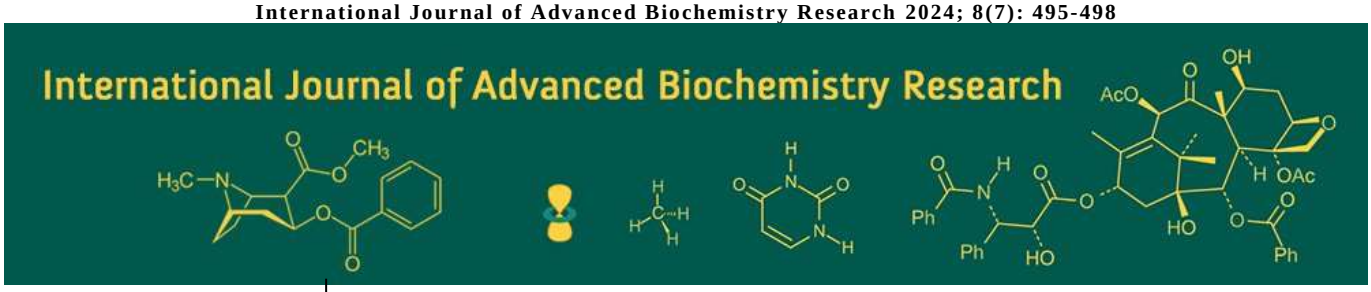


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**DJ Rathod**
Department of Food Engineering, College of Food Processing Technology and Bio-Energy, Anand, Gujarat, India

**AK Sharma**
Department of Agricultural Engineering, College of Agriculture, Anand Agricultural University, Anand, Gujarat, India

**Corresponding Author:**
**DJ Rathod**
Department of Food Engineering, College of Food Processing Technology and Bio-Energy, Anand, Gujarat, India

# Effect of different blanching methods on ascorbic acid and colour value for Aonla segments and shreds

**DJ Rathod and AK Sharma**

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**Abstract**
This study investigates the impact of hot water, steam, and microwave blanching methods on the nutritional and physicochemical attributes of fresh Aonla (Indian gooseberry) segments and shreds. Initial analysis revealed high ascorbic acid content (690.86±5.03 mg/100 g) and moderate tannin levels (1.99±0.83%). Results indicate that steam blanching effectively preserved ascorbic acid, with minimal loss observed after 120 seconds, while hot water blanching showed a gradual decrease from 689.25 mg/100g to 668.58 mg/100g over the same period. In contrast, microwave blanching led to rapid ascorbic acid degradation, with levels decreasing from 684.14 mg/100 g to 666.24 mg/100 g after 120 seconds. Color analysis (L*, a*, b*) demonstrated stable values with steam blanching, whereas microwave blanching resulted in significant fluctuations, indicating potential quality deterioration.

**Keywords:** Blanching methods, ascorbic acid, colour value, Aonla segments, Aonla shreds

## Introduction
Blanching of Aonla (Indian Gooseberry) represents a critical processing step aimed at enhancing both the quality and safety of its products. Blanching process involves precise control of temperature and duration to achieve specific objectives, primarily the preservation of ascorbic acid-an essential nutrient vital for nutritional value and consumer health. Ascorbic acid, or Vitamin C, is renowned for its antioxidant properties and its role in collagen synthesis and immune function. Aonla stands as one of the richest natural sources of this vital nutrient (Hall & Brouwer, 2002) [2]. Optimal blanching conditions are critical to minimize thermal degradation of ascorbic acid while effectively inactivating enzymes and ensuring microbial safety (Ranganna, 1986) [8]. Additionally, maintaining the natural color of Aonla segments and shreds is essential for consumer acceptance and marketability (Sacchetti *et al*., 2003) [9]. Achieving uniform heating and selecting appropriate blanching method tailored to the specific characteristics of Aonla fruits are crucial technical considerations (Mayer & Harel, 1979) [4]. The blanching process demands meticulous control to balance these factors, ensuring minimal nutrient loss, enhanced shelf life, and overall product quality that meets regulatory standards and consumer expectations (Rathod 2019) [7].
In Aonla (Indian gooseberry), Polyphenol oxidase (PPO) is the key enzyme responsible for catalyzing the oxidation of phenolic compounds to quinones, which then undergo non-enzymatic polymerization to produce brown pigments. This enzymatic browning process is well-documented and occurs naturally when Aonla fruits are exposed to air or during processing, significantly impacting their color and overall quality (Mayer & Harel, 1979; Shahidi & Naczk, 1995) [4, 11]. Effective control or inhibition of PPO activity is essential to preserve the desired color and enhance the aesthetic appeal of Aonla products, thereby ensuring their marketability and consumer acceptance (Sacchetti *et al*., 2003; Ranganna, 1986) [9, 8]. Proper management of enzymatic browning through optimized processing techniques is critical for maintaining the visual and sensory characteristics that influence consumer preference and commercial viability in the food industry (Hall & Brouwer, 2002; Kulkarani *et al*., 2017) [2, 3].

## Materials and Methods
**Materials:** Freshly harvested Aonla (Cv. Anand II) with diameters of 30.6±3.1 mm and weights of 24.20±3.05 g were procured from Anand Agriculture University, Anand,

Gujarat. The study utilized catechol, Ethylenediaminetetraacetic Acid (EDTA), phosphate buffer (0.1 M, pH 6.0), Polyvinylpolypyrrolidone (PVPP), and ice-cold distilled water. Instruments included a spectrophotometer, centrifuge, and homogenizer.

**Sample preparation:** The selected Aonla fruits were washed thoroughly under tap water to remove any adhering impurities such as dirt, dust, or foreign matter. Cleaned fruits were drained and then manually prepared into segments and shreds. Five grams of the prepared Aonla sample were homogenized in 25 ml of ice-cold 0.1 M phosphate buffer (pH 6.0) containing 1 mM EDTA and 1% (w/v) polyvinylpolypyrrolidone (PVPP). The homogenate was then centrifuged at 10,000 g for 15 minutes at 4°C, and the supernatant was collected as the enzyme extract and kept on ice.

**Blanching methods:** Three different blanching methods were used to inactivate the enzyme Polyphenol oxidase (PPO) in the Aonla segments and shreds:

**Hot Water Blanching:** The samples were immersed in hot water at 85±2 °C with a sample-to-water ratio of 1:4.

**Steam Blanching:** Samples were exposed to steam produced in a hot water bath (Make: Patel Scientific Instrument, Ahmedabad) at 98±2 °C.

**Microwave Blanching:** The samples were placed in a microwavable bowl with water and processed using an IFB 30FRC2 microwave at 2450 MHz frequency, 1.4 kW rated power, and 100% power level. The sample-to-water ratio was maintained at 1:4.

**Hot water, steam and microwave treatments:** Polyphenol oxidase (PPO) activity, ascorbic acid loss, and colour changes (L*, a*, and b*) were monitored at 20-second intervals.

**Polyphenol oxidase (PPO) activity:** PPO activity was assessed (Steffens *et al*., 1994) [13] by incubating Aonla extract with catechol substrate in phosphate buffer (pH 6.5) for 30 minutes at 25 °C. Absorbance at 420 nm was measured using a spectrophotometer, comparing the reaction mixture to a substrate-only control. Minimal change in absorbance indicated null or inactive PPO activity, while significant increase confirmed enzymatic oxidation of the substrate, offering a rapid method for enzyme activity assessment.

**Ascorbic acid:** Ascorbic acid content in Aonla samples was determined (AOAC 2000) using the titration method with 2,6-dichlorophenol-indophenol (DCPIP) as the titrant. Aonla extract was prepared by homogenizing the sample in a metaphosphoric acid solution to stabilize ascorbic acid. The stabilized extract was then titrated against a standardized DCPIP solution until the color changed from blue to colorless, indicating the endpoint. The volume of DCPIP solution used was recorded, and the concentration of ascorbic acid in the sample was calculated based on a standard curve generated with known concentrations of ascorbic acid.

**Colour:** Colour analysis of Aonla samples was performed (Kulkarani *et al*., 2017; Rathod 2019) [3, 7] using a colorimeter (Lovibond RT850i CREISS) according to the CIELAB colour space. Each sample was measured for L* (lightness), a* (red-green axis), and b* (yellow-blue axis) values. Prior to measurement, Aonla samples were prepared and homogenized to ensure uniformity. The colorimeter was calibrated using a standard white tile, and measurements were taken in triplicate to ensure accuracy. The obtained L*, a*, and b* values were used to assess and compare the colour characteristics of different Aonla samples under study.

## Results and Discussion

Mature, fresh, and high-quality Indian gooseberry (Aonla) fruits of the Gujarat Aonla-II cultivar were analyzed for various physicochemical attributes, as presented in Table 1. The chemical composition analysis of fresh Aonla revealed exceptional nutritional values, notably an ascorbic acid content of 690.86±5.03 mg/100g. This aligns with previously reported values ranging from 520 to 679 mg/100g for different varieties (Pebam, 2010) [6] and 486 to 647 mg/100g for other cultivars (Singh *et al*., 2005) [12]. Gaikwad (2013) reported a lower ascorbic acid value of 450 mg/100g, indicating variability across studies and cultivars. Fresh Aonla also contains 1.99±0.83% tannins, compared to 2.4% reported by Prajapati *et al*. (2011), reflecting differences attributed to variety and maturity levels. Additionally, fresh Aonla is characterized by high moisture content (84.17±2.29%), moderate carbohydrates (8.72±1.23%) and sugars (9.30±1.45%), low protein (0.70±0.07%) and fat (0.21±0.04%), and beneficial fiber (0.89±0.08%). Its acidity (2.68±0.49%) contributes to its tart flavor and preservative qualities, underscoring its potential for various dietary applications and emphasizing the need to standardized blanching methods to preserve these valuable properties.

**Table 1:** Chemical properties of fresh Aonla

| Parameters | Avg.± S.D. |
|---|---|
| Moisture content (%) | 84.17±2.29 |
| Protein (%) | 0.70±0.07 |
| Fat (%) | 0.21±0.04 |
| Ash (%) | 0.69±0.08 |
| Fiber (%) | 0.89±0.08 |
| Carbohydrate (%) | 8.72±1.23 |
| Acidity (%) | 2.68±0.49 |
| Total sugar (%) | 9.30±1.45 |
| Reducing sugar (%) | 7.36±1.50 |
| Ascorbic acid (mg/100g) | 690.86±5.03 |
| Tannin (%) | 1.99±0.83 |

### Effect of blanching methods

The impact of three blanching methods-hot water (85±2°C), steam (98±2°C), and microwave was studied to evaluate the inactivation of Polyphenol oxidase (PPO), changes in ascorbic acid content, and alterations in color values of treated Aonla samples. The effectiveness of these methods on both Aonla segments and Aonla shreds is detailed in Tables 2 and 3, respectively.

### Ascorbic acid content

The ascorbic acid content in Aonla segments and shreds declines with increasing blanching time across all methods, reflecting the sensitivity of this nutrient to heat. In hot water

blanching, a steady decrease in ascorbic acid content is observed, with a notable drop from 689.25 mg/100g to 668.58 mg/100g for segments and from 684.14 mg/100g to 666.24 mg/100g for shreds over 120 seconds. This loss can be attributed to the solubility of ascorbic acid in water, leading to leaching during blanching (Müller, 2000) [5]. Steam blanching demonstrates a similar trend but with a slightly slower rate of decline, suggesting that the absence of direct contact with water reduces nutrient loss, aligning with findings by Selcuk and Erkan (2015) [10]. Microwave blanching shows the most significant reduction in ascorbic acid, particularly notable after 60 seconds, which can be attributed to the uneven distribution of heat and the rapid heating effect of microwaves, causing thermal degradation of ascorbic acid (Vikram *et al*., 2005) [14].

**Enzyme activity**

Polyphenol oxidase (PPO) inactivation time for segments and shreds was observed at 2 minutes for hot water and steam blanching, while it occurred at 1 minute 20 seconds for segments and shreds in microwave conditions, as shown in Tables 2 and 3. The data indicate that steam blanching resulted in lesser change in ascorbic acid content compared to hot water blanching, while microwave treatment led to comparatively higher ascorbic acid loss, likely due to the rapid and instantaneous heating effect of microwaves.

**Table 2:** Effect of different blanching methods for Aonla segments

| Blanching method | Time (s) | Ascorbic acid (mg/100 g) | Enzyme activity | Color value | | |
|---|---|---|---|---|---|---|
| | | | | L* | a* | b* |
| Hot water | Fresh | 689.25 | + | 2.33 | -0.39 | 0.34 |
| | 20 | 687.54 | + | 1.39 | -1.02 | 0.91 |
| | 40 | 686.27 | + | 2.40 | -0.44 | 0.59 |
| | 60 | 684.14 | + | 1.29 | 0.01 | 1.77 |
| | 80 | 672.46 | + | 1.47 | -0.13 | 0.55 |
| | 100 | 669.18 | + | 1.55 | -0.45 | -1.15 |
| | 120 | 668.58 | - | 2.34 | -0.31 | 0.49 |
| Steam | Fresh | 689.25 | + | 1.37 | -1.08 | 0.93 |
| | 20 | 688.10 | + | 1.31 | 0.02 | 1.74 |
| | 40 | 686.91 | + | 1.48 | 0.21 | 0.44 |
| | 60 | 686.69 | + | 1.60 | -0.36 | -1.28 |
| | 80 | 681.23 | + | 1.48 | 0.59 | -0.03 |
| | 100 | 679.05 | + | -0.04 | -0.24 | -0.20 |
| | 120 | 678.85 | - | 1.59 | -0.39 | -1.28 |
| Microwave | Fresh | 689.25 | + | 78.99 | 0.94 | 8.92 |
| | 20 | 665.72 | + | -1.31 | -0.16 | -1.88 |
| | 40 | 632.57 | + | 0.20 | 0.04 | -1.58 |
| | 60 | 588.92 | + | 0.06 | -0.79 | -1.24 |
| | 80 | 572.34 | - | 0.29 | -0.50 | -2.86 |
| | 100 | - | - | - | - | - |
| | 120 | - | - | - | - | - |

**Table 3:** Effect of different blanching methods for Aonla shreds

| Blanching method | Time (s) | Ascorbic acid (mg/100g) | Enzyme activity | Color value | | |
|---|---|---|---|---|---|---|
| | | | | L* | a* | b* |
| Hot water | Fresh | 684.14 | + | 79.12 | 1.49 | 6.75 |
| | 20 | 683.01 | + | -1.45 | -0.71 | 0.30 |
| | 40 | 682.12 | + | -0.08 | -1.34 | 0.92 |
| | 60 | 681.16 | + | 0.07 | -0.51 | 0.59 |
| | 80 | 678.92 | + | 0.15 | -1.05 | -0.68 |
| | 100 | 671.54 | + | 0.93 | -0.72 | 0.98 |
| | 120 | 666.24 | - | -0.16 | -0.38 | 1.86 |
| Steam | Fresh | 684.14 | + | 0.97 | -0.87 | -0.88 |
| | 20 | 684.02 | + | 0.86 | -0.78 | 0.77 |
| | 40 | 683.92 | + | 0.06 | -0.01 | 0.11 |
| | 60 | 683.54 | + | -0.17 | -0.52 | 2.07 |
| | 80 | 680.15 | + | -1.40 | -0.71 | 0.48 |
| | 100 | 678.27 | + | 0.07 | -0.69 | 0.90 |
| | 120 | 672.78 | - | 0.01 | -1.57 | 1.19 |
| Microwave | Fresh | 684.14 | + | 1.46 | 0.22 | 0.34 |
| | 20 | 662.54 | + | 1.58 | -0.59 | -1.19 |
| | 40 | 634.36 | + | 1.49 | 0.53 | 0.09 |
| | 60 | 586.15 | + | -0.09 | -0.16 | 0.11 |
| | 80 | 574.26 | - | 1.35 | -0.83 | 0.84 |
| | 100 | - | - | - | - | - |
| | 120 | - | - | - | - | - |

**Color values:** Color values (L*, a*, and b*) indicate changes in the visual quality of Aonla segments and shreds during blanching. The L* value, representing lightness, shows minor fluctuations in hot water blanching, indicating

relatively stable color with minor darkening over time. Steam blanching maintains more stable L* values, suggesting better preservation of natural color, potentially due to reduced physical damage and nutrient loss (Selcuk and Erkan, 2015) [10]. The microwave method shows significant initial values and greater fluctuations in L*, indicating possible browning or uneven heating effects, which can be undesirable in maintaining the visual appeal of the product (Vikram *et al*., 2005) [14].

The a* values, representing the red/green spectrum, remain close to zero in hot water and steam blanching, indicating minimal changes in these color aspects. However, microwave blanching shows more pronounced fluctuations, suggesting potential chemical changes affecting color. Similarly, the b* values (yellow/blue spectrum) exhibit minor fluctuations in hot water and steam blanching, whereas more significant changes in the microwave method indicate potential degradation of pigments and other compounds affecting color stability (Rathod, 2019) [7].

## Conclusion

This study highlights the impact of different blanching methods on the nutritional and visual quality of Aonla segments and shreds. Hot water blanching shows a consistent decrease in ascorbic acid and enzyme activity with relatively stable color values, while steam blanching better preserves ascorbic acid content and color stability, making it a preferable method for maintaining the quality of Aonla products. Microwave blanching leads to rapid nutrient degradation and fluctuating color values, suggesting it may not be ideal for preserving the quality of Aonla over extended blanching times.

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