

## Enhancing farmer livelihood and consumer health through organic tomato-based food products

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### Abstract

Organic tomato production and value addition have emerged as key strategies for improving rural income, enhancing nutritional security, and ensuring sustainable agricultural practices. This study investigates the integrated organic tomato production–processing model implemented by current research, which focuses on cultivating chemical-free tomatoes and converting them into high-quality, nutrient-rich food products. Organic cultivation practices, minimal post-harvest chemical exposure, and sustainable processing techniques contribute to improved nutritional retention, reduced wastage, and enhanced product shelf-life. The economic analysis reveals that farmers engaged in this organic supply chain receive stable and premium incomes through a fixed purchase agreement, thereby reducing market volatility. Additionally, the zero-waste approach, wherein surplus tomatoes are processed into puree, paste, sauces, and dried products, effectively prevents financial losses during peak harvest seasons. Nutritional analyses indicate that organic tomato products retain higher levels of lycopene, vitamin C, phenolics, and antioxidants compared to conventionally grown counterparts. Consumers benefit from chemical-free, high-nutrient tomato products that promote better health outcomes. The study also highlights socio-economic advantages, including increased local employment opportunities, fair wages, and skill development in food processing units. Overall, the organic tomato processing model demonstrates a sustainable and economically viable pathway that strengthens farmer livelihoods, enhances consumer health, and contributes to environmentally responsible agriculture.

**Keywords:** Tomato, *Solanum lycopersicum* L, farmer livelihood, tomato ketchup

### Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most extensively cultivated and consumed vegetable crops globally due to its high nutritional and functional value. Tomatoes are rich sources of bioactive compounds such as lycopene, vitamin C, phenolics, flavonoids, and antioxidants, which play a significant role in reducing the risk of chronic diseases including cardiovascular disorders and certain cancers (Bhowmik *et al.*, 2012; Badgujar *et al.*, 2021) [2, 3]. Processed tomato products such as ketchup, paste, puree, and sauces further enhance lycopene bioavailability due to heat-induced isomerization during processing (Ahmed & Khan, 2018; Verma & Kumar, 2018) [1, 18].

In recent years, consumer awareness regarding food safety, pesticide residues, and environmental sustainability has led to a rapid increase in demand for organically produced foods. Organic agriculture emphasizes the use of natural inputs, biofertilizers, and ecological pest management, thereby improving soil fertility, biodiversity, and produce quality (Agrawal & Singh, 2020; Codex Alimentarius, 2020) [5, 20]. Studies have reported that organically grown tomatoes possess higher antioxidant activity and improved nutritional attributes compared to conventionally grown counterparts (Giuffrida *et al.*, 2018; Pandey, 2023) [7, 12].

In India, tomato farmers frequently face challenges such as price volatility, post-harvest losses, and lack of organized processing infrastructure. Post-harvest losses in tomatoes can reach up to 20–25%, significantly affecting farmer income (Gupta, 2020) [8]. Value addition through processing has been recognized as a viable strategy to reduce wastage, improve shelf life, and enhance profitability for farmers (FAO, 2019; Kumar, 2022) [6, 10]. Contract-based and integrated processing models have demonstrated improved income stability and reduced market risk for tomato growers (Mittal *et al.*, 2018) [11].

This research has developed an integrated organic tomato production and processing model that links farmers directly with a processing unit, ensuring assured procurement, premium pricing, and zero-waste utilization of surplus produce. This approach not only enhances farmer livelihood but also generates rural employment and delivers chemical-free, nutritionally superior tomato products to consumers (Patel, 2019; Choudhary, 2021) [4, 13]. Consumer preference studies further indicate increasing acceptance of organic food products due to perceived health benefits and absence of chemical residues (Kaur & Kapoor, 2021; WHO, 2019) [9, 19].

The present study aims to evaluate the impact of organic tomato-based food products on farmer livelihood, nutritional quality, and consumer health, using present research as a case study. The research also assesses the socio-economic and environmental benefits associated with sustainable organic tomato processing.

### Images: Harvested but Wasted: The Reality of Tomato Farming





**Materials and Methods**

**1. Study Area and Participants**

The study was conducted in an organic tomato processing unit collaborating with small- and medium-scale farmers practicing certified organic cultivation. A total of 60 organic tomato farmers, 35 processing-unit workers, and 150 consumers were selected for economic, nutritional, and perception-based assessments. The study followed standard socio-economic evaluation approaches as suggested by FAO (2019) [6] and Choudhary (2021) [4].

**2. Organic Tomato Cultivation Practices**

Organic tomato cultivation followed national and international organic standards (Codex Alimentarius, 2020; USDA, 2020) [5, 17]. Cultivation practices included the application of farmyard manure, vermicompost, and biofertilizers to improve soil fertility (Srinivasan, 2020) [16]. Synthetic fertilizers, pesticides, herbicides, and growth regulators were strictly prohibited. Pest and disease management was carried out using biological control agents, botanical extracts, and cultural practices such as mulching and crop rotation (Singh, 2021; Sharma *et al.*, 2022) [14, 15]. Efficient water management was ensured through drip irrigation systems to optimize water use efficiency and crop productivity (Agrawal & Singh, 2020) [20]. Harvesting was performed manually at physiological maturity to ensure maximum nutritional quality and reduced mechanical damage.

**3. Processing of Organic Tomato Products**

Freshly harvested organic tomatoes were processed into value-added products including tomato paste, puree, ketchup, sauces, and dried tomato flakes. Among all these current research paper focuses on production of Ketchup Processing operations such as washing, sorting, blanching, pulping, concentration, pasteurization, and packaging were carried out using hygienic and standardized procedures (Verma & Kumar, 2018; Kumar, 2022) [10, 18]. No artificial colors, synthetic preservatives, or chemical additives were used during processing. Spices, salt, sugar, vinegar, onion, and garlic were added as per standard food processing guidelines to maintain product safety, flavour, and shelf life (Codex Alimentarius, 2020) [5]. The processing methodology ensured minimal nutrient loss while improving lycopene concentration and antioxidant stability (Ahmed & Khan, 2018; Pandey, 2023) [1, 12].

**4. Nutritional Analysis**

Nutritional quality of organic tomato products was evaluated for lycopene content, vitamin C, total soluble solids (TSS), pH, acidity, total phenolic content, and antioxidant activity using standard analytical methods reported in previous studies (Giuffrida *et al.*, 2018; Badgujar *et al.*, 2021) [2, 7]. Nutrient retention after processing was compared with conventionally processed tomato products (Verma & Kumar, 2018) [18].

**5. Economic and Social Assessment**

Economic analysis included assessment of farmer income before and after integration into the organic processing supply chain, price realization, yield, and post-harvest losses (Mittal *et al.*, 2018; Gupta, 2020) [8, 11]. Employment generation, wage structure, and skill development among processing unit workers were evaluated following Patel (2019) [13]. Consumer perception regarding taste, nutritional quality, and health benefits of organic tomato products was assessed using structured questionnaires (Kaur & Kapoor, 2021; WHO, 2019) [9, 19].

**Table 1:** Formulation of Tomato Ketchup

Ingredient	Quantity
Tomato juice	25 kg
Sugar	01kg
Salt	50 g
Garlic (chopped)	13 g
Cinnamon	5 g
Cardamom	1 g
Mace	1g
Glacial acetic acid	50 ml
Onion	1 kg
Clove	320 g
Black pepper	13 g
Cumin	5 g
Red chilli powder	5 g

About one-third of the sugar required is added the time of commencement of boiling to intensify and fix the red tomato colour. If the whole quantity of sugar is added initially, the cooking time will be longer and the quality pulp will be adversely affected. Generally, the sugar content in ketchups/sauces varies from 10 to 26 per cent. On the other hand, salt bleaches the colour of the cooking process. Spices are generally added in powdered form to the product by spice extract bag method. Instead of whole spices, essential oils of spices oleoresins and spice extract can also be used. Essential oils, however, do not give the characteristic true aroma of whole spice but oleoresins provide true aroma. At present, spice extract is used in many industries for ketchup preparations. These do not adversely affect the colour of the product and are generally added a few minutes before the end of cooking. The salt content of the product should be 1.3 to 3.4 percent. Good quality vinegar is essential for the preparation of high-quality sauce/ketchup. It should contain 5.0 to 5.5 per cent acetic acid and should be added when the product has thickened sufficiently, so that the acid is not lost by volatilization. Tomato ketchup generally contains 1.25 to 1.5 per cent acetic acid. Sometimes glacial acetic acid (100 per cent acetic acid) is used which is colourless and cheaper than vinegar.

In order to increase the viscosity and prevent the separation of pulp from clear juice, pectin can be added to the extent of 0.1 to 0.2 per cent by weight of the finished product. The ketchup should be filled hot (about 88°C) to prevent browning and loss of vitamins during subsequent storage. If it is made from tomatoes of good quality, using sugar, salt, vinegar and spices in the correct proportion, it does not spoil for a fairly long time, even after opening the sealed bottle, if the latter is kept in a cool and clean place. It is, however, advisable to add 0.025 per cent sodium benzoate to the product before bottling and then pasteurize the bottles as a precaution against spoilage during the 3 to 4 weeks that the ketchup remains in the opened bottle before it is used up.

**4. Nutritional Analysis**

**Table 2:** Nutritional Comparison between Organic and Conventional Tomato Products

Parameter	Organic Tomato Products	Conventional Products
Lycopene (mg/100 g)	14.2	10.8
Vitamin C (mg/100 g)	24.5	17.9
Phenolics (mg GAE/100 g)	38.3	27.6
Antioxidant Activity (%)	65.8	49.3
TSS (°Brix)	5.5	4.2

Organic tomatoes demonstrated higher nutritional value due to the absence of chemical stressors and improved soil health conditions. Processing further concentrated nutrients,

**Nutrient parameters evaluated**

- Lycopene content (mg/100 g)
- Vitamin C (mg/100 g)
- Total soluble solids (TSS)
- pH and acidity
- Phenolic and antioxidant activity

**5. Economic and Social Assessment**

- Income analysis before and after involvement in organic value-chain
- Employment generation at processing plant
- Consumer health perceptions and market acceptability

**Results and Discussion**

**1. Nutritional Composition of Organic Tomato Products**

particularly lycopene and phenolics.

**2. Farmer Income and Economic Benefits**

**Table 3:** Farmer Income Before and After Organic Integration

Parameter	Before (Conventional)	After (Organic + Processing Supply Chain)
Average yield (ton/acre)	8.5	9.2
Price received (₹/kg)	8–12	20–25 (fixed)
Income stability	Low	High
Post-harvest loss (%)	22%	<5%
Overall net income	Increase by 45–55%	

The guaranteed buy-back system ensured farmers received a stable and premium price. Reduced wastage due to processing

led to improved profit margins.

**3. Employment and Social Impact**

**Table 4:** Employment Generated by Processing Unit

Category	Number of Workers	Benefit
Women workers	22	Improved livelihood and empowerment
Men workers	13	Skilled employment
Technicians	5	Higher technical training

This organic Food Processing created year-round employment, especially benefiting women and rural youth.

**Consumers reported**

- Better taste and natural color
- Relief from concerns related to chemical residues
- Perception of improved digestion and overall wellness
- High acceptability for kids and elderly due to chemical-free preparation

**Conclusion**

Organic tomato cultivation coupled with sustainable value-added processing forms a powerful strategy for improving rural livelihood, ensuring food safety, and promoting environmental health. The integrated model implemented by this Agro Foodex demonstrates significant advantages over conventional tomato production and processing systems.

Farmers benefit from stable incomes, reduced market dependency, and minimized post-harvest losses. The processing of surplus tomatoes into high-quality, nutrient-dense products ensures economic resilience and zero-waste utilization.

Consumers gain access to superior-quality products with higher lycopene, vitamin C, antioxidants, and phenolic content, contributing to improved health outcomes and reduced exposure to chemical contaminants. Environmentally, organic production supports soil health, biodiversity, and long-term sustainability. Additionally, the processing unit generates employment, especially for rural women, thus enhancing socio-economic development.

Overall, organic tomato-based value addition represents a scalable and sustainable model that can be replicated across regions to promote agricultural transformation, rural empowerment, and consumer wellness.

**References**

1. Ahmed M, Khan N. Nutritional evaluation of tomato products. *Food Chemistry*,2018;244:153–160.
2. Badgujar D, *et al.* Role of lycopene in human health. *Journal of Nutritional Biochemistry*,2021;89:108–115.
3. Bhowmik D, *et al.* Tomato as a functional food. *Journal of Pharmacognosy and Phytochemistry*,2012;1(1):33–43.
4. Choudhary M. Organic farming systems and their socio-economic impact. *International Journal of Rural Studies*,2021;28(2):62–70.
5. Codex Alimentarius. Guidelines for organic food production, 2020.
6. FAO. Value addition in horticultural crops for rural development, 2019.
7. Giuffrida F, *et al.* Effect of cultivation practices on lycopene content in tomatoes. *Scientia Horticulturae*,2018;240:166–174.
8. Gupta A. Post-harvest losses in tomato and their management. *Indian Journal of Horticulture*,2020;77(4):582–590.
9. Kaur S, Kapoor H. Consumer perception toward organic foods. *Journal of Food Quality*, 2021, 1–8.
10. Kumar R. Zero-waste processing of vegetable crops. *Journal of Food Processing Technology*,2022;13(2):77–85.
11. Mittal S, *et al.* Economic benefits of contract farming in tomatoes. *Agricultural Economics Review*,2018;19(2):134–147.
12. Pandey V. Antioxidant retention in processed tomato products. *Food Science Today*,2023;5(1):22–29.
13. Patel A. Tomato processing industries and rural employment. *Journal of Agrarian Development*,2019;11(3):99–109.
14. Sharma P, *et al.* Post-harvest technologies for organic produce. *Organic Agriculture Review*,2022;3(4):188–195.
15. Singh D. Organic tomato cultivation and challenges. *Indian Journal of Organic Farming*,2021;5(1):55–63.
16. Srinivasan R. Biofertilizers in vegetable production. *Horticulture International Journal*,2020;4(3):123–129.
17. USDA Organic standards and certification guidelines, 2020.
18. Verma N, Kumar J. Nutrient retention during tomato processing. *Journal of Food Processing*,2018;56(3): 112–118.
19. WHO Health implications of pesticide residues in food, 2019.
20. Agrawal S, Singh P. Organic farming and sustainability in horticultural crops. *Journal of Agricultural Sciences*,2020;12(3):45–53.