Review Article

A Review on Ginger Value Addition: Prospects For Improving Farmer Producer Organization (FPO) Members' Income

ABSTRACT

Ginger (*Zingiber officinale*) is one of the most valuable spices globally, known for its culinary, medicinal, and industrial uses. The cultivation of ginger provides significant income opportunities for farmers, especially in regions where it is a primary cash crop. However, the traditional farming and marketing methods often limit the potential earnings of smallholder farmers. This review explores the concept of value addition in ginger and its prospects for enhancing the income of members of Farmer Producer Organizations (FPOs). By analyzing various value addition techniques, market opportunities, and the role of FPOs in leveraging these opportunities, the paper highlights strategies that can lead to increased profitability and sustainability for ginger farmers.

Keywords: *Zingiber officinale*, *Value addition, Farmer Producer Organizations (FPOs), Income opportunities, Market opportunities.*

INTRODUCTION

Ginger has been cultivated for centuries and is a significant agricultural product in many countries, particularly in Asia and Africa (Wang *et al*., 2020). In recent years, the demand for ginger and its derived products has increased due to its versatile applications in food, pharmaceuticals, and cosmetics (Shaukat *et al*., 2023; Ujang *et al*., 2015). Despite this growing demand, ginger farmers often face challenges in maximizing their income due to the volatile market prices, post-harvest losses, and limited access to value addition technologies (Panme and Thangjom, 2021; Dahal and Rijal, 2020).

Farmer Producer Organizations (FPOs) have emerged as a critical platform for smallholder farmers to collectively access resources, technology, and markets. By pooling their produce and resources, FPO members can potentially achieve economies of scale, better bargaining power, and enhanced income opportunities (Chandrakar *et al*., 2023; Shrivastava *et al*., 2022; Harikrishna *et al*., 2022). This review aims to explore how value addition in ginger can serve as a viable strategy for improving the income of FPO members.

VALUE ADDITION IN GINGER: AN OVERVIEW

Value addition refers to the process of increasing the economic value of a product by altering its form, packaging, or through the addition of services (De *et al*., 2014; Acharya *et al*., 2015). For ginger, value addition can occur at various stages of the supply chain, including cultivation, post-harvest processing, and marketing.

A. Post-Harvest Processing

Post-harvest processing is one of the most critical stages where value can be added to ginger. Techniques such as drying, powdering, oil extraction and candy production are common methods that enhance the shelf life (Figure 1) and market value (Table 1) of ginger.

1. **Drying:** Drying ginger is a crucial process to reduce its moisture content, making it less perishable and easier to store and transport. This process can be achieved through various methods such as sun drying, solar drying, and mechanical drying. Each method has its own impact on the drying time, quality, and essential oil content of the dried ginger.
    - ***Drying Time and Methods*:** Sun drying takes the longest time (up to 9 days), while solar tunnel drying and mechanical drying significantly reduce the drying time (Jayashree *et al*., 2014; Singh *et al*., 2022; Sabareesh *et al*., 2021). Mechanical drying at 60°C is optimal but results in a 12.2% loss in essential oil (Jayashree *et al*., 2014). Solar drying with forced convection and thermal energy storage can reduce drying time by up to 13 hours compared to open sun drying (Sabareesh *et al*., 2021; Sekhar *et al*., 2021).
    - ***Moisture Content*:** Both sun drying and solar drying can reduce the moisture content of ginger to below 10%, which is within the acceptable range for the international market (Jayashree *et al*., 2014; Eze and Agbo, 2011; Sekhar *et al*., 2021). Oven drying can achieve a moisture content of around 10.49%, while direct sun drying may only reduce it to about 17%. (Mamata *et al*., 2022).
    - ***Quality and Essential Oil Content*:** Whole ginger rhizomes dried under sun or solar tunnel drying retain the maximum essential oil and oleoresin content (Jayashree *et al*., 2014). Peeling and slicing ginger before drying can reduce the essential oil and oleoresin content, as well as the pungency constituents like gingerols and shogaols (Jayashree *et al*., 2014; Mamata *et al*., 2022). Carbonic maceration (CM) treatment before drying can enhance the retention of active components and antioxidant activities (An *et al*., 2020).
    - ***Drying Efficiency and Models*:** Solar drying with sensible heat storage increases the average temperature of the dryer, improving drying efficiency (Sekhar *et al*., 2021). Various mathematical models, such as the Page model and parabolic fit, effectively describe the drying behavior of ginger. (Singh *et al*., 2022; Sabareesh *et al*., 2021; Sekhar *et al*., 2021).
    - ***Microbial Load and Nutritional Content*:** Solar drying reduces the total variable count (TVC) more effectively than open-air drying, improving the hygienic quality of the dried ginger (Eze and Agbo, 2011). Solar dried ginger may contain less protein compared to air-dried ginger, but it retains better colour and aroma (Eze and Agbo, 2011).
2. **Ginger Powder:** Grinding dried ginger into powder is a popular method for adding value to ginger, especially in regions where fresh ginger is not readily available. Ginger powder is widely used in culinary applications due to its convenience and longer shelf life.
    - ***Processing Techniques*:** Enzyme-assisted liquefaction followed by spray-drying is an effective method for producing high-quality ginger powder. This process retains the pungent principles of ginger, such as gingerols and shogaols, and results in a homogenous product (Schweiggert *et al*., 2008).

- ***Properties*:** Superfine grinding produces ginger powder with a narrow and uniform particle size distribution, which enhances surface area and bulk density while reducing the angle of repose and slide (Zhao *et al*., 2009; Zhao *et al*., 2020). Ultrafine grinding of ginger stem powders results in smaller particle sizes, higher bulk density, and increased oil-holding capacity. These changes improve the solubility of the powder and make it more suitable for food, and feed applications (Zhao *et al*., 2020). The reduction in particle size through superfine grinding significantly increases the water absorption index (WAI), water solubility index (WSI), and protein content of ginger powder (Zhao *et al*., 2009). Ultrafine grinding does not damage the main cellular structure of ginger stem powder, preserving its nutritional and medicinal values. This makes it a valuable ingredient for developing new functional products in the food and feed industry (Zhao *et al*., 2020).

3. **Essential Oil Extraction:** Ginger essential oil, extracted through steam distillation, is highly valued in the pharmaceutical and cosmetic industries. This process not only adds value but also opens up new market avenues for farmers (Fitriady *et al*., 2017).
4. **Candied Ginger:** Producing candied ginger involves boiling fresh ginger in sugar syrup and drying it. This product has a long shelf life and appeals to niche markets, particularly in health food segments (Bag, 2018). The process of ginger infusion and candying has been optimized for scalability, ensuring consistent quality and efficiency in large-scale production (Sukla *el at*., 2019)

B. Packaging and Branding

In India, innovative packaging and branding strategies are increasingly vital for enhancing the market appeal of ginger products, especially for high-end and export markets. Research shows that advanced packaging solutions, such as flexible packaging using multilayer films, provide essential benefits like moisture, oxygen, and light barriers, which are crucial for maintaining the freshness and potency of spices like ginger. This type of packaging, combined with resealable features, is especially attractive for consumers seeking convenience and longer shelf-life (Anonymous, 2023a; Anonymous, 2023b).

The growing demand for high quality, export-grade packaging aligns with India's expanding ginger and spice markets, where products must meet stringent international standards. This includes protection against contamination during shipping and the use of innovative packaging technologies like vacuum sealing and modified atmosphere packaging to extend shelf life and retain freshness (Anonymous, 2023b).

Furthermore, branding plays a significant role in differentiating ginger products in competitive markets. By incorporating visually appealing designs and clear product information on packaging, brands can stand out and gain consumer trust, especially in export markets (Rambabu and Porika, 2020).

These strategies not only enhance market appeal but also allow ginger producers, including members of Farmer Producer Organizations (FPOs), to command higher prices and reach new customer segments both domestically and globally.

C. Diversification of Ginger Products

In India, diversifying ginger products, including ginger tea, ginger-based beverages, snacks, and supplements, can significantly enhance market opportunities and mitigate risks associated with price fluctuations in raw ginger. Research and initiatives focusing on value-added ginger products, such as ginger oil, ginger candies, and ginger beverages like ginger ale and ginger beer, highlight the increasing demand for such products due to their health benefits and culinary versatility.

For instance, ginger-based beverages like ginger ale and ginger beer are gaining popularity for their health benefits and refreshing flavors. Similarly, products like crystallized ginger and ginger chews cater to the increasing demand for snacks that promote wellness. This trend can also boost farmers' income by enabling them to target various market segments, including the food and pharmaceutical industries (Anonymous, 2022).

Additionally, the growing awareness of ginger's health benefits, such as its use in supplements, is driving demand across industries, providing a stable income stream to producers in India. Diversifying into processed and packaged ginger products also helps reduce waste and supports sustainability by utilizing the entire ginger rhizomes (Anonymous, 2023a).

ROLE OF FARMER PRODUCER ORGANIZATIONS (FPOS) IN VALUE ADDITION

FPOs can play a crucial role in the value addition process by facilitating access to technology, finance, and markets for their members. The collective approach of FPOs allows for shared resources and reduced costs, which are essential for implementing value addition strategies. The following are key areas where FPOs can contribute:

1. Access to Technology and Training

Farmer Producer Organizations (FPOs) play a crucial role in providing farmers with access to modern processing equipment and training programmes that are otherwise unaffordable for individual farmers. The organizations help farmers adopt new technologies and improve their agricultural practices, ultimately leading to higher productivity and income. Additionally, training programmes on post-harvest handling, processing, and packaging can equip farmers with the necessary skills to produce high-quality value-added products.

- ***Adoption of Technologies and Good Agricultural Practices:*** Membership in FPOs significantly influences the adoption of modern technologies and good agricultural practices among farmers. This positive impact is crucial for improving productivity and income (Verma *et al*., 2019).
- ***Access to Investment, Technology, and Inputs:*** FPOs provide better access to investment, technology, and agricultural inputs, which are essential for enhancing productivity and ensuring competitive pricing for farmers' products. This collective approach helps small and marginal farmers address various challenges in agriculture (Shrivastava *et al*., 2022).
- ***End-to-End Services and Market Linkages:*** FPOs offer end-to-end services, including technical support, processing, and marketing, which are vital for small farmers. These services help improve market linkages, increase farmers' income, and strengthen their economic position (Chandrakar *et al*., 2023).

2. Marketing and Export Opportunities

FPOs can help farmers reach broader markets by aggregating their produce and negotiating better prices with buyers. They can also explore export opportunities for value-added products, which often command higher prices than domestic markets.

- ***Market Linkages and Elimination of Intermediaries:*** FPOs help farmers by eliminating intermediaries, thus allowing them to receive a larger share of the final consumer price (Krishna, 2018; Mondal *et al*., 2021; Vedasri and Mishra, 2022; Chandrakar *et al*., 2023). They facilitate direct contact between farmers and consumers, improving price realization and reducing transaction costs (Nikam *et al*., 2019; Mondal *et al*., 2021).
- ***Increased Competitiveness and Market Access:*** FPOs enhance farmers' competitiveness in emerging high-value markets, including modern retail and export markets (Sawairam, 2015; Nikam *et al*., 2019; Vedasri and Mishra, 2022). They provide access to fair and remunerative markets through market aggregators and other channels (Nikam *et al*., 2019; Shasani *et al*., 2023).
- ***Value Addition and Infrastructure:*** FPOs support value addition to agricultural produce, which can command higher prices in both domestic and international markets (Mahapatra, 2023). They help in creating necessary infrastructure for value addition and marketing, which is crucial for exploring export opportunities (Mahapatra, 2023).
- ***Government Support and Policy Framework:*** Government initiatives, such as the formation and promotion of FPOs under various schemes, provide financial and technical support to enhance market linkages (Krishna, 2018; Mondal *et al*., 2021; Shasani *et al*., 2023). Policies aimed at mobilizing farmers and registering FPOs as companies help in formalizing and scaling up their operations (Mondal *et al*., 2021; Shasani *et al*., 2023).
- ***Capacity Building and Professional Management:*** FPOs focus on capacity building through advanced agricultural practices and professional management, which increases productivity and market participation (Nikam *et al*., 2019; Vedasri and Mishra, 2022; Shasani *et al*., 2023). They offer end-to-end services, including technical support, processing, and marketing, which are essential for successful market integration (Chandrakar *et al*., 2023; Shasani *et al*., 2023).

3. Financial Support and Investment

Access to finance is a major constraint for smallholder farmers looking to invest in value addition. FPOs can facilitate access to credit and investment by collaborating with financial institutions and government programmes. Additionally, FPOs can invest in shared processing facilities that benefit all members.

- ***Role of Government and Cooperative Societies:*** Central and state governments, along with cooperative societies, have initiated various measures to promote FPOs and develop financial products tailored to their needs. These efforts have led to improved access to institutional credit, better decision-making, and enhanced marketing facilities for farmers. However, challenges such as inadequate professional management, limited access to credit, and lack of technical skills remain (Sharma *et al*., 2020.

- ***Impact of Rural Producer Organizations (RPOs):*** The presence of RPOs significantly increases access to formal agricultural credit. Membership in RPOs enhances the likelihood of farmers requesting and receiving credit. This positive impact is observed across different sources of credit (public vs. private banks) and among farmers of varying wealth levels (Benson and Faguet, 2022).
- ***Finance for Smallholder Cash Crops:*** Smallholder farmers in Sub-Saharan Africa often require seasonal credit to purchase inputs. Loans to intermediary traders can facilitate this process. However, high rates of loan default pose a challenge. Mechanisms such as interlocked contracts can improve loan repayment rates (Poulton *et al*., 1998).
- ***Climate Finance for Smallholder Farmers:*** Public climate finance can support smallholder farmers in adopting low-emission farming practices. In Kenya's dairy sector, climate finance can strengthen linkages between farmers and financial institutions, build capacities, and manage risks. Financial instruments like concessional loans, credit guarantee funds, and grants are essential for this purpose (Odhong *et al*., 2019).

4. Advocacy and Policy Support

FPOs play a crucial role in supporting small and marginal farmers by addressing challenges in the agricultural value chain. They can advocate for policies that support value addition in agriculture, such as subsidies for processing equipment, access to export markets, and favourable tax policies. By engaging with policymakers, FPOs can create an enabling environment for value addition activities.

- ***Importance of Market Linkages and Value Addition:*** Establishing reliable market linkages and promoting value addition are crucial for the success of FPOs (Kumari *et al*., 2021; Sangappa *et al*., 2023). FPOs help in strengthening the agricultural value chain, which leads to decreased costs and increased revenue for farmers (Kumari *et al*., 2021).
- ***Collective Action and Economies of Scale:*** FPOs provide collective strength to farmers, improving access to production technology, value-addition services, high-quality inputs, and marketing services (Gurung and Choubey, 2022; Bikkina *et al*., 2018; Gurung *et al*., 2023). Collective actions through FPOs have been shown to enhance incomes and reduce transaction costs for small and marginal farmers (Bikkina *et al*., 2018).
- ***Economic Impact of FPO Membership:*** FPO membership has a positive and significant impact on net returns, return on investment (ROI), and profit margins for farmers 5. Members of FPOs experience higher annual net returns and profit margins compared to non-members, indicating the economic benefits of collective action (Gurung *et al*., 2023).
- ***Role of Leadership and Organizational Models:*** Leadership plays a critical role in the success of FPOs, and successful models and practices can be replicated or scaled up in other regions (Kumari *et al*., 2021; Sangappa *et al*., 2023). Effective leadership and well-designed business models are essential for the sustainability and growth of FPOs (Kumari *et al*., 2021; Sangappa *et al*., 2023).

CHALLENGES AND OPPORTUNITIES

While value addition presents significant opportunities for increasing farmers' income, several challenges need to be addressed:

A. Challenges

- **High Initial Investment:** Setting up processing facilities requires substantial investment, which may be difficult for FPOs with limited financial resources.
- **Market Access:** Despite value addition, accessing lucrative markets, especially international ones, can be challenging due to competition, quality standards, and logistical issues.
- **Skill Gaps:** Lack of technical expertise among farmers can limit the effectiveness of value addition initiatives.

B. Opportunities

- **Growing Demand:** The global demand for ginger and its products is rising, driven by consumer trends towards natural and health-focused products.
- **Government Support:** Many governments are recognizing the potential of FPOs and value addition, offering support in the form of subsidies, grants, and training programmes.
- **Innovation:** Advances in processing technology and packaging offer new opportunities for value addition that were previously inaccessible to smallholder farmers.

CONCLUSION

Value addition in ginger offers significant potential for enhancing the income of FPO members. By adopting advanced processing techniques, improving packaging and branding, and exploring new markets, FPOs can help their members achieve better profitability and sustainability. However, realizing these benefits requires addressing the challenges of investment, market access, and skill development. With the right support from government and other stakeholders, FPOs can play a pivotal role in transforming the ginger value chain and improving the livelihoods of smallholder farmers.

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Table 1. Comprehensive comparison between raw ginger and various processed ginger products (**Source:** Thirumalaiselvi *et al*., 2024)

Ginger value-added products	Production (Kg)	Gross Income (Rs.)	Gross Cost (Rs.)	Net Income (Rs.)	BCR	Consumer acceptability
Ginger Powder	50 (Rs. 500/kg)	25000	7900	17100	3.2	4.7
Ginger Candy	50 (Rs. 700/kg)	35000	10200	24800	3.4	4.8
Ginger Pickle	50 (Rs. 300/kg)	15000	3600	11400	4.2	4.8
Ginger Squash	50 (Rs. 200/kg)	10000	3200	6800	3.1	4.8
FP: Raw Ginger	50 (Rs. 25/kg)	1250	500	750	2.5	-

BCR: Benefit Cost Ratio; FP: Farmer Practice

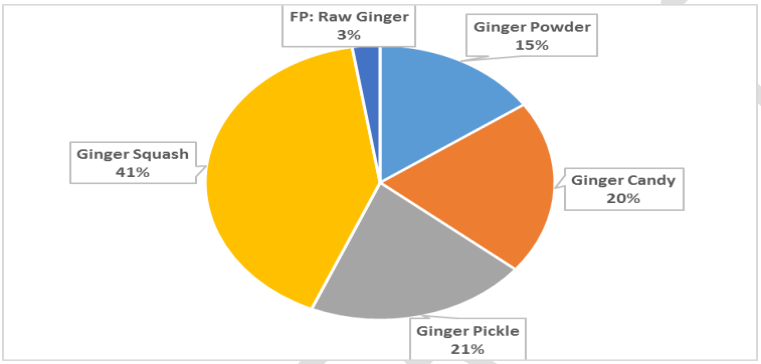

Figure 1. Shelf-life between raw ginger and various processed ginger products.

(**Source:** Thirumalaiselvi *et al*., 2024)