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Effect of different pre-treatment on nutritional and sensory qualities of cassava chips

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Abstract
Fresh cassava tubers (*Manihot esculenta* C.) were processed into dried chips. The proximate composition and physico-chemical properties were determined. This study was aimed to evaluate the effect of pre-treatments on chemical composition and sensory characters. Physical (blanching) and chemical (1% salt and 0.5% citric acid soaking for 20 minutes) treatments were done to cassava slices followed by drying at 60°C. In the present investigation, treatment T_2 (blanching for 5 minutes) obtained the beneficial characters like maximum recovery (38.17%), minimum dehydration ratio (2.62), rehydration ratio (2.52) non enzymatic browning (0.05) low moisture content (6.47%), water activity ($0.16a_w$), minimum non enzymatic browning (0.05OD) and treatment T_6 found maximum for dry matter (42.40) and ash content (1.46%).Whereas, result of sensory evaluation reveals that treatment T_2 found highest score for colour and appearance, taste, mouth feel and overall acceptability and for texture T_6 found maximum score. Our study concludes that blanching for five minutes helps in retention of nutritional and sensory characters.

Keywords: Cassava, dried chips, physic-chemical, blanching, sensory

Introduction
Cassava (*Manihot esculenta* Crantz.) is the fifth most important crop grown globally after wheat, rice, maize and potato and is considered as staple food in many developing and developed countries. Fresh cassava tubers cannot be stored for long because they rot within 48 h of harvest. They are bulky with about 70% moisture content. Therefore cassava must be processed into various forms in order to increase the shelf life of the products, facilitate transportation and marketing, reduce cyanide content and improve palatability. The nutritional status of cassava can also be improved through fortification with other protein-rich crops. Processing reduces food losses and stabilizes seasonal fluctuations in the supply of the crop. Traditionally, cassava roots are processed by various methods into numerous products and utilized in various ways according to local customs and preferences. Traditional cassava processing methods in use in Africa probably originated from tropical America, particularly north-eastern Brazil and may have been adapted from indigenous techniques for processing yams. The processing methods include peeling, boiling, steaming, slicing, grating, soaking or seeping, fermenting, pounding, roasting, pressing, drying, and milling (Onyenwoke and Simonyan, 2014) [11].

Material and Methods
The investigation was carried out during 2017-18 at K. R. C. College of Horticulture Arabhavi. The experiment was laid in completely randomized design. Cassava genotype (TCMS-1) was used for the experiment with different pre-treatments (physical and chemicals). Observations were recorded viz, recovery, dehydration ratio, rehydration ratio, reconstitution ratio were calculated by using the formula, non-enzymatic browning was done by using spectrophotometer, dry matter was carried out by microwave oven instrument, moisture content was estimated by moisture analyser, water activity by digital water activity meter, ash content was done by using muffle furnace, β-carotene was measured using petroleum ether by spectrophotometer method estimation were done according to Ranganna (1986) [15] and Srivastava, and Kumar (2002) [19]. Sensory evaluation was carried out by panel members using nine point hedonic scale.

Methodology for preparation of cassava chips

The selected cassava tubers were cleaned by removing adhered soil particles by washing. Outer skin was removed by using hand peeler. Peeled tubers were sliced into uniform size of approximately 2 mm thickness using a motorized slicer. They were weighed and treated to according to the set pre-treatments. They were dried at 60 °C in air convection tray drier for 24 hours. The slices were packed and further used for frying. Dried slices were fried in refined oil and chips were sprinkled with salt and chilli powder evenly and subjected to organoleptic evaluation.

Result and Discussion

Recovery (%)

As evident from the mean values of recovery of slices, it indicated that there was a significant influence of different pre-treatments on recovery of the slices. There was a significant difference in the recovery percentage of dehydrated cassava slices in Table 1. Treatment T_2 (Blanching for 5 minutes) showed highest recovery of chips (38.17%) which was followed by treatment T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) with recovery (35.50%). The increase in recovery was due to the positive action of blanching on the overall recovery. This result was found in line with studies of Jeevan *et al.* (2016) [5] in sweet potato. The treatment with lowest recovery (25%) was treatment T_1 (control). This mainly due to without any pre-treatments led to disintegration of the cells therefore reducing the recovery of quality slices (Pavlos *et al.*, 2011) [12].

Dehydration Ratio

As evident from the mean values of dehydration ratio of slices, it indicated that there was a significant influence of different pre-treatments on dehydration ratio of slices. There was a significant difference in the dehydration ratio of dehydrated cassava slices. Treatment T_2 (Blanching for 5 minutes) showed lowest dehydration ratio of slices (2.62) which was followed by treatment T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) with recovery (2.81). While treatment T_1 (control) showed highest dehydration ratio (4.00). Wherever, the recovery was found higher, dehydration ratio was lower which indicated the inverse relation between the recovery percent and its dehydration ratio. The similar findings are reported by Sagar *et al.* (1997) [16] in carrot and Suman and Krishnakumari (2002) [20] in carrot (Table 1).

Rehydration Ratio

The results revealed that, the different pre-treatments imposed to cassava slices affected on rehydration ratio of chips significantly. Treatment T_2 (Blanching for 5 minutes) recorded minimum rehydration ratio of chips (2.52) which was followed by treatment T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) with rehydration ratio (2.93). Similarly treatment T_1 (control) showed maximum rehydration ratio (3.60). The quick and high rehydration capacity of dried commodities indicated their better quality as reported by Rajeshwari *et al.* (2011) [14] in case of leafy vegetables. Similar results were also reported by Krokida and Phillippopoulos (2005) [8] in sweet potato (Table 1).

Reconstitution Ratio

The data revealed that the different pre-treatments had a non-significant effect on reconstitution ratio of slices (Table 2)

Non-enzymatic browning (OD value)

The results revealed that, the different pre-treatments imposed to slices affected on non-enzymatic browning of slices significantly. Treatment T_2 (Blanching for 5 minutes) recorded minimum non-enzymatic browning of slices (0.05) which was followed by treatment T_7 (Blanching for 5 minutes + dipping in 0.5% citric acid solution for 20 minutes) with non-enzymatic browning (0.11). While treatment T_1 (control) showed maximum non-enzymatic browning (0.23). Several factors such as temperature, moisture, organic acids, water activity, oxygen and sugars have been reported to be responsible for causing non-enzymatic browning in dehydrated products as reported by Sharma *et al.* (2000) [18] in apricot (Table 2).

Dry Matter (%)

As evident from the mean values of dry matter of slices, it indicated that there was a significant influence of different pre-treatments on dry matter content of the slices. Dry matter content relates to good cooking qualities and extended storage life as it indirectly indicates presence of moisture Maximum dry matter content of cassava slices (42.40%) was observed in T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) revealed which was followed by treatment T_2 (Blanching for5 minutes) with dry matter (40.07%). Similarly, minimum dry matter (27.77) was found treatment T_1 (control). This might be due to treatment blanching with salt which reduces the sugar content in dehydrated chips there by increases the dry matter content in dehydrated products. Similar results reported were by Krokida and Phillippopoulos (2005) [8] in sweet potato (Table 2).

Moisture (%)

As evident from the mean values of moisture content of slices, it indicated that there was a significant influence of different pre-treatments on moisture of the slices. Treatment T_2 (Blanching for 5 minutes) revealed minimum moisture content of chips (6.47%) which was followed by treatment T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) with moisture (6.73%). The treatment with maximum moisture (15.67%) was found in treatment T_1 (control). It is necessary to dry the product in a short time in order to obtain product with desirable moisture content. Further, blanching had shown significant effect on the texture, hence letting uniform drying of the chips and reduction in moisture content. Similar results were reported by Pavlos *et al.* (2011) [12] and Jeevan (2015) [6] in sweet potato (Table 2).

Water Activity

As evident from the mean values of water activity of slices, it indicated that there was a significant influence of different pre-treatments on water activity of the chips. Treatment T_2 (Blanching for 5 minutes) recorded minimum water activity of slices (0.16) which was followed by treatment T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) with water activity (0.18). The treatment with maximum water activity (0.32) was showed in treatment T_1 (control). Water activity is an intrinsic product characteristic feature and it is free bounded moisture present in the product (Phisut *et al.*, 2013) [13]. Water activity plays an important role in the physical properties such as texture and shelf life of foods. The blanching allowed uniform drying of chips and resulted in lower water activity in chips. Similar results were observed by Krishnakumar and Vishwanath (2014) [7] in potato chips and in sweet potato chips (Jeevan, 2015) [5] (Table 3).

Ash (%)

The results as evident from the mean values revealed that the amount of ash content of dehydrated slices significantly varied with the treatments. The highest total ash contents (1.47% and 1.25%) were obtained from T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes) and T_7 (Blanching for 5 minutes + dipping in 0.5% citric acid solution for 20 minutes) and lowest ash content (0.41%) was found in treatment T_1 (control). Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides the total amount of minerals within the food (Shahnawaz *et al.*, 2009) [17]. Similar results were reported by Nafeesa *et al.*, 2012 [10] in potato and Abano *et al.,* 2011 [1] in sweet potato (Table 3).

β-carotene (μg/100g)

The results as evident from the mean values revealed that the amount of β-carotene content from the chips significantly varied with the treatments. The maximum β-carotene contents (0.79μg/g and 0.73μg/g) were obtained from T_8 (Blanching for 5 minutes + dipping in 1% salt solution + 0.5% citric acid for 20 minutes) and T_7 (Blanching for 5 minutes + dipping in 0.5% citric acid solution for 20 minutes). Minimum β-carotene content was obtained (0.35 mg/g) from T_1 (Control). Degradation of β-carotene increases with increase in drying temperature of dehydrated cassava slices. Blanching of carrot slices before dehydration resulted in higher retention of β-carotene. The present findings are supported by Sagar *et al.* (1997) [16], Charanjit and Kapoor (2001) [4] in french bean and carrot and Machewad *et al.* (2003) [9] in carrot (Table 3).

Sensory evaluation of fried chips

Drying extends the shelf life, reduces weight, preserves the product and provides convenience with respect to package, storage and transportation. In the present investigation of fried cassava chips, the maximum scores for color and appearance, mouth feel, taste and overall acceptability (8.00, 7.23, 8.00 and 7.23 respectively) were obtained with the treatment T_2 (Blanching for 5 minutes), Similarly the highest score for texture (8.17) were obtained with the treatment T_6 (Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes). Core Whereas, lowest score recorded for all sensory characters by treatment T_1 (Figure 1).

Frying of foods is one of the most common processing techniques throughout the world. It provide acceptable quality attributes although it is considered as a healthy alternative for baking process due to its potential to provide texture and colour with existence of less oil (Tuta and Palazoglu. 2017) [21]. The results might be attributed to the beneficial effects of blanching, citric acid and salt on the above mentioned parameters. Similar results were reported by Akpapunam and Abiante (1991) [2], Aurelie *et al.* (2011) [3] in sweet potatoes.

Conclusion

As evident from the overall assessment it can be concluded that, the pre-treatments T_2 (blanching for 5 minutes) and T_6 (blanching for 5 minutes + soaking 1% salt for 20 minutes) were found nutritionally and organoleptically best pre-treatment among all based on the qualities like high recovery, low water activity, moisture, non-enzymatic browning, *etc.*

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Table 1: Effect of different pre-treatments on recovery, dehydration ratio and rehydration ratio of cassava slices

Treatments	Recovery (%)	Dehydration ratio	Rehydration ratio
T_1: Control	25.00	4.00	3.60
T_2: Blanching for 5 minutes	38.17	2.62	2.52
T_3: Dipping in 1% salt solution for 20 minutes	32.50	3.07	3.11
T_4: Dipping in 0.5% citric acid for 20 minutes	28.50	3.37	3.43
T_5: Dipping in 1% salt solution + 0.5% citric acid for 20 minutes.	30.17	3.31	3.18
T_6: Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes	35.50	2.81	2.93
T_7: Blanching for 5 minutes + dipping in 0.5% citric acid solution for 20 minutes	34.33	2.89	3.07
T_8: Blanching for 5 minutes + dipping in 1% salt solution + 0.5% citric acid for 20 minutes	34.83	2.87	3.07
Mean	32.38	3.12	3.11
S.Em±	0.43	0.07	0.17
C.D. @ 1%	1.31	0.22	0.53

Table 2: Effect of different pre-treatments on reconstitution ratio, non-enzymatic browning dry matter and moisture content of cassava slices

Treatments	Reconstitution ratio	Non enzymatic browning (OD)	Dry matter (%)	Moisture (%)
T_1: Control	0.90	0.23	27.77	15.67
T_2: Blanching for 5 minutes	0.96	0.05	40.07	6.47
T_3: Dipping in 1% salt solution for 20 minutes	1.01	0.13	36.11	7.27
T_4: Dipping in 0.5% citric acid for 20 minutes	0.98	0.18	31.66	7.60
T_5: Dipping in 1% salt solution + 0.5% citric acid for 20 minutes.	1.00	0.66	33.51	8.07
T_6: Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes	1.04	0.39	42.40	6.73
T_7: Blanching for 5 minutes + dipping in 0.5% citric acid solution for 20 minutes	1.06	0.11	38.33	7.87
T_8: Blanching for 5 minutes + dipping in 1% salt solution + 0.5% citric acid for 20 minutes	1.07	0.10	38.70	10.80
Mean	1.00	0.23	35.85	8.81
S.Em±		0.11	0.75	0.33
C.D. @ 1%	NS	0.35	2.25	0.99

(OD: Optical density)

Table 3: Effect of different pre-treatments on water activity, ash and beta-carotene of cassava chips

Treatments	Water activity	Ash (%)	Beta-carotene (µg/g)
T_1: Control	0.32	0.41	0.35
T_2: Blanching for 5 minutes	0.16	1.20	0.68
T_3: Dipping in 1% salt solution for 20 minutes	0.27	1.08	0.53
T_4: Dipping in 0.5% citric acid for 20 minutes	0.23	0.77	0.41
T_5: Dipping in 1% salt solution + 0.5% citric acid for 20 minutes.	0.28	0.42	0.63
T_6: Blanching for 5 minutes + dipping in 1% salt solution for 20 minutes	0.18	1.47	0.73
T_7: Blanching for 5 minutes + dipping in 0.5% citric acid solution for 20 minutes	0.24	1.25	0.60
T_8: Blanching for 5 minutes + dipping in 1% salt solution + 0.5% citric acid for 20 minutes	0.21	0.71	0.79
Mean	0.24	0.91	0.59
S.Em±	0.02	0.24	0.05
C.D. @ 1%	0.08	0.72	0.15

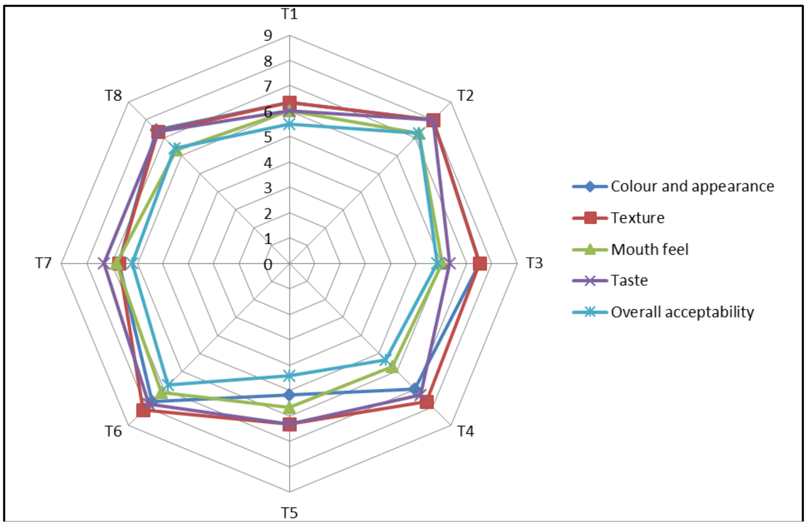

Fig 1: Effect of different pre-treatments on colour and appearance, texture, mouth feel, taste and overall acceptability of cassava slices

Reference

1. Abano EE, Ma H, Qu W. Effects of pre-treatments on the drying characteristics and chemical composition of garlic slices in a convective hot air drier. Journal of Agricultural Food Technology. 2011; 1(5):50-58.
2. Akpapunam MA, Abiante DA. Processing and quality evaluation of sweet potato chips. Plant Food Human Nutritrion. 1991; 41:291-297.
3. Aurelie B, Andrew W, Geoffrey M, Keith IT. Effect of pre treatments for retaining total carotenoids in dried and stored orange-fleshed-sweet potato chips. Journal of Food Quality. 2011; 34:259-267.
4. Charanjit K, Kapoor HC. Effect of Different Blanching Methods on the Physico-chemical Qualities of Frozen French Beans and Carrots. Journal of Food Science Technology. 2001; 38(1):65-67.
5. Jeevan R, Naik KR, Kukanoor L. Studies on processing of sweet potato (*Ipomoea batatas* L.). National conference on tuber crops, CTCRI, Thiruvananthapuram (India), 2016.
6. Jeevan R. Studies on processing of sweet potato (*Ipomoea batatas* L.). M. Sc. Thesis, University of Horticultural Science. Bagalkot, Karnataka (India) 2015.
7. Krishnakumar T, Vishvanathan R. Acrylamide in food products: A Review. Journal of Food. Processing Technology. 2014; 5(7):1-9.
8. Krokida MK, Philippopoulos C. Rehydration of dehydrated foods. Drying Technology. 2005; 23(4):799-830.
9. Machewad GM, Kulkarni DN, Pawar D, Surve VD. Studies on dehydration of carrot (*Daucus carota* L.). Journal of Food Science Technology. 2003; 40(4):406-408.
10. Nafeesa A, Kolawole OF, John OA. Effect of cultivar on quality attributes of sweet potato fries and crisps. Food Nutrition and Science. 2012; 3:224-232.
11. Onyenwoke CA, Simonyan KJ. Cassava post-harvest processing and storage in Nigeria: A review. African Journal of Agricultural Research. 2014; 9(53):3853-3863.
12. Pavlos T, Angelos D, Jeffrey KB. Hot water treatment and pre-processing storage reduce browning development in fresh-cut potato slices. Horti Science 2011; 46(9):1282-1286.
13. Phisut N, Rattanawedee M, Aekkasak K. Effect of osmotic dehydration process on the physical, chemical and sensory properties of osmo-dried cantaloupe. International Journal of Food Research. 2013; 20(1):189-196.
14. Rajeswari P, Bharati P, Naik NR, Johri S. Value addition to amaranthus green herbage through dehydration and drying. Research Journal of Agriculture Science. 2011; 2:348-350.
15. Ranganna S. Manual of Analysis of Fruits and Vegetable products. Tata Mc Graw Hill Publishing Co. Ltd, New Delhi, 1986, 1-13.
16. Sagar VR, Maini SB, Rajesh K, Netra P. Studies on sun drying of carrots. Vegetable Science. 1997; 24(1):64-66.
17. Shahnawaz M, Sheikh SA, Nizamani SM. Determination of nutritive value of Jamun fruit (*Euginea jambolana* L) products. Pakistan Journal of Nutrition. 2009; 8:1275-1280.

18. Sharma KD, Kumar R, Kaushal BBL. Effect of packaging on quality and shelf life of osmo air dried apricot. Journal of Scientific and Industrial Research. 2000; 59:949-954.
19. Srivastava RP, Kumar S. Fruit and Vegetable Preservation: Principles and practices, 3rd edition CBS publishers, Uttar Pradesh, 2002.
20. Suman M, Krishnakumari K. A study on sensory evaluation, β-carotene retention and shelf-life of dehydrated carrot products., Journal of Food Science Technology. 2002; 39(6):677-681.
21. Tuta S, Palazoglu TK. Effect of baking and frying methods on quality characteristics of potato chips.