagen supplements. The survey revealed 85% willingness to adopt a plant-based, affordable collagen booster.* ***Conclusion:*** *The developed vegan collagen-boosting instant juice mix is nutritious, safe, cost-effective, and highly acceptable. It offers a sustainable alternative to animalderived collagen supplements for promoting skin and connective tissue health.*

**KEYWORDS:** Collagen, Tamarind seed, Amla, Beetroot, Carrot, Strawberry, Plant-based supplement.

## INTRODUCTION

Collagen is the most abundant structural protein in the human body, comprising about 30% of total protein. It is crucial for maintaining skin elasticity, hydration, joint strength, and connective tissue stability (Shukla et al., 2019). However, collagen production begins to decline with age, leading to wrinkles, reduced skin hydration, and joint stiffness (Khan et al., 2020).

Commercial collagen supplements are widely available but are typically sourced from bovine or marine origins, which limits their acceptance among vegetarian and vegan consumers (Proksch et al., 2014). Moreover, their high cost restricts access to large populations (Verma et al., 2020).

Plant-based alternatives with collagen-boosting properties have gained interest in recent years. Tamarind seeds are rich in proteins and polysaccharides with collagenlike functions (Singh et al., 2018; Kumar et al., 2018). Amla (Emblica officinalis) is one of the richest natural sources of vitamin C, which is essential for collagen synthesis (Baliga et al., 2011; Tiwari et al., 2015). Carrots and beetroot are rich in carotenoids, fiber, and nitrates, supporting circulation and skin health (Morton et al., 2000; Goyal et al., 2015), while strawberries contain polyphenols, anthocyanins, and flavonoids that protect collagen fibers from oxidative stress (Afrin et al., 2016; Chen et al., 2018).

The present study was designed to develop a vegan collagen-boosting instant juice mix incorporating these ingredients, standardize its formulation, and assess its nutritional, sensory, microbial, cost, and consumer acceptability parameters.

## MATERIALS AND METHODS

**Ingredients and Formulation:** Tamarind seed powder, tamarind shell powder, amla powder, carrot powder, beetroot powder, and strawberry powder were used. Three variations were formulated by altering amla and strawberry levels while keeping other components constant.

**Table 1**

| Ingredients | Variation I | Variation II | Variation III |
|---|---|---|---|
| Tamarind seeds | 20g | 20g | 20g |
| Amla | 20g | 15g | 17.5g |
| Carrot | 20g | 20g | 20g |
| Beetroot | 20g | 20g | 20g |
| Strawberry | 15g | 20g | 17.5g |
| Tamarind shell powder | 5g | 5g | 5g |

**Processing:** Powders were sieved, blended, and packed in airtight pouches.

**Nutritional Analysis:** Nutritional composition was estimated using AOAC methods for proximate analysis (AOAC International, 2016). Vitamin C content and antioxidant capacity were measured using standard protocols.

**Microbial Analysis:** Microbial safety was tested through Total Plate Count (TPC), yeast and mold count, and coliform detection, compared with FSSAI standards (Gupta et al., 2019).

**Sensory Evaluation:** Thirty semi-trained panelists evaluated the formulations for color, taste, aroma, texture, and overall acceptability using a 9-point hedonic scale (Bandyopadhyay et al., 2018).

**Cost Analysis:** The cost per serving (20 g) of the developed product was calculated and compared with commercial collagen supplements (Verma et al., 2020).

**Shelf-Life Studies:** The formulations were tested over 45 days for microbial safety and sensory quality (Sharma et al., 2017).

**Survey:** A structured questionnaire was distributed to 75 participants to assess collagen awareness, cost sensitivity, and preference for vegan options (Dutta et al., 2020).

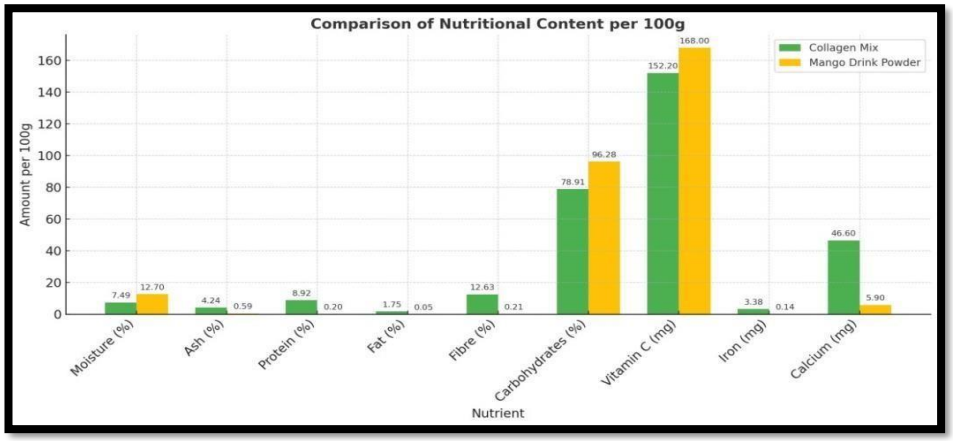
## RESULTS

### Nutritional Composition:

The developed juice mixes were rich in vitamin C and antioxidants, which are essential for Collagen synthesis. Carbohydrate content was high due to fruit powders, while fiber contributed to digestive health.

| Parameter | Var-1 | Var-2 | Var-3 |
|---|---|---|---|
| Energy (kcal/100g) | 320 | 340 | 330 |
| Protein (g/100g) | 7.2 | 7.8 | 7.5 |
| Vitamin C (mg/100g) | 210 | 230 | 225 |
| Antioxidant Activity | High | Very High | High |

**Comparison of Nutritional Content per 100g**




### Microbial Analysis:

All samples were within safe permissible limits.

Total Plate Count (TPC): $1.0 \times 10^3$ CFU/g (well below $10^5$ CFU/g limit)

Yeast and mold: < 10 CFU/g

Coliforms: Absent

**Sensory Evaluation**: Variation 2 scored the highest overall acceptability (8.7/9), reflecting a balanced taste profile of amla and strawberry. Variations 1 and 3 scored 8.2 and 8.5 respectively, but were still well accepted (Bandyopadhyay et al., 2018).

**Cost Analysis**: Each 20 g serving cost ₹8–10, while commercial collagen supplements cost ₹60–100 per serving (Verma et al., 2020).

**Shelf-Life**: All formulations remained stable for 45 days at ambient conditions with no major microbial growth or sensory deterioration (Sharma et al., 2017).

**Survey Results:** 72% of participants were aware of collagen supplements, 81% reported cost concerns, and 85% expressed willingness to adopt vegan, affordable alternatives (Dutta et al., 2020).

## DISCUSSION

The study demonstrated that a vegan collagen-boosting instant juice mix can be developed using tamarind seed, amla, carrot, beetroot, and strawberry. The high vitamin C content from amla and strawberries enhanced collagen biosynthesis (Tiwari et al., 2015), while tamarind seeds contributed proteins and polysaccharides with collagen-like functions (Kumar et al., 2018). Carotenoids from carrot and beetroot supported skin and cardiovascular health (Morton et al., 2000; Goyal et al., 2015), and polyphenols from strawberries provided antioxidant protection (Afrin et al., 2016; Chen et al., 2018).

Sensory analysis indicated that ingredient balance was key, with Variation 2 showing the highest acceptance. Cost analysis showed the developed product to be significantly cheaper than imported animal-derived collagen powders (Verma et al., 2020). Microbial and shelf-life findings confirmed stability and safety for up to 45 days (Sharma et al., 2017).

Consumer responses highlighted strong demand for affordable vegan supplements, aligning with global trends toward plant-based nutraceuticals (Singh et al., 2023; Kumar et al., 2024). The absence of clinical trials is a limitation, and future research could focus on in vivo effects of the juice mix on skin health.

## CONCLUSION

The formulated vegan collagen-boosting instant juice mix using tamarind seed, amla, carrot, beetroot, and strawberry proved nutritionally rich, safe, economical, and highly acceptable. Among the three variations, Variation 2 emerged as the most effective in terms of nutrient profile, sensory appeal, and affordability. The product holds promise as a sustainable and accessible plant-based alternative to animal-derived collagen supplements.

## REFERENCES

1. Afrin S, et al. Strawberry phytochemicals: Nutritional and therapeutic roles. Int J Mol Sci. 2016;17(5):615.
2. AOAC International. Official methods of analysis. 20th ed. Rockville: AOAC; 2016.
3. Baliga MS, et al. Phytochemistry and pharmacology of amla. Pharmacogn Rev. 2011;5(9):1-12.
4. Bandyopadhyay S, et al. Development of instant drink mixes: a review. J Food Sci Technol. 2018;55(7):2391-2400.
5. Chandra A, et al. Role of antioxidants in delaying skin aging. Clin Interv Aging. 2019;14:1609-1617.
6. Chen L, et al. Anthocyanins in strawberries and their health benefits. Food Chem. 2018;268:322-330.
7. Chen Y, et al. Plant-derived peptides and their role in collagen synthesis: A systematic review. Front Nutr. 2022;9:946285.
8. Clifford T, et al. Beetroot and its effect on human health. Nutrients. 2017;9(10):1101.
9. Dutta S, et al. Consumer perception of plant-based supplements. J Food Qual Prefer. 2020;84:103938.
10. Goyal A, et al. Antioxidant properties of beetroot. J Food Sci Technol. 2015;52(10):6703-6709.
11. Gupta C, et al. Microbial safety in functional foods. Food Control. 2019;106:106716.
12. Hosseini B, et al. Effects of dietary polyphenols on skin aging. Nutrients. 2017;9(9):917.
13. Joshi A, et al. Functional foods and nutraceuticals in skin health. J Funct Foods. 2020;64:103641.

14. Kaulmann A, et al. Phytochemicals in vegetables and human health. J Agric Food Chem. 2016;64(38):7039-7049.
15. Khan A, et al. Amla (Emblica officinalis) and its role in skin health. J Ethnopharmacol. 2020;249:112377.
16. Khan MI, et al. Stability of bioactive compounds in plant powders. Food Res Int. 2019;116:177-185.
17. Kumar D, et al. Tamarind seed protein characterization. Food Res Int. 2018;106:880887.
18. Kumar S, et al. Nutraceuticals for skin health: Emerging evidence from plant-based formulations. J Cosmet Dermatol. 2024;23(2):567-75.
19. Kumari R, et al. Antioxidant activity of tamarind seed polysaccharides. J Food Biochem. 2017;41(2):e12350.
20. Li Y, et al. Functional food powders and consumer acceptability. Food Hydrocoll. 2021;118:106753.
21. Morton LW, et al. Bioactive compounds in carrots. J Agric Food Chem. 2000;48(5):1292-1297.
22. Patel K, et al. Tamarind seed polysaccharides: extraction and applications. Int J Biol Macromol. 2020;150:1084-1093.
23. Proksch E, et al. Oral supplementation of collagen peptides improves skin health. Skin Pharmacol Physiol. 2014;27:113–119.
24. Satpathy G, et al. Nutraceutical applications of amla. J Food Sci Technol. 2015;52(12):7873-7883.
25. Sharma A, et al. Shelf-life studies of functional food powders. LWT. 2017;83:1-9.
26. Shukla R, et al. Collagen and its role in anti-aging. Int J Pharm Sci Res. 2019;10(5):2000-2006.
27. Singh A, et al. Dietary antioxidants and human health. Nutr Res Rev. 2019;32(2):230247.
28. Singh P, et al. Functional beverages enriched with bioactive compounds: Advances and challenges. Trends Food Sci Technol. 2023;138:38-52.
29. Singh V, et al. Nutritional benefits of tamarind seeds: A review. Food Chem. 2018;258:392-399.
30. Tiwari S, et al. Role of vitamin C in collagen biosynthesis. J Nutr Biochem. 2015;26(7):597-606.
31. Verma P, et al. Cost analysis in functional food development. Int J Food Sci Nutr. 2020;71(6):727-735.
32. Wang Y, et al. Vitamin C intake and skin health: A systematic review. Dermatol Ther. 2018;31(5):e12681.
33. Zhao X, et al. Carotenoids and human skin health. Nutrients. 2019;11(5):1044.