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Effect of different cooking methods on vitamins, minerals and antinutritional factors of immature drumstick pods.

Efecto de diferentes métodos de cocción sobre vitaminas, minerales y factores antinutricionales de vainas de baquetas inmaduras

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ABSTRACT

Drumstick tree is a miracle source of phytonutrients in the drought prone areas of tropical and subtropical countries. With the emphasis to increase adoption of immature drumstick pods at homestead level, this study was planned to assess the effect of different cooking methods on vitamins (β-carotene; Rangana, 1995) & Ascorbic acid: AOAC 2000), minerals (iron & calcium; AOAC 2000) and antinutritional factors (phytates; Haug and Lantzsch, 1983, total phenols; AOAC method 2000, and oxalates; Abeza *et al*, 1968). The findings of present study revealed that all the cooking methods led significant decrease ($p \leq 0.01$) in nutrients and antinutritional factors of immature drumstick pods except total phenols. In all cooking methods, sauteing resulted in higher retention of β-carotene, iron, calcium and antinutritional factors in immature drumstick pods. In wet cooking methods, both microwave cooking and pressure cooking were found to preserve more nutrients in immature drumstick pods than boiling and blanching.

Key words: immature drumstick pods, cooking methods, nutrient retention.

RESUMEN

El árbol de baquetas es una fuente milagrosa de fitonutrientes en las áreas propensas a la sequía de los países tropicales y subtropicales. Con el énfasis en aumentar la adopción de vainas de baquetas inmaduras a nivel familiar, este estudio se planificó para evaluar el efecto de diferentes métodos de cocción sobre las vitaminas (β-caroteno; Rangana, 1995) y ácido ascórbico: AOAC 2000), minerales (hierro y calcio ; AOAC 2000) y factores antinutricionales (fitatos; Haug y Lantzsch, 1983, fenoles totales; método AOAC

2000 y oxalatos; Abeza et al, 1968). Los hallazgos del presente estudio revelaron que todos los métodos de cocción provocaron una disminución significativa ($p \leq 0.01$) de los nutrientes y factores antinutricionales de las vainas inmaduras de baquetas, excepto los fenoles totales. En todos los métodos de cocción, el salteado resultó en una mayor retención de β-caroteno, hierro, calcio y factores antinutricionales en las vainas inmaduras de baquetas. En los métodos de cocción húmedos, se encontró que tanto la cocción con microondas como la cocción a presión conservan más nutrientes en las vainas de baquetas inmaduras que hervir y escaldar.
Palabras clave: vainas inmaduras de baquetas, métodos de cocción, retención de nutrientes.

INTRODUCTION

Drumstick (*Moringa oleifera*), a fast-growing drought-resistant native tree grows abundantly in tropical and subtropical parts of the world (Lockelt and Grivetti 2000, Nikkon *et al* 2003). Due to its several nutritional, pharmacological and industrial applications, drumstick is is referred as "Miracle Tree" or "Wonder Tree", "Natural Nutrition for Tropics" (Fugile 2001) and "Mother's Best Friend" (Sudhir *et al* 2010). Every part of the Drumstick tree is a promising food source, with treasure trove of nutrients and several bioactive compounds. The commonly used parts of the drumstick tree are leaves, mature pods, flowers and seeds. Among all these parts, the leaves and pods are the proven source of several phytonutrients such as zeatin, quercetin, β-sitosterol, caffeoylquinic acid, kaempferol, kaempferitrin, isoquercitrin, rhamnetin, rhamnose and also a fairly unique group of compounds called glucosinolates, isothiocynates and alkaloids (Mehta *et al* 2003). These components have different types of biological actions in human body like anticancer, antimicrobial, anti-inflammatory, antiulcer, antispasmodic, antiepileptic, diuretic, antihypertensive, cholesterol lowering, antioxidant, immuno stimulating, antidiabetic and hepatoprotective activities (Chumark *et al* 2008). Thus, drumstick leaves and pods are being frequently employed for the treatment of different ailments in the indigenous system of medicine (Fahey 2005).

The nutraceutical potential of drumstick tree is very well known but it is still not efficiently harnessed as common food source. Due to maturity and ripening, the use of pods is underutilized due to its fibrous and hard texture. To avoid the undesirable texture and for better organoleptic properties, immature drumstick pods can be used. The adoption of immature drumstick pods at homestead level may provide a cost effective and efficient strategy to combat malnutrition and several degenerative diseases due to its vitamin and mineral profile. In addition to the nutrients, plant foods contain several antinutritional factors such as tannins, phytates, polyphenols and oxalates which can depress absorption of mineral and vitamins by forming insoluble compounds. Most of these anti-nutritional factors can be removed or minimized by appropriate processing or cooking method. During cooking, destruction of vitamins and minerals also occurs due to degradation, diffusion and leaching (Negi and Roy 2000). Thus, the use of appropriate cooking methods for effective time period is necessary to maintain the nutritional quality of vegetables. Cooking at home is generally performed by some conventional methods which mainly include boiling, pressure cooking, blanching and frying etc. In today's time microwave cooking is also very common. Thus, this study was planned to assess the effect of cooking methods on vitamins (β-carotene and ascorbic acid), minerals (calcium and iron) and antinutritional factors (phytates, oxalates and polyphenols) of immature drumstick pods for its better adoption at homestead level.

MATERIALS AND METHODS

Samples of drumstick *(Moringa oleifera*) pods (free from blemishes and damage) were procured thrice in a week during mid-June to mid November 2011 from the Department of Vegetable Crops, Punjab Agricultural University, Ludhiana, India. This variety of drumstick tree gives pods in month of mid-June to mid-November and leaves in whole year. Drumstick pods were used in between the 4-12 days of fruiting to yield fresh and tender pods. After necessary cleaning and washing, on sample of 100g drumstick pods (cuttings of 1-1.5cm), following cooking methods were applied:

A. Boiling in a stainless-steel pan (without lid) with 100ml water for 2 minutes.
B. Blanching in a stainless-steel pan with 300ml water for 2 minutes and then quickly air dried.
C. Pressure cooking with 100ml water till it blows two whistles.
D. Microwave cooking in glass bowl with 100ml water for 2 minutes in domestic microwave oven.
E. Sauteing in small skillet with 5ml of soybean oil till it became tender. It takes approximately 5 minutes.

After cooling, all the samples were homogenized and sealed in air tight packets for further chemical analysis. Fresh samples were used for beta carotene (Rangana, 1995) and ascorbic acid estimation (AOAC method, 2000). The dried samples were used for analysis of minerals and antinutritional factors. In minerals, iron and calcium were analyzed by AOAC method (2020). In antinutritional factors, estimation of phytin phosphorus (Haug and Lantzsch, 1983), total phenols (AOAC method (2000) and oxalates (Abeza *et al*, 1968) were performed. Appropriate statistical analysis was performed by using GSTAT 07 computer software.

RESULTS AND DISCUSSION

Vitamin content: The effect of cooking methods on β-carotene and ascorbic acid content of immature drumstick pods are presented in Table 1 and Fig. 1.

Table 1: Effect of cooking methods on β-carotene and ascorbic acid content of drumstick pods (on fresh weight basis)

Cooking methods	β-Carotene (μg/100g)	% Retention	Ascorbic acid (mg/100g)	% Retention
Fresh drumstick pods	370.45±0.03	100	118.33±2.36	100
Boiling	130.24±0.02	35.15	45.83±1.77	38.72
Blanching	188.10±0.01	50.77	60.83±4.12	51.40
Pressure cooking	257.40±0.16	69.48	100.83±0.59	85.19
Microwave cooking	224.56±0.15	60.62	99.16±14.73	83.78
Sauteing	352.60±0.05	95.18	33.33±4.71	28.16
F –ratio	20.89**		13.36**	
CD	70.89		32.547	

Values are presented as Mean ± SE

β-carotene: The β-carotene content of immature drumstick pods was 370.45μg/100g on fresh weight basis. Longwah *et al* (2017) and Fugile (2001) reported 17.28 and 110μg β-carotene in 100g edible portion in mature drumstick pods respectively. The high content of β-carotene in immature drumstick pods may be due to the soft outer green covering of pods, which is edible. Application of cooking methods on immature drumstick pods resulted in significant decrease ($p \leq 0.01$) in β-carotene content. Highest retention of β-carotene was seen in sauteing as 95.18% i.e. 352.60±0.05μg/100g. Maximum retention of beta carotene in sauteing may be due to its more solubility in fats as compared to water. In wet cooking methods, pressure cooking resulted in 69.48% retention of β-carotene followed by microwave cooking as 60.62%. Blanching was found to retain 50.77 percent of β-carotene while only 35.15% retention of β-carotene was observed in boiling.

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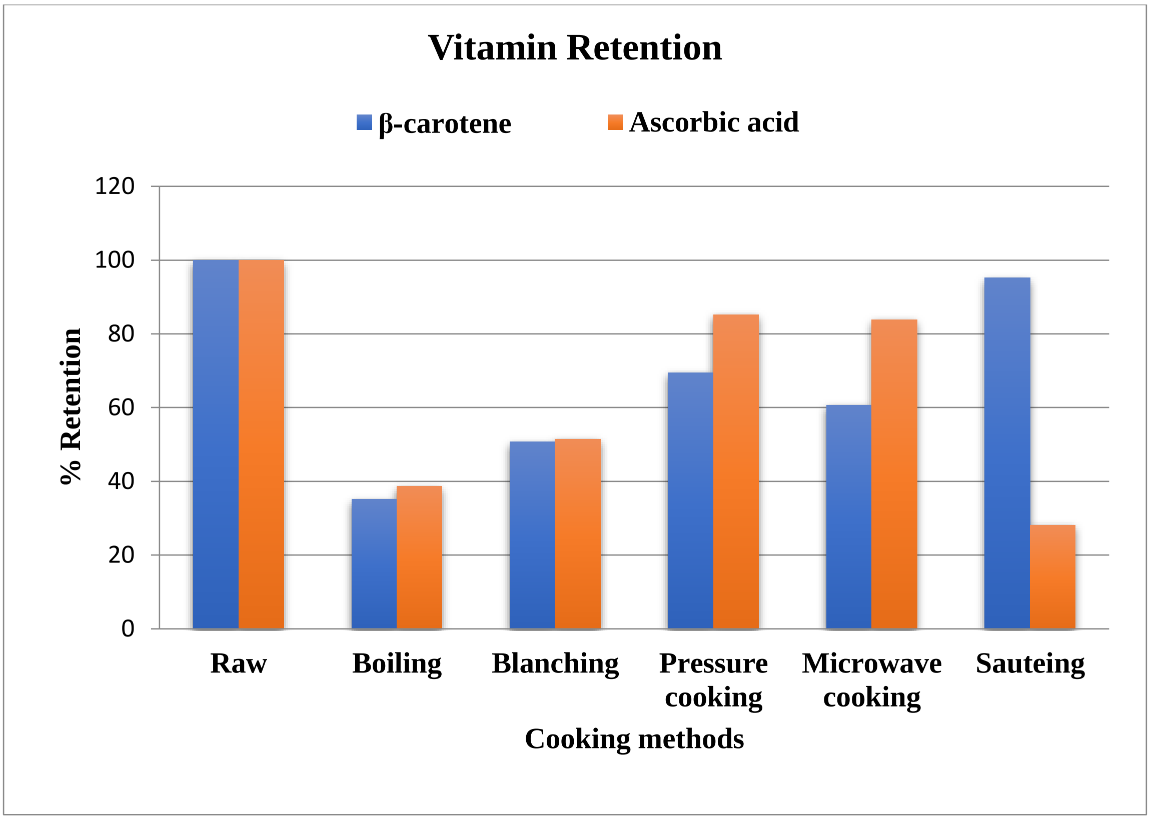

Fig. 1: Effect of cooking methods on percent retention of β-carotene and ascorbic acid in drumstick pods (on fresh weight basis)

Ascorbic acid: The ascorbic acid content of immature drumstick pods was 118.33mg/100g. Brhama *et al* (2009) and Bosch (2004) reported 106.95 and 141mg ascorbic acid in 100g edible portion of drumstick pods respectively. Application of cooking methods resulted in significant decrease ($p \leq 0.01$) in ascorbic acid content of immature drumstick pods with the mean values of ascorbic acid ranged from 33.33±4.71 to 100.83±0.59 mg/100g. Sauteing resulted in lowest retention of ascorbic acid of drumstick pods as 28.16% i.e. 33.33mg/100g. Pressure cooking was found to retain maximum ascorbic acid as 85.19% (100.83mg/100g) which was comparable to microwave cooking as 83.78% (99.16mg/100g). Boiling and blanching resulted in only 38.72% and 51.40% retention of ascorbic acid respectively. Deol (2009) reported ascorbic acid retention in pressure cooking and boiling of seeds of cow pea pods as 56.32 and 47.38% respectively. Punia *et al* (2008) reported 50.23 and 44.37% losses in ascorbic acid during frying of cow pea and French beans with spices respectively.

Mineral content: The effect of cooking methods on iron and calcium content of immature drumstick pods are presented in Table 2 and Fig. 2.

Table 2: Effect of cooking methods on iron and calcium content of drumstick pods (on dry weight basis)

Cooking methods	Iron (mg/100g)	% Retention	Calcium (mg/100g)	% Retention
Fresh drumstick pods	2.65±0.18	100	50±0.57	100
Boiling	2.02±0.02	76.60	32±0.31	64
Blanching	2.12±0.01	80.38	39±0.12	78
Pressure cooking	2.31±0.02	87.17	40±0.27	80
Microwave cooking	2.25±0.01	84.09	44±0.31	88
Sauteing	2.57±0.18	96.98	47±0.34	94
F –ratio	2.63		1.18	
CD	NS		NS	

Values are presented as Mean ± SE

NS-non significant

**Significant at 1% level of significance

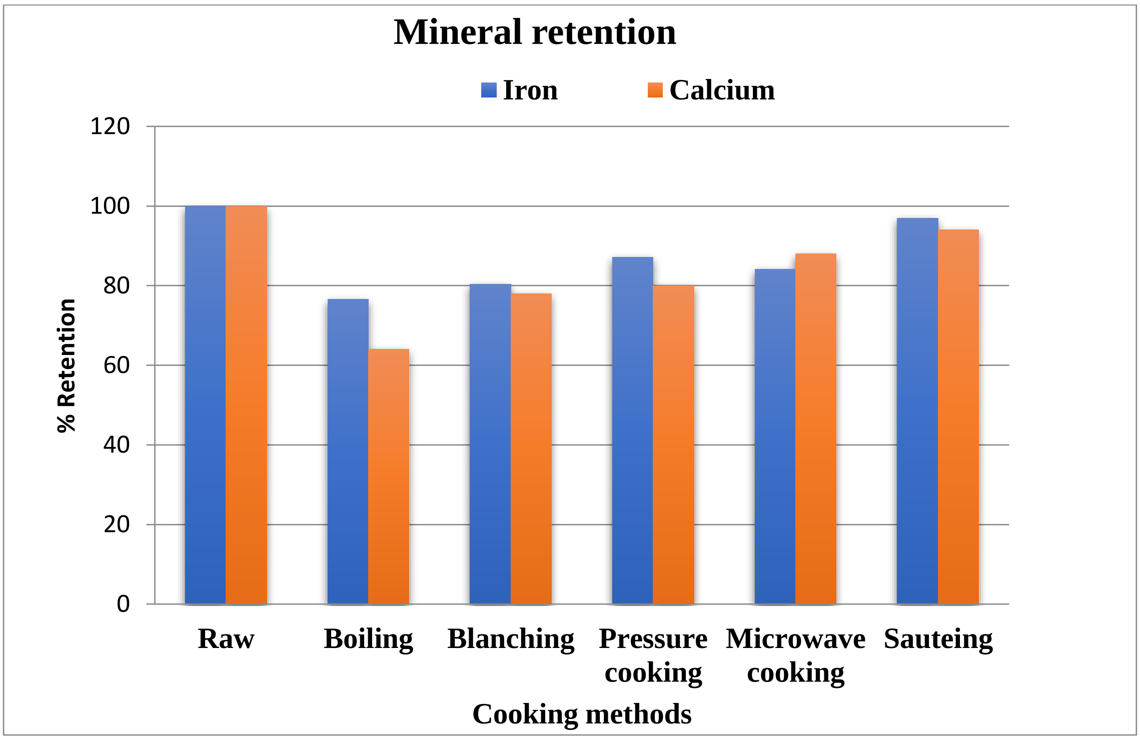

Fig. 2: Effect of cooking methods on percent retention of iron and calcium in drumstick pods (on dry weight basis)

Iron: The results of present study revealed that immature drumstick pods contain 2.65mg/100g iron on dry matter basis. Bosch (2004) and Longvah *et al* (2017) reported the iron content in mature drumstick pods as 0.4 and 0.73mg/100g respectively. Application of cooking methods resulted in non-significant reduction in iron content of drumstick pods. In all the cooking methods, iron content of drumstick pods varied from 2.02±0.02mg/100g to 2.57±0.18mg/100g. Sauteing resulted in higher retention (96.98%) of iron in drumstick pods. However, boiling resulted in lower retention (76.60%) of iron which may be due to more leaching of minerals in cooking water. Pressure cooking was found to retain 87.17% iron in immature drumstick pods followed by microwave cooking (84.09%) and blanching (80.38%). Similar to this study, Deol (2009) reported non-significant difference in cooking methods for retention of iron in seeds of cow pea pods as 86.23, 79.46 and 83.90% in pressure cooking, boiling and microwave cooking respectively.

Calcium: The calcium content of immature drumstick pods was 50±0.57mg/100g on dry matter basis. Tee *et al* (1984) reported only 22.4mg/100g calcium content in fresh drumstick pods. Application of cooking methods resulted in non-significant changes in calcium content of drumstick pods. It may be due to the fact that immature drumstick pods contain low amount of calcium. Boiled drumstick pods contain lowest amount of calcium as 32±0.31mg/100g (64% retention) while shallow fried pods had highest retention of calcium as 94% retention with the mean value of 47±0.34mg/100g. Microwave cooking resulted in 88% retention of calcium as 44±0.31mg/100g. Pressure cooking and blanching were found to retain similar amount of calcium as 40±0.27 and 39±0.12mg/100g respectively. The results of present findings are in line with Deol (2009) who reported the percent retention of calcium in pressure cooking, boiling and microwave cooking of seeds of cow pea pods as 82.53, 76.45 and 73.74 respectively. Bedi (2004) also reported that microwave cooking retained more calcium in commonly consumed vegetable preparations as compared to boiling.

Antinutritional factors: The effect of cooking methods on antinutritional factors of immature drumstick pods are presented in Table 3 and Fig. 3.

Phytin phosphorus: The results revealed that the phytate content of fresh immature drumstick pods was 152.49mg/100g on dry matter basis. Longvah *et al* (2017) reported 85.74 mg phytin phosphorus in 100g fresh mature drumstick pods on fresh weight basis. Application of cooking methods resulted in significant changes ($p \leq 0.01$) in phytate content of immature drumstick pods. The decrease of phytates in immature drumstick pods ranged from 1.69 to 13.78% in different cooking methods. In sauteing, minimum decrease of phytates i.e. 1.69% was observed in immature drumstick pods with the mean value of 149.68±0.89mg/100g. In wet cooking methods, the minimum percent reduction of phytates was found in blanching and microwave cooking as 2.58 and 9.09% respectively. With 12.96% losses, the phytate content of pressure-cooked pods was 132.52±1.41mg/100g. Maximum phytate reduction was seen in boiling as 13.78% with the mean value of 131.28mg/100g. The results of present study are in line with Deol

(2009) who reported that the average percent losses of phytates in pressure cooking, microwave cooking and boiling were 13.77, 16.11 and 20.54 respectively.

Table 3: Effect of cooking methods on antinutritional factors of drumstick pods (on dry weight basis)

Cooking methods	Phytin phosphorus (mg/100g)	% Decrease	Total phenols (mg/100g)	% Increase	Oxalates (mg/100g)	% Decrease
Fresh drumstick pods	152.49±0.67	-	152.46±4.90	-	594±19.09	-
Boiling	132.28±0.72	13.78	197.50±0.81	29.45	315±12.73	46.97
Blanching	148.31±0.08	2.58	189.42±1.63	24. 24	477±12.73	19.69
Pressure cooking	132.28±1.41	12.96	210.21±1.66	37.90	319.5±9.54	46.21
Microwave cooking	138.42±0.44	9.09	224.07±1.63	46.97	351±6.37	40.91
Sauteing	149.68±0.89	1.69	176.71±0.81	15.90	571.5±15.91	3.79
F –ratio	70.47**	-	57.45**	-	44.96**	-
CD	13.734	-	11.541	-	65.466	-

Values are presented as Mean ± SE

**Significant at 1% level of significance

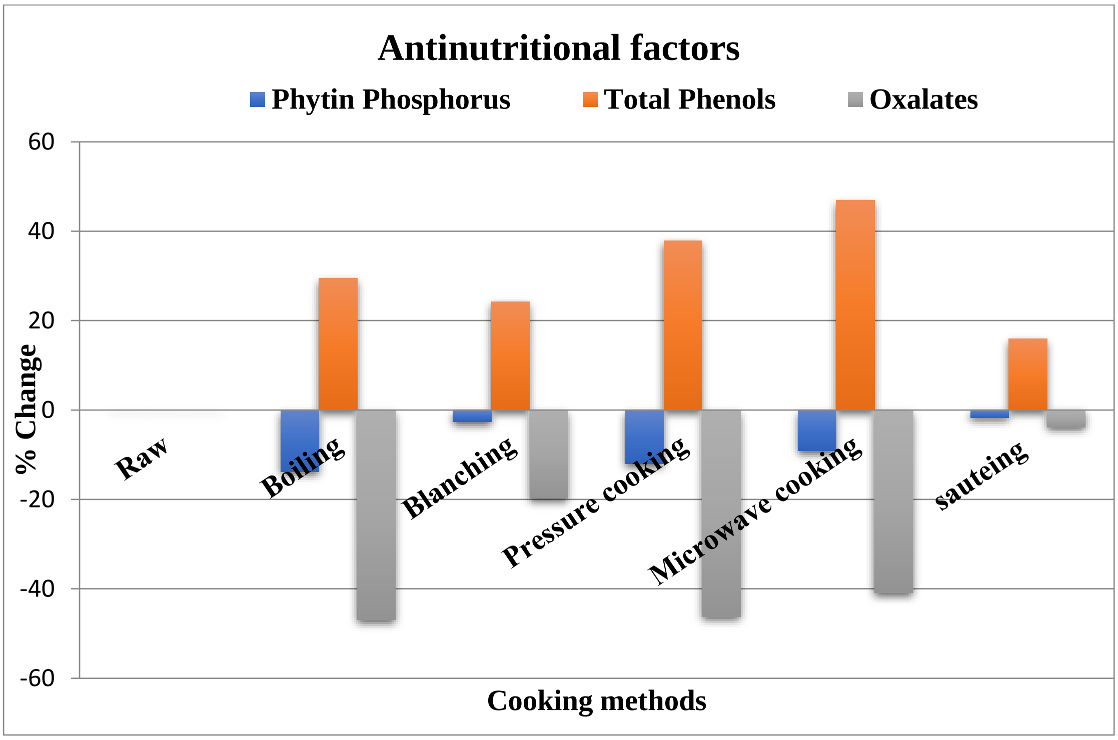

Fig. 3: Effect of cooking methods on percent decrease in phytin phosphorus, total phenols and oxalates content of drumstick pods (on dry weight basis)

Total phenols: The results of present study revealed that immature drumstick pods contain 152.46mg/100g total phenols as tannic acid equivalent. After applying cooking methods, a significant increase ($p \leq 0.01$) in total phenols was observed in immature drumstick pods. It may be due to release of more phenolic compounds during initiation of heating. Percent increase in cooked drumstick pods ranged from 15.90 to 46.97% in different cooking methods being minimum for sauteing and maximum in microwave cooking. Pressure cooking of drumstick pods resulted in 37.90% increase in drumstick pods followed by boiling and blanching as 29.45 and 24.24% respectively. Similar to present findings, Kaur (2012) reported the average percent increase in total phenols of broccoli, cabbage and capsicum in microwave cooking, boiling and stir frying were 21.73, 46.83 and 10.4 respectively.

Oxalates: The results revealed that the oxalates content in fresh immature drumstick pods was 594mg/100g on dry matter basis. Longvah *et al* (2017) reported 123mg/100g oxalates as organic acids in mature drumstick pods on fresh weight basis. Application of cooking methods resulted in significant difference ($p \leq 0.01$) in oxalates content of immature drumstick pods which ranged from 315±12.73 to 571.5±15.91mg/100g. Minimum decrease in oxalates content was seen in sauteing of drumstick pods as 3.79%. In blanching, the loss in oxalates content of drumstick pods was found as 19.69%. However maximum reduction of oxalates in drumstick pods as 46.97% was found in boiling followed by 46.21% in pressure cooking. Microwave cooked drumstick pods was found to have 351±6.37mg oxalates as 40.91% retention. More decrease in oxalates in wet cooking methods may be due to more extraction of soluble oxalates in cooking water. Kumar *et al* (2006) reported that blanching of green beans resulted in 13.24% losses in oxalates of green beans on wet weight basis.

As conclusion, all the cooking methods were found to decrease nutrients and antinutritional factors of immature drumstick pods except total phenols. The total phenols increased due to release of more phenolic compounds in short duration cooking. Different cooking methods resulted in significant changes ($p \leq 0.01$) in vitamin content and antinutritional factors of drumstick immature pods. A non-significant retention was found in iron and calcium content of immature drumstick pods in different cooking methods. In all cooking methods, sauteing resulted in higher retention of β-carotene, iron and calcium in drumstick immature pods. However, sauteing also retained minimum antioxidants compounds as ascorbic acid and total phenols with maximum retention of antinutritional factors. However, the consideration of oxalates as organic acid and phenols as antioxidants also increases the phytonutrient profile of immature drumstick pods.

Among wet cooking methods, boiling was found to have less retention of nutrients as well as antinutritional factors. Blanching, microwave cooking and pressure cooking were found in similar range for retention of β-carotene and iron content. Ascorbic acid retention was highest in pressure cooking followed by microwave cooking and blanching. It may be due to less oxidation of ascorbic acid in cover lid cooking under pressure. Microwave cooking resulted in maximum retention of calcium in drumstick pods followed by pressure cooking and blanching. More losses of antinutritional factors as oxalates and phytates were observed in pressure cooking compared to blanching and microwave cooking. Microwave cooking was found to increase more phenols as compared to all cooking methods. Microwave cooking resulted in better retention of nutrients as well as antinutritional factors in drumstick pods. As overall, pressure cooking was found superior in conserving nutrients as well as reducing antinutritional factors of drumstick pods compared to other cooking methods.

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