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Research Article

EFFECT OF DIFFERENT BLANCHING TREATMENTS ON ASCORBIC ACID RETENTION IN GREEN LEAFY VEGETABLES

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Abstract- A field experiment was conducted on Department of Food Science and Nutrition, ASPEE College of Home Science and Nutrition, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the, effect of different blanching treatments on micronutrient retention in green leafy vegetables. Blanching is a prerequisite for preservation of green leafy vegetables. However, it may cause partial destruction of some nutrients like ascorbic acid, which is highly oxidizable with time in the post-harvest period on atmospheric exposure. The objective of the present study was to identify a suitable blanching treatment and conditions (temperature, time and media) for commonly consumed green leafy vegetables that ensures enzyme inactivation and maximum ascorbic acid retention. Twelve treatment combinations consisting of four commonly consumed leafy vegetables, viz. spinach leaves (*Spinacia oleracea*), Fenugreek Leaves (*Trigonella*), Drumstick Leaves (*Moringa oleifera*) and Amaranth Leaves (*Amaranthus gangeticus Linn.*)were blanched for 1, 2, and 4min at 80 ℃ and 90 ℃ in water and chemical media, steamed for 5 and 10 min with and without chemical treatment and microwaved for 1 and 1.5 min, unblanched greens served as control. Retention of ascorbic acid was reduced as the blanching time and temperature increased in all greens. It was comparatively higher in chemically treated samples both in conventional and steam blanched samples. Steam blanched samples (5 min) had a higher level of ascorbic acid than conventional blanched samples irrespective of blanching media. Ascorbic acid content of microwave-blanched samples was better in some greens compared to conventionally blanched greens. Blanching at 80 ˚C for 1 min, steaming for 5 min and microwaving for 1 min was sufficient to inactivate peroxidase in all except two green leafy vegetables irrespective of the blanching media. From the nutrition point of view, chemical blanching proved to be advantageous both in steam and conventional blanching for short period and it also ensured enzyme inactivation.

Keywords- Leafy vegetables, Ascorbic acid, Steam blanching, Chemical blanching, Microwave blanching, Peroxidase inactivation.

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Introduction

Human beings need wide range of nutrients for growth, development and to lead an active and healthy life. The nutrients include protein, fat, carbohydrates, minerals and vitamins which are present in the foods we eat daily. Most foods contain almost all the nutrients in various proportions, some foods being rich in certain nutrients [1].

Blanching consist of mild heat treatment of the vegetables in different heating system (steam, hot water and microwave) to varying time periods. It is influenced by various factors such as balancing media, temperature, time, physical and physiological characteristic of vegetables, average size of the pieces and uniformity of heat distribution and penetration [2]. These factors are highly specific for different leafy vegetables as the surface area exposed per unit mass varies from one to another [3].

Blanching at 88°C stops all life process, inactivates enzymes, fixes green colour and removes certain harsh flavors common in vegetables. Cooking also cause significant changes in the nutritional properties of foods as well as gelatinization of starches and coagulation of proteins to improve their digestibility and sensory properties [4].

Blanching in hot water or steam is commonly carried out to a wide range of fruits and vegetables allowing stabilization and commercialization of product. The benefits of heat treatment in enzymes inactivation and vegetative microbial cells destruction have been addressed in literature [5]. In some cases, the presence of some high heat resistance enzymes such as peroxidase makes heat treatments itself a problem and not a solution [5, 6]. The effectiveness of blanching process has been assessed by using peroxidase due to the highest thermo stability in plant-based foods. The other advantages such as simple and inexpensive activity measurement were also reported [7, 8].

Ascorbic acid, the antioxidant vitamin, is heat labile and sensitive to light, oxygen and oxidizing agents. Though blanching is a prerequisite to inactivate enzymes, it is deleterious to the vegetables causing vitamin losses by thermal degradation, diffusion and leaching". The extent of loss, however, will depend on the extent and duration of exposure to these factors [9]. Ascorbic acid is the most difficult of the vitamins to preserve during blanching and dehydration. Chemical blanching is known to have a protective effect on ascorbic acid. The protective effect of sodium metabisulphite has been demonstrated by Chaudharyand Rao [10] and Badifu [11] which is supported by Mulay *et al* [12] who reported that the use of potassium metabisulphite (KMS) for pretreatment of the green leafy vegetables can reduce the extent of loss of ascorbic acid. A combination of chemicals (0.5% potassium

metabisulphite + 0.1 %magnesium oxide + 0.1 % sodium bicarbonate) used for blanching is known to have better retention of ascorbic acid when compared to individual chemicals used for blanching [13].

As blanching is a prerequisite for preserving green leafy vegetables, it is very much essential to establish the conditions of blanching to enhance the utility of this nutritious economical source. The investigation was undertaken to identify the blanching treatment and conditions (temperature, time and media) for the commonly consumed green leafy vegetables that ensures enzyme inactivation and maximum ascorbic acid retention.

Materials and Methods

Ten commonly consumed green leafy vegetables namely: spinach leaves (*Spinacia oleracea*), Fenugreek Leaves (*Trigonella*), Drumstick Leaves (*Moringa oleifera*) and Amaranth Leaves (*Amaranthus gangeticus Linn*.) were procured from a single lot from a local market of sardarkrushinagar (Gujarat).

Processing

The selected green leafy vegetables were derooted, washed in tap water to remove the adhering mud particles, drained well and rinsed with distilled water.

The greens were thoroughly drained, weighed, chopped into 1 cm pieces and blanched with 3 parts of water/ solution by the following methods: (i) Blanched at 80 ± 1 ˚C and 90 ±1 ˚C for 4 min in glass distilled water, (ii) Blanched at 80 ± 1 ˚C for 1, 2 and 4 min in water and in a chemical solution containing 0.5% potassium metabisulphite+0.1% magnesium oxide+0.1% sodium bicarbonate, (iii) Steam blanched for 5 and 10 min in a pressure cooker with and without chemical treatment, and (iv) Microwave blanched for 60 and 90 sec at high power in distilled water (model no. Samsung CombiCl062-S/XTL, India microwave cooking system).

Chemical analysis

The above blanched samples were analyzed for ascorbic acid by titrimetrically using 2, 6-dichlorophenol indophenol dye by the method described by Harris and Ray [14]. The dye solution was standardized against ascorbic acid (AR).

Statistical analysis

Analysis of Variance was applied to test the differences in the retention of ascorbic acid blanched under different conditions. Analysis was done using the statistical method complete randomized design (CRD) repeating each treatment four times, probability level was fixed at 5 per cent. The data obtained for all characteristics were analyzed as per the procedure of completely randomized design [15].

Results and Discussion

Effect of blanching temperature on retention of ascorbic acid

Ascorbic acid content of all greens blanched at 80 ^{0}C showed a reduction but the extent of loss varied between the vegetables. All greens blanched at 80 ^{0}C for 1 minute in distilled water retention was comparatively higher in spinach leaves (> 80%) and moderate in drumstick, fenugreek and amaranth leaves (70-80%). With increase in blanching time for another 1 min, retention was comparatively higher in drumstick leaves (> 70%) and moderate in spinach, fenugreek and drumstick leaves (60-70%). All greens blanched at 80 0C for 4 minute in distilled water, retention was spinach, fenugreek, drumstick and amaranth leaves (50-60%). The differential loss of ascorbic acid in the leafy vegetables treated under identical conditions could be attributed to differing vulnerabilities due to surface area, mechanical damage, and initial ascorbic acid content and enzymatic activities. With increase in temperature by another 10°C, spinach, fenugreek, drumstick and amaranth showed a further reduction of 5 to 10 % reduction.

These findings confirm the earlier reports that ascorbic acid is a highly soluble substance and thermal processing results in maximum losses 15'". Further increase in temperature though reduced the ascorbic acid content, the extent of differences between the different temperature treated samples was not significant (P> 0.05). These findings are in accordance to those reported by Gupte and Francis [16] where in they have shown that there is an increase in the loss of ascorbic acid in fenugreek leaves with every 10°C rise in the temperature of blanching media.

Effect of blanching time and media on retention of ascorbic acid of the greens blanched at 80°C for 1 min in distilled water fenugreek and amaranth leaves showed least retention (70-75%) while spinach and drumstick leaves showed highest retention (75-85%) of ascorbic acid. With increase in blanching time for another 1 min, spinach, fenugreek, drumstick and amaranth leaves showed a further loss of 2 -15% of ascorbic acid. When the blanching time was increased to 4 min, spinach, fenugreek drumstick and amaranth leaves showed a further loss of 15, 15, 20 and 9 % respectively in comparison with the samples blanched for 2 min, while in others the losses were negligible. Analysis of variance revealed that increasing the blanching time by 1-2 min at same temperature would significantly affect the loss of nutrients (P> 0.05). The findings are similar to [Table-1] those reported for Swiss chard (*Beta vulgaris* Linn.) leaves where in a 18% increase in loss of ascorbic acid was reported with increase in the blanching time from 30-120 sec [17].

Table-1 *Effect of blanching temperature and time on the retention of ascorbic acid content (%)*

Treatments	GLVs			
	Spinach Leaves	Fenugreek Leaves	Drumstick Leaves	Amaranth Leaves
Blanched in glass distilled water				
80 ± 1˚C for 1	83.20	71.92	78.54	73.46
80 ± 1˚C for 2	70.79	61.58	76.68	66.18
80 ± 1˚C for 4	55.94	52.54	57.23	57.47
90 ± 1˚C for 4	50.12	47.46	51.53	49.02

Greens blanched in the chemical solution at 80°C for 1 min showed maximum retention of ascorbic acid in spinach and amaranth (80-90%) and least in fenugreek and drumstick leaves (70-80%). With increase in blanching time to 2 min, spinach and drumstick showed a further loss of 10-20%, fenugreek and amaranth leaves showed a remarkable loss of 25-30%. No significant losses were encountered with increase in the blanching time by 1-2 min at the same temperature in chemical media (P>0.05). The chemically treated green leafy vegetables had a better colour retention as magnesium oxide and sodium bicarbonate used in the media has a protective effect on colour of these vegetables.

Greens blanched at 80°C for 1 min in chemical solution had 5-10% higher retention of ascorbic acid compared to water blanched ones. Even with increase in blanching time by 1-2 min, chemically blanched greens showed significantly higher (P< 0.01) retention of ascorbic acid over water blanched one. Similar observations were reported for fenugreek leaves and other vegetables [13].

These findings infer that chemical media offer a protection against oxidation of ascorbic acid and there by a higher retention of the water-soluble vitamin was observed in spite of subjecting the green leafy vegetable to thermal treatment. From [Table-2] it can be seen that chemically blanched greens for longer time (2 min) had higher retention of ascorbic acid compared to those blanched in water for a shorter time (1 min) also.

Table-2 *Effect of blanching time on the retention of ascorbic acid (%)*

Leafy Vegetables	Blanched at 80 ˚C			
	Times in minute			
	Chemical		Water	
	1	2	1	2
Spinach	84.89	86.56	83.20	70.79
Fenugreek	72.42	72.73	71.92	61.58
Drumstick	79.27	81.27	78.54	76.68
Amaranth	80.89	82.79	73.46	66.18

Steam blanching and ascorbic acid retention

On steam, blanching for 5 min the retention of ascorbic acid content ranged from 80-95% in 2 greens and 65-80% in 2 greens [Table-3]. Chemically pretreated greens showed a comparatively higher retention i.e. 90-98% in three and 70-85% in seven greens, respectively. Within crease in blanching time to 10 min, a further reduction of 5-10% was observed in two of untreated and 5% in two of the chemically pretreated greens. The time of steam blanching showed no association

with ascorbic acid retention both in treated and untreated greens (P>0.05). The greens blanched for five minutes were better in appearance than those blanched for ten minutes.

Microwave blanching and ascorbic acid retention

Greens blanched in a microwave oven for 1 min showed 95-98% retention of ascorbic acid in spinach and fenugreek while in others it ranged from 85-95%. With increase in time by another 30 sec, four greens showed a further loss of 3-10% but the extent of losses were not found to be statistically significant (P> 0.05).

Table-3 *Effect of steam blanching at different time intervals on ascorbic acid (%)*

Leafy Vegetables	Times of blanching in minute			
	Chemical		Water	
	5	10	5	10
Spinach	94.24	93.55	91.69	85.86
Fenugreek	97.07	93.56	90.79	88.12
Drumstick	84	82.69	78.95	69.37
Amaranth	80.47	71.95	79.04	69.69

Peroxidase test (qualitative)

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 inactivated". Blanching time would be the time required to achieve inactivation of peroxidase. This would depend on a wide range of factors as heating method, temperature, size, shape and thermal conductivity of product, type and concentration of enzymes. During present study, it was observed that blanching at 80 C for 1 minute in water; steam blanching for 5 minute and microwave treatment for 1 min were found sufficient for peroxide inactivation for most of the greens. Chemical treatment did not have any additional benefit in this process.

Conclusion

Among the greens selected, spinach had maximum retention of ascorbic acid followed by fenugreek, drumstick and amaranth by all blanching treatments irrespective of time and temperature chemically treated samples showed better retention of ascorbic acid than their respective untreated samples irrespective of blanching method or greens. Blanching at 80°C for 1 min ensured peroxidase inactivation in all except four greens. Thus, it can be suggested that 80°C for 1 min, chemical media and microwave blanching are most ideal for blanching greens with maximum nutrient retention. The study results may serve as a guide to select blanching method, time, media and temperature for processing the commonly consumed green leafy vegetables.

Conflict of Interest: None declared

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