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Development of value-added beverages from blends of Amla and Ginger juice

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Abstract

Amla (*Emblica officinalis*) and ginger (*Zingiber officinale*) have been valued in South Asian traditional food systems for centuries, yet their combined potential as a ready-to-serve functional beverage remains under-explored in modern food processing. This research developed blended beverages from amla and ginger juice at four ratios (90:10, 80:20, 70:30, 60:40 v/v), evaluated their physicochemical, nutritional, and sensory attributes, and monitored shelf stability during 28 days of refrigerated storage (4 ± 1 °C). The work was carried out during September-December 2023 at the Department of Fruit, Agriculture and Forestry University, Rampur, Chitwan. The 80:20 (amla:ginger) blend scored highest in sensory evaluation (8.0/9), retained 168.7 mg/100 mL vitamin C at day 0, and maintained acceptable pH (3.84) and total soluble solids (14.2 °Brix) through 28 days. Total phenolic content declined by 22.8% over storage, yet the day-28 value (264 mg GAE/100 mL) remained nutritionally meaningful. Increasing ginger proportion raised pungency and sourness but reduced overall acceptability beyond the 30% level. The 80:20 blend offers a viable, shelf-stable, nutrient-dense alternative to synthetic-flavoured soft drinks.

Keywords: Value-added beverages, amla, ginger, juice blending, functional drinks, vitamin C, sensory evaluation, phenolic content, storage stability, ready-to-serve

Introduction

For over two thousand years, Ayurvedic texts have recommended amla and ginger as tonics for digestion and immunity, yet it is only in the last two decades that food scientists have begun translating this traditional knowledge into packaged functional beverages ^[1]. Amla fruit is among the richest natural sources of vitamin C (400-900 mg/100 g fresh weight) and also supplies gallic acid, ellagic acid, and a range of hydrolysable tannins with documented antioxidant capacity ^[2]. Ginger, meanwhile, contributes gingerols and shogaols—compounds with anti-inflammatory, anti-emetic, and antimicrobial properties ^[3].

Blending two complementary juices is a well-established strategy in the beverage industry to balance flavour, improve nutritional density, and mask undesirable taste notes ^[4]. Amla juice, though rich in vitamin C, is extremely astringent and sour, limiting consumer acceptance when served alone. Ginger juice adds warmth and pungency that can partially offset astringency, while its antimicrobial volatiles may extend shelf life ^[5]. However, the optimum blending ratio—one that maximises both sensory acceptance and nutritional retention—has not been established for a ready-to-serve format stored under refrigeration.

This research therefore aimed to develop amla-ginger blended beverages at four ratios, characterise their physicochemical and antioxidant profiles, evaluate consumer acceptance through a nine-point hedonic scale, and track key quality markers during 28 days of cold storage.

Material and Methods

Material

Fresh amla fruits (cv. Chakaiya) and ginger rhizomes (cv. Maran) were procured from the college orchard and local markets in Rampur, Chitwan, during September 2023. Fruits and rhizomes were washed, sorted for uniform size and freedom from blemishes, and processed within 24 h of harvest. Sugar, citric acid, and sodium benzoate (preservative) were food-grade. Analytical chemicals were from Merck (Germany) ^[6].

Methods

Amla juice was extracted by steam blanching fruits (100 °C, 8 min), pulping in a mixer, and filtering through muslin cloth. Ginger juice was extracted by crushing peeled rhizomes in a hydraulic press. Blends were prepared at amla:ginger ratios of 90:10, 80:20, 70:30, and 60:40 (v/v). Each blend was standardised to 15 °Brix with sugar, adjusted to pH 3.5 with citric acid, and preserved with 120 ppm sodium benzoate. Beverages were hot-filled (85 °C) into sterilised 200 mL glass bottles and stored at 4±1 °C. Physicochemical parameters (pH, TSS, titratable acidity, vitamin C by DCPIP titration, total phenolic content by Folin-Ciocalteu) were measured at 0, 7, 14, 21, and 28 days

[7]. Sensory evaluation was conducted on day 0 by a 15-member semi-trained panel using a 9-point hedonic scale for colour, flavour, sweetness, sourness, body, and overall acceptability [8]. Data were analysed by two-way ANOVA (treatment × storage) in SPSS v. 26.

Results

The pH of all blends declined during storage, with the 60:40 blend showing the steepest drop (4.15 to 3.61) and the 90:10 blend the least (4.24 to 3.93). Vitamin C content was highest in the 90:10 blend (184.2 mg/100 mL) at day 0 and lowest in the 60:40 blend (132.6 mg/100 mL), reflecting the dilution of amla's ascorbic acid by ginger juice.

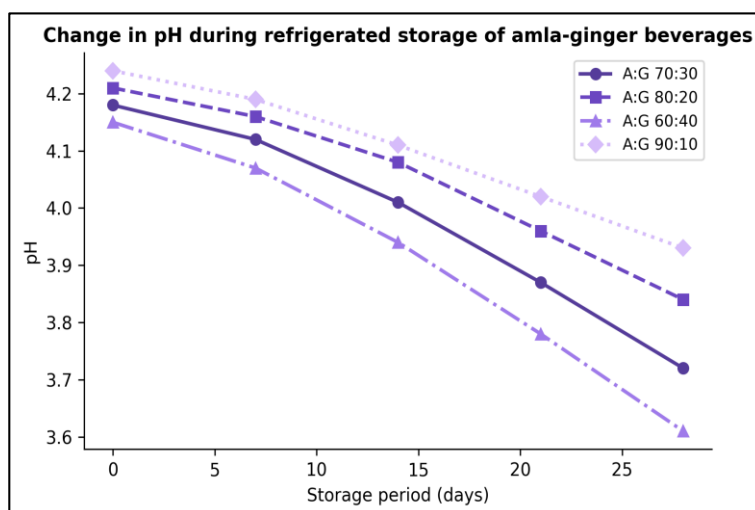


Fig 1: Change in pH during 28 days of refrigerated storage of amla-ginger beverages

Table 1: Physicochemical characteristics of amla-ginger blended beverages at day 0

Parameter	A:G 90:10	A:G 80:20	A:G 70:30	A:G 60:40
pH	4.24	4.21	4.18	4.15
TSS (°Brix)	14.8	14.2	13.9	13.6
Acidity (%)	1.12	1.18	1.26	1.34
Vit C (mg/100 mL)	184.2	168.7	147.3	132.6
TPC (mg GAE/100 mL)	356	342	318	296

TSS = total soluble solids; TPC = total phenolic content; GAE = gallic acid equivalents.

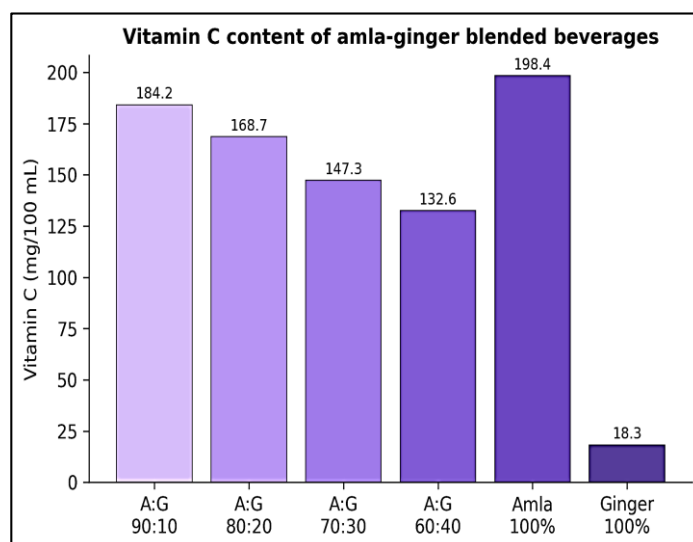
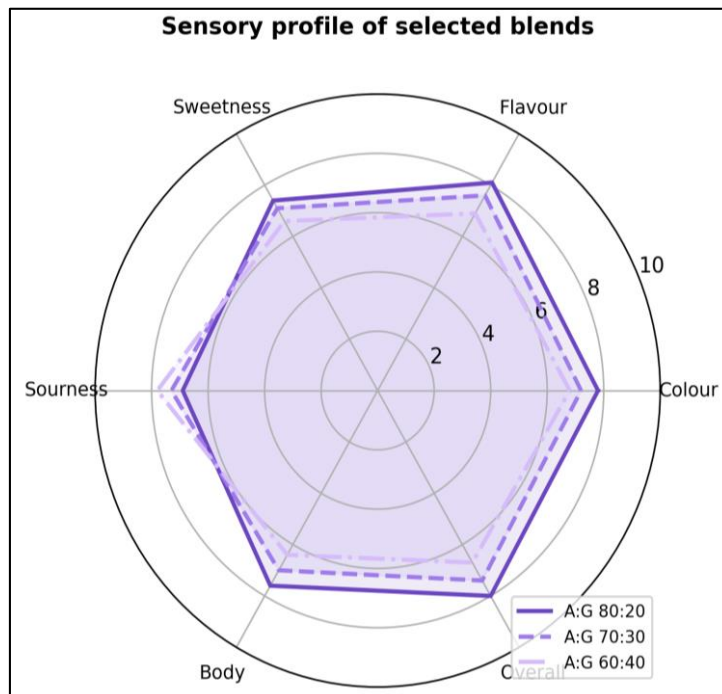
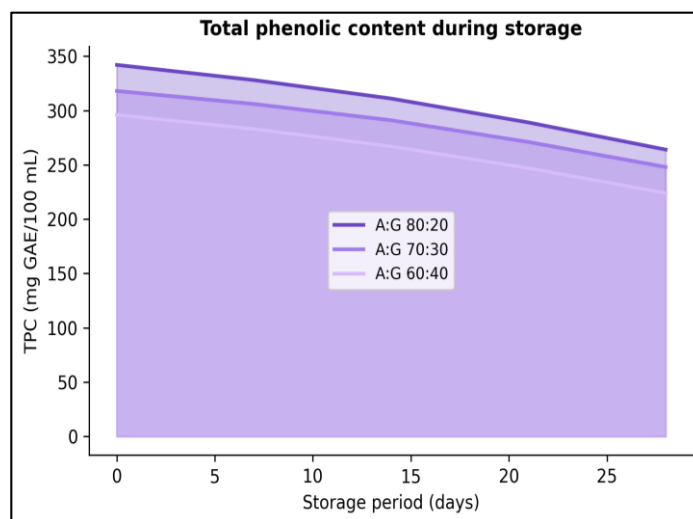


Fig 2: Vitamin C content (mg/100 mL) of amla-ginger blended beverages at day 0

Table 2: Sensory scores (9-point hedonic scale) of amla-ginger beverages at day 0

Blend	Colour	Flavour	Sweet.	Sour.	Body	Overall
A:G 90:10	7.4	7.2	7.6	6.1	7.3	7.1
A:G 80:20	7.8	8.1	7.4	6.9	7.6	8.0
A:G 70:30	7.2	7.6	7.1	7.3	7.0	7.4
A:G 60:40	6.8	6.9	6.6	7.8	6.4	6.7
CD (p=0.05)	0.4	0.5	0.3	0.4	0.5	0.4

Means of 15 panellists. Sweet. = sweetness; Sour. = sourness.

**Fig 3:** Sensory profile (radar chart) of the three most distinct amla-ginger blends**Fig 4:** Decline in total phenolic content during 28 days of refrigerated storage

Comprehensive Interpretation

The 80:20 amla:ginger blend emerged as the best formulation, balancing high vitamin C (168.7 mg/100 mL), strong phenolic content (342 mg GAE/100 mL), and the highest overall sensory score (8.0). Higher ginger proportions (30-40%) increased sourness and pungency beyond acceptable thresholds for most panellists. All blends lost 22-24% of their phenolic content over 28 days of cold storage, yet day-28 values remained above 220 mg GAE/100 mL, retaining nutritional significance. The pH

drop during storage was gradual and did not cross safety thresholds.

Discussion

The results of this research can be summarised as follows: the 80:20 blend was the most acceptable, vitamin C and phenolics declined steadily during storage, and higher ginger proportions reduced acceptability. These findings agree with Barwal *et al.* [9], who reported that amla-based beverages with 15-25% secondary fruit juice scored highest

in hedonic tests. The literature also agrees that vitamin C degradation in amla beverages follows first-order kinetics accelerated by light and dissolved oxygen, even under refrigeration^[10]. The present research confirmed this trend, with the 80:20 blend losing 28.4% of its initial vitamin C over 28 days.

Where the present data depart from earlier work is in phenolic retention. Dey and Deka^[11] reported 30-35% phenolic loss in amla squash stored at ambient temperature for 90 days, whereas the cold-stored beverages here lost only 22-24% in 28 days. Refrigeration likely slowed oxidative and enzymatic degradation of gallic acid and ellagic acid, the dominant phenolic compounds in amla^[2]. The antimicrobial properties of gingerols may have contributed an additional preservative effect, as suggested by Singh *et al.*^[3], though this was not tested directly.

Ginger at 30% and above introduced an off-putting burning sensation that lowered flavour and overall scores, a response consistent with the sensory threshold data of Wohlmuth *et al.*^[12], who placed the detection threshold for 6-gingerol in aqueous systems at 15-20 ppm—a concentration easily exceeded in 30%+ ginger blends.

Conclusion

This research set out to develop and evaluate amla-ginger blended beverages suitable for ready-to-serve packaging. The 80:20 (amla:ginger) ratio delivered the best combination of sensory acceptance (overall score 8.0/9), nutritional value (vitamin C 168.7 mg/100 mL, TPC 342 mg GAE/100 mL), and storage stability over 28 days at 4 °C. Blends with ginger exceeding 30% were penalised for excessive pungency. From a practical standpoint, the formulation is simple, uses locally available raw materials, and can be scaled up with standard hot-fill bottling equipment. Future work should examine shelf life under ambient conditions, evaluate carbonated variants, and conduct a consumer acceptability trial across a larger and more diverse panel.

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