

Effect of blanching on nutritional quality of dehydrated colocasia, *Colocasia esculenta* (L.) Schott leaves

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The quality of taro leaves, *Colocasia esculenta* (L.) Schott, dried in mechanical dehydrator was studied as an attempt to develop a dehydrated product from this vegetable. The effect of different blanching types (water blanching and steam blanching), time period (10 sec to 3 min) and chemical blanching (MgO, NaCl, NaHCO₃ and EDTA) was also studied with respect to the nutritional characteristics. The fresh leaves of Colocasia had a moisture content of 83.4 to 87.0% with a total soluble solids (TSS) varying from 1.8-3.2°B. Drying of fresh leaves without any pre-treatment and in the absence of blanching resulted in undesirable colour changes from green which is a typical of fresh vegetable to olive brown or brown discolouration. Blanching of taro leaves in water for 10 seconds or in alkali like sodium bicarbonate @ 0.1% resulted in superior product which unlike the steam blanched or unblanched leaves by showing minimal loss of green colour as reflected in chlorophyll content and nutritional characteristics.

Keywords: Colocasia leaves, Ascorbic acid, Blanching, Peroxidase, Chlorophyll retention.

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Introduction

Taro, *Colocasia esculenta* (L.) Schott, a perennial, tropical plant native to Southeast Asia is primarily grown as a root vegetable for its edible starchy corm but the versatility of the plant is reflected by the fact that not only the corm but its stem and leaves are also used frequently as seasonal vegetable. Green leaves of colocasia are considered as a rich source of β -carotene, ascorbic acid, folic acid, riboflavin and minerals such as iron, calcium and phosphorus. In spite of the nutritional potential of the leaves, the high moisture content renders them perishable and seasonal availability limits their utilization all round the year. Development of post harvest processing and utilization techniques could certainly resolve some, if not all, of the problems that affect the consumption and utilization of taro as well as go a long way in increasing labour efficiency, productivity, income of farmers, shelf-life of product, marketing opportunities and upgrade nutrition of consumers while substantially contributing to food security. Hence, there is a need to preserve these leaves of colocasia through proper processing techniques for safe storage and efficient nutrient retention.

Peroxidases are the enzymes present in plant tissues that cause oxidation of many compounds in presence of oxygen on storage¹. One of the common techniques employed to arrest enzyme activity and associated changes before processing is blanching. It is influenced by various factors such as blanching media, temperature, time, physical and physiological characteristics of the vegetables, average size of the pieces and uniformity of heat distribution and penetration^{2,3}. Chemical blanching is known to have a protective effect on ascorbic acid apart from colour (chlorophyll) as demonstrated by various authors^{4,6}. Thus, present investigation was undertaken to examine the effects of different blanching treatments and conditions (temperature, time and media) for colocasia leaves that ensures enzyme inactivation and maximum quality retention.

Materials and Methods

The leaves of colocasia were procured from a single lot from a local market of Solan, Himachal Pradesh. The leaves were destalked and washed under running tap water and thoroughly drained, cut into 20-22 cm long and 1.5 cm thick shreds. Cut shredded leaves (100 g) were used for each treatment. The leaves were blanched in 3 parts of water/solution or steam by the different methods. Water blanching

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at 98°C was done for different time periods i.e. 5, 10 and 30 seconds, 1, 2 and 3 minutes while steam blanching was done for 1, 2 and 3 minutes.

Blanch methods: The shortest blanching time for leaves was established as determined by negative peroxidase test⁷. Shredded leaves were blanched in water at 98°C ± 1°C and in steam.

Chemical treatment: The blanching time and method standardized from the above experiment with respect to peroxidase activity was further used for standardizing the chemical/alkali used for blanching resulting in maximum colour (chlorophyll) retention and other quality attributes. The different alkali used were Ethylene Diamine Tetra Acetic Acid (EDTA), magnesium oxide, sodium bicarbonate, sodium chloride in the concentrations of 0.1, 0.5 and 1.0% comparing with control. Blanched leaves were then loaded into a perforated stainless steel trays spread on muslin cloth and dried in mechanical dehydrator such at 55+5°C for 4.5 h to 6-8% moisture content. The dried colocasia leaves were packed quickly in polythene bags and used for further studies.

Chemical analysis: The blanched and dried leaf samples were analyzed for different quality characteristics, viz. ascorbic acid, moisture and ash by the methods of Ranganna⁸. For ascorbic acid analysis, 1.0 g sample was extracted in 3% metaphosphoric acid and the extract was titrated against the 2,6-dichlorophenol-indophenols dye of known strength⁹. The peroxidase activity was tested by Guaiacol peroxide method and antioxidant property by free radical scavenging activity as per the method of Brand-Williams *et al*¹⁰. DPPH (2, 2-diphenyl-1-picrylhydrazyl) was used as a source of free radical. A quantity of 3.9 mL of 6 × 10⁻⁵ mol/L DPPH in methanol was put into a cuvette with 0.1 mL of sample extract and the decrease in absorbance was measured at 515 nm for 30 min or until the absorbance become steady. Methanol was used as blank. The remaining DPPH concentration was calculated using the following equation.

$$\text{Antioxidant activity (\%)} = \frac{\text{Ab}_{(B)} - \text{Ab}_{(S)}}{\text{Ab}_{(B)}} \times 100$$

Where,

Ab_(B) = Absorbance of blank

Ab_(S) = Absorbance of sample

Chlorophyll determination: Two gram each of fresh and dried samples was used for analysis. The leaves were separately ground in mortar and the chlorophyll was then extracted with acetone/water mixture (80:20) using small volumes in successive stages until no trace of green remained in the ground pulp. The total chlorophyll content was estimated according to the formula given by MacKinney¹¹.

$$\text{Total chlorophyll (mg/g tissue)} = 20.2A645 + 8.02A663 \times V/1000 \times W$$

A645 = Absorbance at 645 nm

A663 = Absorbance at 663 nm

W = Weight of sample extracted

V = Final volume (cm³) of extract

Statistical analysis: The data were analyzed statistically by following completely randomized design (CRD) for physico-chemical parameters¹².

Results and Discussion

Data summarized in Table 1 shows that the fresh leaves of colocasia had a moisture content of 83.4 to 87.0 % with a total soluble solids (TSS) varying from 1.8-3.2^oB containing appreciable amounts of phenol (28.33-30.53 µg/100 g) and ascorbic acid (19.5-22.7 mg/100 g) thus highlighting its antioxidant activity. Fibre and ash content of colocasia leaves ranged between 0.87-1.47 and 10.6-12.2 per cent respectively. The pH of the fresh colocasia leaves was recorded as 7.70-7.76, thus slight change in its pH may result in colour change or chlorophyll degradation.

Effect of blanching on peroxidase activity: Peroxidase is the most thermally stable enzyme present in vegetable systems hence this is usually used as an index of the effectiveness of blanching treatments. If this enzyme is inactivated, other enzymatic systems responsible for tissue degradation will also be inactivated¹³. During the present study, it was

Table 1—Physico-chemical characteristics of fresh Colocasia leaves

S. No	Parameter	Mean±SD
1.	Moisture (%)	85.2 ± 1.8
2.	Total soluble solids (°B)	2.5 ± 0.7
3.	Ash (%)	11.4 ± 0.8
4.	pH	7.73 ± 0.3
5.	Phenols (µg/100g)	29.43 ± 1.1
6.	Fibre (%)	1.17 ± 0.3
7.	Ascorbic acid (mg/100 g)	21.1 ± 1.6

observed that blanching at 98°C for 10 seconds in water was found sufficient for peroxide inactivation while the steam blanching did not result in complete inactivation of enzyme. Therefore, out of different time temperature relations, 98°C for 10 seconds was sufficient to inactivate peroxidase enzyme and was therefore, further used for chemical blanching. Appreciable loss of ascorbic acid was observed in blanched dried colocasia leaves (Fig. 1). About 13.74, 43.12 and 63.19% of ascorbic acid in colocasia leaves is lost at blanching at 98°C for 10 sec, 1 and 3 minutes, respectively in water followed by mechanical drying. Gupta *et al*¹⁴

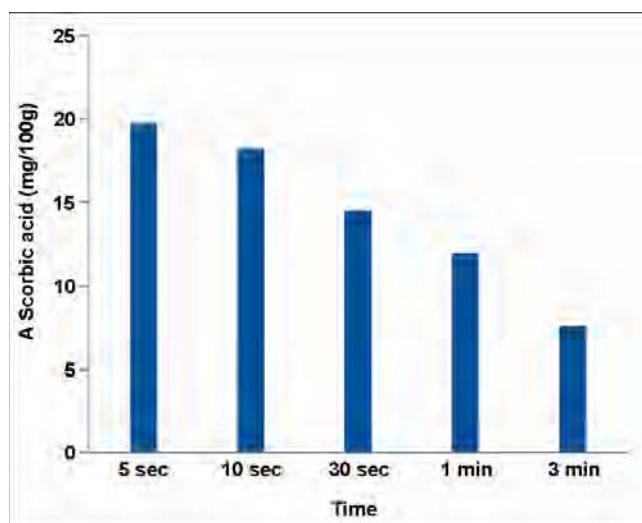


Fig. 1—Effect of water blanching at different time intervals on ascorbic acid retention (mg/100g) in Colocasia leaves

while studying the effects of blanching temperature observed that ascorbic acid content of all greens blanched at 80°C showed a reduction of 25-50 % which was supported by various authors^{15,16}.

Out of the different chemicals used like Ethylene Diamine Tetra Acetic Acid (EDTA), magnesium oxide, sodium bicarbonate, sodium chloride in the concentrations of 0.1, 0.5 and 1.0%, blanching of colocasia leaves in sodium bicarbonate @ 0.1% resulted in superior quality dried product (6.095 mg/g) followed by sodium chloride @ 0.1% (6.022 mg/g) with respect to chlorophyll retention. From data summarized in Table 2 it was observed that appreciable chlorophyll content was retained in chemical blanching in EDTA (1.0%) 5.543 ± 0.09 , magnesium oxide (0.1%) 3.555 as compared to control (blanched) 2.809 ± 0.04 , control (unblanched) 2.09 ± 0.08 mg/g tissues. Antioxidant activity of chemically blanched and dried Colocasia leaves revealed that the antioxidant activity ranging from 2.7 to 22.43% where the maximum was retained in sodium bicarbonate (0.1%) and minimum in unblanched colocasia leaves. Sodium chloride @ 0.1% also had appreciable amounts of antioxidant activity (20.73%) followed by EDTA @ 1.0% (15.72%). Increasing concentration of alkali used for blanching was not directly correlated with chlorophyll retention. Further, the water activity of the blanched colocasia leaves ranged between 0.506 to 0.566 as measured by water activity analyzer^{16,17}.

Table 2—Effect of chemical blanching on chlorophyll content and antioxidant activity of dried Colocasia leaves*

S. No.	Chemical	Concentration (%)	Cholorophyll (mg/g)	Antioxidant activity (%)
1.	EDTA	0.1	4.278 ± 0.02	9.35
2.	EDTA	0.5	4.552 ± 0.11	11.2
3.	EDTA	1.0	5.543 ± 0.09	15.72
4.	Magnesium oxide	0.1	3.555 ± 0.11	6.24
5.	Magnesium oxide	0.5	3.424 ± 0.07	7.75
6.	Magnesium oxide	1.0	2.393 ± 0.02	6.01
7.	Sodium bicarbonate	0.1	6.095 ± 0.01	22.43
8.	Sodium bicarbonate	0.5	4.321 ± 0.13	6.03
9.	Sodium bicarbonate	1.0	3.473 ± 0.06	6.37
10.	Sodium chloride	0.1	6.022 ± 0.06	20.73
11.	Sodium chloride	0.5	4.207 ± 0.05	10.81
12.	Sodium chloride	1.0	4.566 ± 0.02	11.98
13.	Control (Blanched)	-	2.809 ± 0.04	3.9
14.	Control (unblanched)	-	2.09 ± 0.08	2.7

*100 g shredded leaves dried at $55 \pm 5^\circ\text{C}$ after blanching

Conclusion

The fresh leaves of colocasia contain 28.33 to 30.53 µg/100 g of phenols and 19.5 to 2.7 mg/100 g of ascorbic acid. The pH of the fresh leaves was recorded as 7.70-7.76. Out of the different time temperature relationship, water blanching at 98°C for 10 seconds resulted in inactivation of peroxidase enzyme responsible for browning of cut tissues with only 13.74% of ascorbic acid degradation. About 43.12 and 63.19% of ascorbic acid is degraded at 1 and 3 minutes of water blanching. Further sodium bicarbonate @ 0.1% used in chemical blanching resulted in superior quality dried product.

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