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Evolving Trends in the Value-added Apple Product Market in India

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ABSTRACT

Background: The Indian apple sector supports farm income and agro-processing employment in the major producing states and supplies a widely consumed source of dietary fibre and micronutrients, giving it direct economic and public-health relevance. Although apple production increased during last decade, India still imports apples due to supply-demand gaps and post-harvest losses.

Methods: The study uses secondary sources of datasets, *viz*., Annual Survey of Industries dataset, Indiastat and FAOSTAT supplemented by a structured survey of apple juice products listed on the Amazon India e-commerce platform. Descriptive analysis to calculate the share, along with data visualization using line graphs, bar charts and box-and-whisker plots, is used for the study.

Result: Most apples are produced in Jammu and Kashmir (79%), with lesser shares from Himachal Pradesh and Uttarakhand, showing regional differences in productivity. Despite strong production potential, apple processing is limited in major producing states due to inadequate local processing infrastructure, while non-producing states lead in value-added products. An increase in consumer preference for convenient and healthy food choices has further boosted demand for processed apple juice. To encourage sustainable growth, the industry should improve post-harvest facilities, expand processing in local areas and adopt new technologies. Thus, it can be implicated that coordinating such efforts with health-sector needs and supportive government policy may help improve both economic and health-related outcomes.

Key words: Apple processing industry, Apple value-added products, Health and nutrition, Market growth.

INTRODUCTION

Apples are among the top three most widely grown and economically important fruits globally (FAO, 2024). Their popularity stems from their good taste, year-round availability and reported health benefits. Apples are widely regarded as a functional food due to their rich composition of dietary fiber, vitamins, minerals and bioactive compounds such as polyphenols, flavonoids and phenolic acids. The bioactive compounds present exhibit antioxidant and anti-inflammatory properties in vitro and have been associated with a lower risk of chronic diseases including cardiovascular diseases, cancer, diabetes, obesity and gastrointestinal disorders (Boyer and Liu 2004; Oyenihi *et al*., 2022).

Globally, the apple industry represents a significant segment of the horticulture sector, contributing to employment generation, agricultural income and agro-processing development with increasing demand due to the rising interest of consumers in healthy dietary patterns. India, one of the largest fruit producers, has seen a steady rise in apple consumption. Over the past two decades, there has been a significant increase in apple consumption in India. In 2004, the domestic consumption of apples stood at 1,746,400 metric tons (MT), which rose to 2,681,300 MT in 2014 and further to an estimated 2,979,000 MT in 2024 (Indexmundi, 2025). This upward trend can be attributed to factors such as population growth, rising income levels, improved fruit availability and greater health awareness for the Indian market, USDA Foreign Agricultural Service (FAS) estimated that domestic apple consumption in market year (MY) 2021/22 was 2.58 million metric tons (MMT), of which close to 60 per cent was consumed fresh and the remaining 40 percent was processed (USDA FAS, 2021). Despite this growth, the Indian apple sector continues to face structural challenges, including regional concentration of production, low productivity in certain states and inefficiencies in post-harvest management (Pundir *et al*., 2026).

The global fruit juice market has grown significantly, with apple juice and its concentrate being top traded products. In India, apple processing is becoming important for adding value and diversifying the market. Growing consumer

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demand for healthy, convenient options is boosting the need for ready-to-drink and health-focused apple products like juices and concentrates**.** This has created opportunities for establishing apple processing units along with the development of a diverse range of apple-based products, catering to evolving market preferences.

Despite its potential, apple processing in India is still underdeveloped. This is mainly due to poor cold-chain systems, limited value addition in the main apple-growing states and heavy reliance on traditional processing methods that reduce the nutritional value of products. Given these challenges, a thorough review of the sector is needed, covering production, trade, processing and its connections to the health industry. No recent study has jointly examined production and trade, processing-sector structure, nutritional composition, market projections and currently marketed products for the Indian apple sector. Therefore, the present study aims to (i) assess apple production and export–import trends in India; (ii) evaluate the structure of the apple processing industry using ASI data; (iii) review the nutritional and bioactive composition of apples and apple juice; (iv) examine apple juice market trends and projections; and (v) assess the health-related attributes of apple juice products marketed on Amazon India, in order to identify opportunities to align the apple market with the expanding health-conscious market segment and food sectors.

MATERIALS AND METHODS

The study uses secondary sources of datasets, *viz*., Annual Survey of Industries dataset (GoI, 2024), Indiastat (Indiastat, 2025), FAOSTAT (FAO, 2024), Statista (Statista, 2025) and Amazon India website. Descriptive statistics (percentage shares, ranges and averages) were computed in MS Excel and box-and-whisker plots, line graphs and bar charts were generated to visualize distributional and trend patterns. Details regarding the data sources are given in the Table 1.

RESULTS AND DISCUSSION

Export, import and production of apples

It was analysed that, the production of apples increased from 2.2 million tonnes in 2012 to 2.5 million tonnes in 2022, while fluctuations were observed during the period (Fig 1). India has been a net importer of apples over the decade 2012-22. Import volumes and production levels moved in a broadly similar direction over this period.

Further, assessing the production and productivity of apples across states in India, it is reported that production is concentrated in a few states, *viz*. Jammu and Kashmir, Himachal Pradesh and Uttarakhand, with a maximum share of 79% for Jammu and Kashmir, followed by Himachal Pradesh (19%) and Uttarakhand (2%) (Fig 2). Other states in the figure include Arunachal Pradesh, Ladakh, Nagaland and Manipur and other minor apple producing states. The apple production in India in 2023-24 is 2.6 million MT. The corresponding area under apple is 304 thousand hectares. The major apple-producing state, Jammu and Kashmir also has the highest apple productivity (12 MT/ha). The other two highest apple-producing states, Himachal Pradesh and Uttarakhand have very low apple productivity of about 4 MT/ha (Indiastat, 2025). The variation in apple yield in Himachal Pradesh was mainly due to changing climatic and environmental conditions, management practices and the genetic potential of the cultivar used for planting (Rani *et al*. 2026). Shilpa *et al*. (2019) reported that yield effects in all apple-growing areas of Himachal Pradesh were due to varietal improvement.

Domestic supply quantity and losses

The domestic supply quantity of apples in India has fluctuated between 2.4 million tonnes in 2012 to 3 million tonnes in 2020 over the period of 2012-22 (FAO, 2024). (According to FAOSTAT, 'losses' are defined as amount of the commodity lost through wastage (waste) during the year at all stages between the level at which production is recorded and the household, *i.e.* storage and transportation.) Efforts are needed to improve post-harvesting techniques to curb waste at various processing levels, thereby balancing the production-consumption pattern, reducing imports and enhancing export capacity. This can be a small yet significant step that may contribute to imparting self-sufficiency and economic growth in the apple market.

Dynamics of processed apple

Apples are a nutritious fruit available year-round. However, due to their short shelf life, they need to be processed and preserved. About 25-30 per cent of world apple production is processed, of which 65% is processed into apple juice concentrate and the remaining 35% into RTS apple juice, apple wine, cider, puree, jam and dried apple products (Bhushan *et al*., 2008).

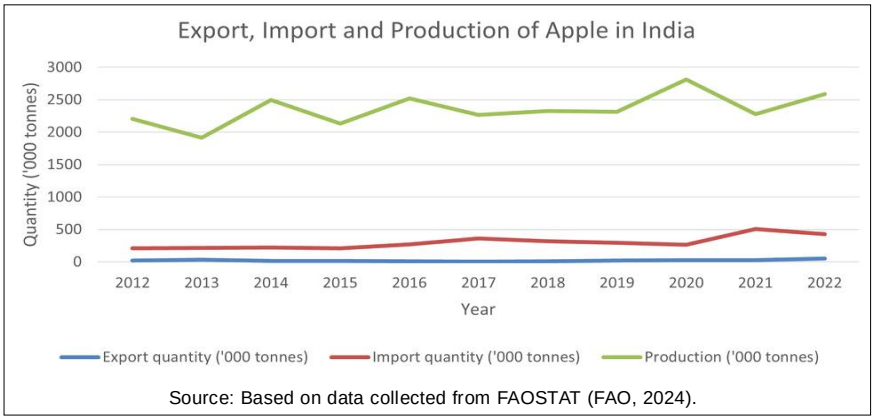
As per the analysis conducted by Global AgriSystem Pvt. Ltd. (GAPL) for the Ministry of Food Processing Industries (MoFPI), 25% of the total apples available are used for processing in the country and these are usually C-grade apples. The demand for processed apple products is increasing rapidly, as reflected in the import market value (in lakhs). For instance, the import market value for apple juice was 9,194 lakh in 2018, which rose to 11,205 lakh in 2020, an increase of 22% in two years (MOFPI, 2021).

This calls for exploring the factors behind low investment in apple processing in our country, such as poor market demand, limited processing infrastructure, a lack of value-added products and economic factors.

The census data of the Annual Survey of Industries (ASI) dataset was analyzed to examine the share of various states in the gross sale value of processed apple products, extracted using the NIC product codes and establishment counts detailed in Table 1. The processed apple products have the classes, *viz*., apple juice (including various types) and processed apple pulp/concentrate. Of the two classes, apple juice is the major product manufactured in India,

Table 1: Datasets used in the study.

Database	Years	Variables	Unit	Inclusion/exclusion criteria
FAOSTAT	2012-22	Export quantity, import quantity and production of apples in India. Domestic supply quantity and post-harvest losses associated with apples in India	'000 tonnes	Data of the most recent decade is considered
Indiastat	2023-24	State-wise total apple production in India	Area ('000 Hectares), Production ('000 MT), Productivity (MT/Hectare) Also, presented as share (%) of total apple production in India	Data of the most recent year is considered
Annual Survey of Industries (NIC 2008 Codes: 2143501, 2143599 and 2143502)	2022-23	Organization-type-wise and sector-wise gross sale value of processed apple products produced in India	Presented as share (%) of gross sale value of processed apple products produced in India	All observations (19 establishments) given in the dataset extracted for the specified NIC codes were considered for analysis.
Annual Survey of Industries (NIC 2008 Codes: 2143501, 2143599 and 2143502)	2022-23		Quantity sold, stock, net sale value of apple juice	Quantity sold (K. Litre), stock (K. Litre), net sale value of apple juice (Rs./K. Litre) all observations (19 establishments) given in the dataset extracted for the specified NIC codes were considered for analysis.
Amazon India website		Information collected between 15th-18th April 2025	Brand name, major ingredient (%). Energy (Kcal), total sugar (g/100 ml), Added sugar (g/100 ml), Minerals (mg or mcg/100 ml), Vitamins, health claims (label claims were not independently verified through laboratory analysis)	A search using the keyword 'apple juice' was conducted on Amazon India website (www.amazon.in) between 15th-18th April 2026. All apple juice products showing on the first 3 pages were considered. Green apple products, sponsored products and duplicate brand/pack-size variants were excluded.



Source: Based on data collected from FAOSTAT (FAO, 2024).

Fig 1: Export, import and production of apple in India.

whereas apple pulp/concentrate is manufactured for sale in minor quantities, as observed from the ASI dataset.

The major states contributing to India's gross sale value of processed apple products are Maharashtra (27%), Haryana (24%) and Jammu and Kashmir (9%) (Fig 2). Mostly, Non-Government Company-Private and Non-Government Company-Public units (the official ASI ownership categories) are in the business of apple processing, contributing 71 per cent and 17 per cent, respectively, to India's gross sale value of processed apple products (Fig 3). Strengthening government support and policy reforms, along with encouraging startups and private investments, are necessary to increase the gross sale value of processed apple products. This can reinforce the processed apple industry in meeting the consumer's demand for health and other processed goods.

Market dynamics of the rural and urban sectors

Based on the summary presented (Fig 3), the ASI dataset divides the sector into two categories, rural and urban. Rural establishments account for 82 per cent of the gross sale value of processed apple products in India. Correspondingly, the average quantity of apple juice manufactured is also higher in rural areas. However, the variation as well as the average net sale value of per unit of apple juice is higher for apple processing units of urban areas. The apparently differential market dynamics in terms of production capacity and pricing calls for understanding the opportunities and challenges for producers in the urban as well as rural sectors. It can also be observed from the box-and-whisker plot that manufacturing units in urban areas carry higher inventory or unsold quantities of processed apple juice for the following year (referred as 'stock carried over' in Fig 3).

Nutritional and health-promoting constituents in apples

Apples are considered a good source of fiber, vitamins, minerals and phytochemicals with antioxidative properties. These nutrients and bioactive components have health-promoting properties and vary depending on factors such as apple variety, harvest season, storage practices and soil conditions.

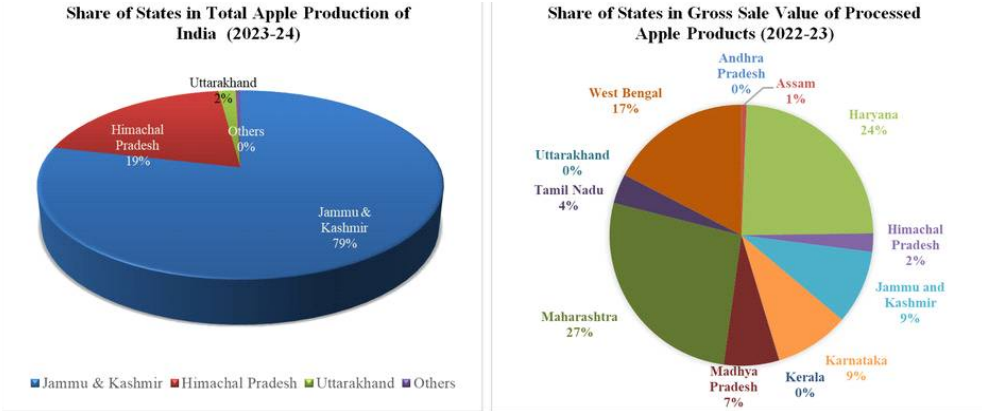
Apples contain a good amount of carbohydrates (11-15%), which include sugars (mainly fructose) and fiber. Fiber in apples is around 1-4 per cent of which cellulose and hemicellulose constitute insoluble dietary fiber and pectin is the major soluble fiber. Both soluble and insoluble fiber have health-promoting effects, such as lowering lipid levels (Koutsos *et al*., 2020), managing glycemic response (Inoue *et al*., 2022) and improving gut health (Koutsos *et al*., 2017).

Apples are a good source of micronutrients. They contain a good amount of potassium, followed by magnesium, phosphorus and calcium. Nour *et al*. (2010) reported that the potassium content in various apple varieties ranged from 82 to 160.8 mg/100 g fresh weight. The magnesium, phosphorus and calcium content (mg/100 g fresh weight) ranged from 5-11.8, 3.7-17 and 1.7-8.7, respectively. Among vitamins, the average ascorbic acid content was observed to be 6.18 mg/100 g (ranging 2.6-18.7).

Polyphenols are known to exhibit antioxidative properties and apples are an excellent source of polyphenols. The major polyphenols present in apples are flavanols, phenolic acids, dihydrochalcones and flavonols. These polyphenols, along with vitamin C, contribute significantly to the antioxidant capacity of apples (Kschonsek *et al*., 2018). The polyphenols present in apples are known to reduce the risk of chronic diseases. The phytochemicals found in apples are reported to be protective against cancer, heart disease, type 2 diabetes, asthma and obesity because of the antioxidant property of polyphenols (Boyer and Liu, 2004).

Apple juice market

Mass awareness, such as increased health consciousness and greater awareness of balanced diets, are important



Source: Authors' calculations based on apple production 2023-24 data sourced from Indiastat (Indiastat, 2025) (left) and the annual survey of industries (ASI) 2022-23 dataset (Government of India, 2024) (right).

Fig 2: State-wise shares in total apple production of India (2023-24) and gross sale value of processed apple products (2022-23).

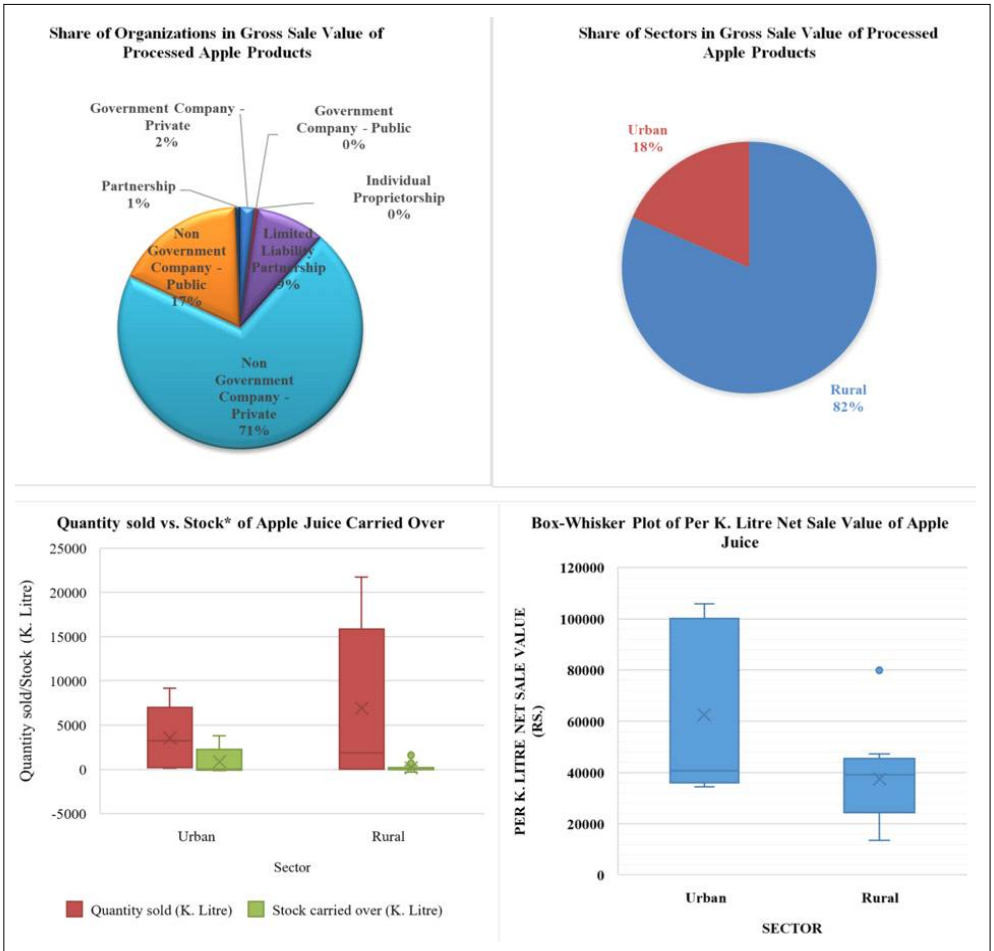
drivers of the health industry's growth. A rise in consumer preference for natural, healthy beverages has boosted the apple juice market.

Apple juice constitutes a convenient and easy way to increase fruit consumption and improve the overall quality of the diet. A review of interventional trials in humans has reported that apple juice consumed in moderation is associated with favourable changes in specific biomarkers related to cardiovascular disease, cancer and neurodegenerative disease risk, which may not implicate established clinical effectiveness for preventing or treating these conditions (Vallée *et al*., 2022). These effects are associated with various mechanisms, such as antioxidation, protection of the vascular endothelium, reduction of blood lipids, anti-inflammatory and antiapoptotic (Zhang *et al*., 2023). Apple juice consumption has also been reported to modify the gut microbiota, exert a prebiotic effect and show an association with lifestyle-related disease markers (Kon *et al*., 2024).

An increasing trend has been observed in the sale of apple juice. Based on Statista's historical estimates, the volume of apple juice sold has increased from 3.91 million litres in 2020 to 4.22 million litres in 2025 and is projected to increase further as per Statista estimates. Several factors identified for driving the growth of volume of apple juice sold are rising health consciousness, increasing disposable income, especially in urban areas, rise in e-commerce and convenience stores, growing demand for ready-to-drink juices, *etc*. (Statista, 2025). This expected rise in the apple juice industry draws attention towards increasing the production of apples in the country and the expansion of processing industries, benefiting all value chain stakeholders.

Innovations in the apple juice health industry: Availability and opportunities

Apple juice and apple juice concentrate are the most widely marketed value-added products derived from apples. The generalized method of apple juice extraction includes the following sequential steps: washing and sorting apples; crushing/mashing (at this time, ascorbic acid treatment is applied to prevent browning); pressing to



Source: Authors' calculations based on annual survey of industries (ASI) dataset 2022-23 (GoI, 2024).

Fig 3: Summary of the annual survey of industries (ASI) data on processed apple products, 2022-23.

extract juice. The juice thus obtained is unclear, with a cloudy appearance, which may be used as it is or further processed to produce clear juice. The juice clarification steps include enzyme treatment and the use of filtering agents followed by centrifugation process to obtain clarified juice. Further, to improve the shelf life, pasteurization is done and finally the apple juice is canned or bottled. To manufacture the apple juice concentrate, the juice undergoes the process of evaporation (FAO, 2001). However, viewing from a health perspective, during the conventional apple juice manufacturing process, loss of nutrients occurs. Loss of phenolic compounds and vitamin C, known to exhibit antioxidant properties, is reported. Dietary fibres having diverse therapeutic attributes are also lost during the process (Arya *et al*., 2023).

Fortunately, progress is being made by the health food industry to come up with better options and cater to the diverse consumer needs. Studies have shown that the conventional method of manufacturing juice includes thermal processing, which depletes the heat-labile nutrients and bioactive components, naturally present in the fruit. This processing technique is a drawback, given its impact on consumption among nutritionally informed, health-conscious consumers. Innovations in the non-thermal processing technologies *viz*. high pressure processing (HPP), pulsed electric field (PEF), ultrasound,

Table 2: Description of various brands of apple juice marketed on amazon.

Brand name	Major ingredient	Nutrients per 100 ml	Nutrients per 100 ml	Nutrients per 100 ml	Nutrients per 100 ml	Nutrients per 100 ml	Health claims
Brand name	Major ingredient	Energy (Kcal)	Total sugar (g)	Added sugar (g)	Minerals	Vitamins	Health claims
Real activ	Apple juice concentrate-18.6%	48	12	-	4 mg (Calcium) 40 mg (Sodium) 60 mg (Potassium)	preservatives	No added sugar No added
Paper boat	Apple puree concentrate-4.7%	55.2	13	12	58.6 mg sodium	5 mcg (Vit D)	No added colours No added preservatives No GMOs, fulfils 50% of daily recommended vitamin D requirement
B Natural	Apple juice 15%	44	10.9	9.4	5.0 mg sodium	0.23 mg (vit E) 10 mg (vit C)	No artificial flavour No added preservatives, contains vitamin C and E, godness of fruit and fiber
Real	Apple juice concentrate-3.85%	57	14.2	12	1 mg (calcium) 0.4 mg (iron) 10 mg sodium 15 mg (Potassium)	10 mg (vit C)	No added preservatives rich in vitamin C
Appy	Apple juice concentrate-2.1%	51.8	12.9	12.9	21.2 mg (Sodium)		No added caffeine carbonated water
Tropicana	Apple juice concentrate-4.3%	42	10	6.9	3.6 mg (Sodium) 30 mg (Potassium)		Contains non-caloric sweetener
Vita apple-grape juice	Apple juice 60%	52	12.6	-	2.6 mg (Sodium)		No sugar added grape juice 40%
Electrorush		36.8	9.2	8.0	117 mg (Sodium) 78.5 mg (Potassium) 147 mg (Chloride)		No preservatives No fat No cholesterol No artificial sweetner No caffeine contains vital electrolytes

pulsed light, UV and high-pressure homogenization and hydrodynamic cavitation do not involve high-temperature processing and thereby help in retaining the natural freshness, physicochemical properties and nutritional composition of fruit juice along with improving shelf life (Archana and Lekshmi, 2020; Arya *et al*., 2023; Ozkan *et al*., 2025).

Another innovative technique to improve the nutritional and keeping quality of apple juice for the health-conscious consumers is fortification. Use of phenolic acid ensures better shelf life, along with augmenting health-boosting properties. For instance, fortification of apple juice with ferulic acid exhibited antilisterial activity, enhanced antioxidant activity along with preserving the sensory attributes (Abadias *et al*., 2024). Similarly, to impart the desirable nutritional, safety and stability attributes encapsulation technology is used in which bioactive agents such as anti-microbial, vitamins, prebiotic, anti-browning agents, polyphenols *etc*. are incorporated in fruit juice (Ephrem *et al*., 2018; Gomez-Gaete *et al*., 2024).

Enrichment of apple juice with other bioactive rich plant products is an additional means to increase the popularity as functional beverage. It was seen that enriching the apple juice with the extracts of strawberry tree fruits, persimmon fruits, myrtle berries and saffron flowers improved the nutritional, functional and sensory properties of the blends (Gil *et al*., 2023). Extracts of herbal plants *viz.* mint, lemon balm, oregano, wild thymus and salvia (Ivanisova *et al*., 2015) and blue honeysuckle berry juice (Grobelna *et al*., 2019) were used to enrich apple juice which showed an increase in antioxidant activities compared to pure apple juice and positive sensorial effect. Development of such functional juice with positive nutritional physicochemical and sensorial attributes are important to meet consumers' expectations.

In the present study, information regarding currently marketed apple juice products available on the popular e-commerce website, Amazon India website (www. amazon. in), was collected through the search term 'apple juice'. Further attempts were made to analyze the available apple juice brands with respect to their health-related attributes (Table 2) to assess the current availability of health-oriented apple juice drinks and to explore potential future developments in this sector.

The majority of apple juice brands, such as Real Activ and Appy were found to be thermally processed. Most brands claimed to have no added colour or preservatives, while only two brands-Real activ and vita apple-grape juice claimed no added sugar. Sodium, potassium, calcium, iron and chloride were major minerals present in apple juices, though the levels varied among brands. As manufacturer/ marketplace claims rather than independently validated health effects, the good amount of electrolytespresent in the brand Electrorush-was marketed as beneficial in diarrhoea, for pre and post workout, muscle recovery, instant energy and maintenance of fluid balance. Few brands claimed to be enriched with vitamins. For example, Paper boat brand with vitamin D; B Natural brand with vitamin E and C. A little amount of fiber was claimed in the brand B natural. Vita apple-grape juice was found to be a blend of grape juice.

Overall, while many brands demonstrated certain strengths, it was observed that there remains considerable room for improvement to position apple juice as a functional beverage and better serve the health-focused segment of the market.

Health-optimized apple juice could be developed through cold-press processing for better nutrient and antioxidant retention, fortification for target groups such as children, the elderly and athletes, low- or no-sugar formulations and probiotic, prebiotic or functional-ingredient blends (*e.g*., turmeric, ashwagandha, ginseng) have the potential to open new avenues for the expansion of health and wellness sector and the e-commerce market in apple juice industry.

Limitations of the study

This study has some limitations. It relies on secondary data, so the patterns described are descriptive and do not establish causal relationships. The ASI covers registered factories only and may not be suitable as a representative of small and informal processors. The Amazon India survey is a snapshot of one platform during 15-18 April 2025; listings change over time and may not represent offline retail.

CONCLUSION

The Indian apple market is at a critical crossroads, balancing significant growth potential with structural challenges requiring strategic intervention. Over the years, apple consumption and production in India have grown remarkably, driven by population growth, rising disposable incomes and increasing health awareness among consumers. Despite India's substantial production base, which is concentrated in Jammu and Kashmir, Himachal Pradesh and Uttarakhand, these regions continue to face challenges related to post harvest management and local processing infrastructure, which limit the translation of their production potential into greater value addition. This suggests that targeted investments in cold-chain infrastructure, transportation logistics and on-farm storage capacity are needed to reduce import substitution pressures and enhance domestic supply adequacy. Aligning these improvements with health industry needs and strong policies can boost both economic efficiency and public health.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of 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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