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Influence of chemical pre-treatments on biochemical and sensory qualities of dried and fried sweet potato (*Ipomoea batatas* L.) chips

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Abstract
Drying method is commercially accepted and economic of the raw and intermediate sweet potato products to preserve by reducing the bulk weight. Pre-treatment is an essential step before processing of food materials. Many researchers have investigated the effect of different pre treatments on various fruits, vegetables and other foods for drying. In the present investigation, different pre-treatments were studied and different quality parameters of the dried and fried sweet potato chips were analyzed. The treatment T_8 (blanched pieces soaked in 0.5% sodium metabisulphite) recorded low non-enzymatic browning (0.103) and high ash content (1.50%). The treatment was acceptable with sensory scores of 8.73 for texture, 7.87 for taste and 7.97 for overall acceptability in case if dried chips, and sensory scores of 7.33 for texture, 7.50 for mouth feel, 7.67 for taste and 8.00 for overall acceptability in case of fried chips and hence selected as best one for preparation of fried and dried chips from sweet potato.

Keywords: chemical pre-treatments, biochemical, sensory qualities, sweet potato

Introduction
The processed products made from sweet potato not only compete with cereals, but also with each other's processed products in terms of market and raw material. Declining availability of rice, population growth, modest absolute income levels for large segments of consumers, and declining farm size will contribute to a growing use of fresh roots, and in certain areas, of leaves for human consumption. Sweet potato chips, flakes, flour and cubes are now gaining commercial importance due to their addition in various food preparations but there are some problems like browning of processed products, shrinkage of stored tubers, etc. The nutritional qualities of sweet potato which are important in meeting human nutritional needs include carbohydrates, vitamins, proteins, fiber and minerals like potassium and iron. Pre-treatment is an essential step before processing of food materials. The present study was undertaken with an objective to access the influence of chemical pre-treatments on biochemical and sensory qualities of dried and fried sweet potato chips.

Material and Methods
The present investigation was carried out in the laboratory Rashtriya Krishi Vikas Yojana (RKVY) research unit of the Department of Postharvest Technology, Kittur Rani Channamma College of Horticulture (University of Horticultural Sciences, Bagalkot), Arabhavi, Gokak Taluk and Belgaum district situated in northern dry zone (Zone-3) of Karnataka state at 16°15' north latitude, 74°45' east longitudes and at an altitude of 612.05 m above the mean sea level, during the period from 2016-17.

Selection and preparation of sweet potatoes for experiments
Representative even sized fresh sweet potatoes tuber of different varieties were procured from the research field of AICRP - Tuber crops, operating at Regional Horticulture Research and Extension Centre, Dharwad of Karnataka state. Tubers were well matured and free from damage of pest and disease infestation. Procured sweet potatoes were washed under running tap water to remove adhered soil; damaged and infected tubers were discarded and good tubers were dried under shade. Outer skin was removed by using hand peeler. Peeled tubers were sliced into uniform size of approximately two mm thickness using a hand 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 3 hours. The chips were packed and further used for frying. Dried slices were fired in refined oil and chips were sprinkled with salt and chilli powder evenly.

All the chemicals used in this investigation were of analytical grade and were procured from Thomas Baker Chemicals Ltd., Mumbai, Hi Media Laboratories, Mumbai and Loba Chemicals Co., Mumbai. Glucoamylase enzyme was obtained from Sigma Aldrich Laboratories, Bangalore.

Treatments

T_1: Control
T_2: Blanching
T_3: Soaking the chips in 0.1% citric acid
T_4: Soaking the chips in 0.5% sodium metabisulphite
T_5: Soaking the chips in 1% ascorbic acid
T_6: Soaking the chips in 10% salt solution
T_7: Blanching + soaking the chips in 0.1% citric acid
T_8: Blanching + soaking the chips in 0.5% sodium metabisulphite
T_9: Blanching + soaking the chips in 1% ascorbic acid
T_{10}: Blanching + soaking the chips in 10% salt solution

Note: (i) Blanching period: 5 min
(ii) Soaking period: 30 min
(iii) Drying in tray drier at 60 °C temperature

Non-enzymatic browning (OD value)

Non enzymatic browning was measured by using a spectrophotometer. Five grams of dried sweet potato slices / flour were soaked in 100 ml of 60 per cent alcohol for 12 hours (sample and alcohol in 1:5 ratios). Then it was filtered and absorbance was read at 420 nm using 60 per cent alcohol as blank. The readings displayed in the spectrophotometer was noted and expressed as optical density (OD).

Oil uptake (ml)

Oil uptake was calculated as a difference in weight of refined oil before and after frying the dried sweet potato slices. The difference in weight of oil was expressed as oil uptake in terms of ml. From each replication 50 grams of dried sweet potato chips were taken for frying.

Total ash content (%)

Ash content of the fresh sample of sweet potato tuber and powder formed after drying was determined by using muffle furnace. In test, two gram of sample was taken and was placed into a dried pre-weighed porcelain crucible, burning away the polymer in an air atmosphere at temperatures above 500 °C in a muffle furnace. The crucible was weighed after cooling to a room temperature in desiccators (AOAC, 1990) [2]. Ash content was estimated by using the following formula.

$$\text{Total ash content} = \frac{C - A}{B - A} \times 100$$

Where,
A - Weight of empty crucible
B - Weight of sample + crucible
C - Weight of sample after ashing

Organoleptic evaluation

Organoleptic evaluation of sweet potato chips and flour was carried out by a panel of judges. The sensory characters like colour and appearance, texture, taste, mouth feel and overall acceptability were evaluated on a nine point hedonic scale.

Results and Discussions

The observations on different parameters of chips and flour are discussed below.

Total ash content in chips (%)

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) [10]. In this study, the highest total ash contents (1.64% and 1.61%) were obtained from T_7 (blanched slices soaked in 0.1% citric acid) and T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) which were on par with each other. These treatments had highest recovery and higher dry matter, resulting in highest ash content, followed by T_3 (unblanched slices soaked in 0.1% citric acid), T_{10} (blanched slices soaked in 10% salt) and T_8 (blanched slices soaked in 0.5% sodium metabisulphite) with ash contents of 1.56, 1.52 and 1.50 per cent and were on par with each other. Similar results were reported by Abano *et al.*, 2011 [1] in sweet potato.

Non-enzymatic browning in chips (OD values)

Browning is one of the most important colour reactions that affect the quality of fruits and vegetables. This is mainly due to the presence of the enzyme Polyphenol Oxidase (Macheix *et al.*, 1991) [5]. Maintenance of the natural colour of the fruits and vegetables during drying and subsequent storage is another important quality parameter that determines acceptability of a product. Non-enzymatic browning (NEB) during processing is caused mainly by the reducing sugars and amino acids, which undergo Maillard reaction at high temperatures (Marquez and Anon, 1986) [6].

Table 1: Changes in biochemical constituents in sweet potato chips as influenced by chemical pre-treatments

Treatments	Dried chips		Fried chips
	Total ash content (%)	Non-enzymatic browning (OD values)	Oil uptake (%)
T_1	1.33	0.188	10.04
T_2	1.42	0.171	10.65
T_3	1.56	0.166	9.90
T_4	1.61	0.131	9.70
T_5	1.46	0.506	10.27
T_6	1.45	0.142	10.53
T_7	1.64	0.158	10.53
T_8	1.50	0.103	10.50
T_9	1.41	0.256	10.50
T_{10}	1.52	0.143	10.55
Mean	1.49	0.20	10.32
S.Em±	0.011	0.003	0.19
C. D. @ 1%	0.06	0.01	NS

NS: Non-significant

In present investigation, the lowest value (0.103) for non-enzymatic browning was recorded in T_8 (blanched slices soaked in 0.5% sodium metabisulphite) followed by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite), T_{10} (blanched slices soaked in 10% salt) and T_6 (unblanched slices soaked in 10% salt) with OD values of 1.131, 1.142 and 1.143 respectively. Whereas, least browning was recorded in T_8 which might be due to the effect of sodium metabisulphite pre-treatment and also blanching, which inactivates the enzymes and maintains the color. The results are in

confirmation with the investigation of Egwim *et al.* (2013) [3] who reported that sodium metabisulphite pre-treatment completely inhibited browning in the processed yam flour.

Oil uptake by the chips

The different pre-treatments didn't have any significant effect on oil uptake by the chips.

Sensory qualities of dried chips

The highest scores for color and appearance (8.73 and 8.67 respectively) were secured by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) and T_9 (blanched slices soaked in 1% ascorbic acid) which were on par with each other. The highest scores for texture (8.83 and 8.73 respectively) were secured by the T_9 (blanched slices soaked in 1% ascorbic acid) and T_8 (blanched slices soaked in 0.5% sodium metabisulphite) which were on par with each other. Similarly the highest scores for mouth feel (8.67 and 8.37 respectively) were obtained in treatment T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) and T_7 (blanched slices soaked in 0.1% citric acid). The highest score for taste (8.80) was obtained by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) followed by T_5 (unblanched slices soaked in 1% ascorbic acid) with score of 8.30. The highest score for overall acceptability (8.87) was obtained by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) which was followed by T_9 (blanched slices soaked in 1% ascorbic acid) with score of 8.20. These beneficial results might be attributed to the beneficial effects of sodium metabisulphite, ascorbic acid and blanching on the above mentioned parameters. Similar results were obtained by Jeevan *et al.* 2016 [4].

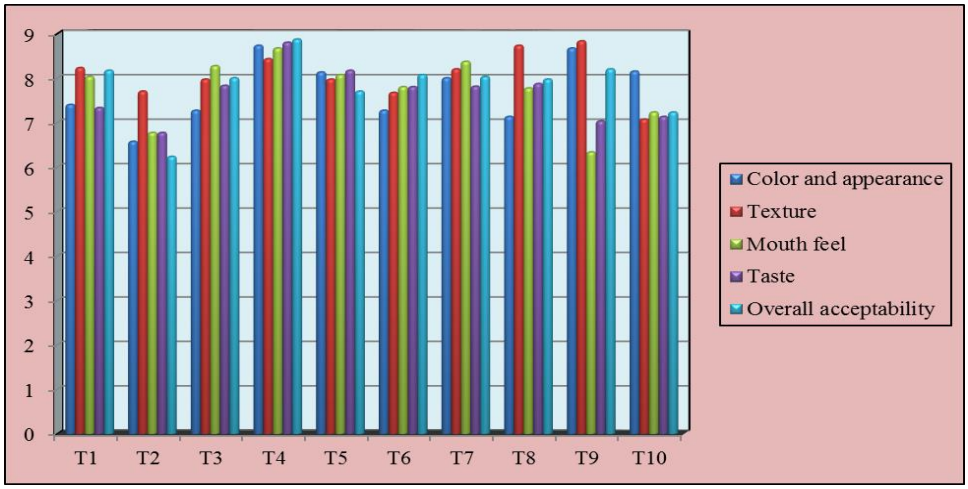

Fig 1: Sensory qualities if dried chips as influenced by chemical pre-treatments

Sensory qualities of fried chips

The maximum scores for color and appearance (7.75 and 7.67 respectively) were obtained by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) and T_{10} (blanched slices soaked in 10% salt). The highest score for texture (7.58) was obtained by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) which was on par with T_8 (blanched slices soaked in 0.5% sodium metabisulphite) with score of 7.33. The highest score for mouth feel (7.83) was obtained by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) which was on par with T_3 (unblanched slices soaked in 0.1% citric acid) with score of 7.5. The treatments T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) and T_3 (unblanched slices soaked in 0.1% citric acid) obtained highest scores (8.70 and 7.70) for taste. The maximum scores (8.35 and 8.00 respectively) were obtained by T_4 (unblanched slices soaked in 0.5% sodium metabisulphite) and T_8 (blanched slices soaked in 0.5% sodium metabisulphite). The favorable results might be attributed to the beneficial effects of sodium metabisulphite and salt as discussed by Jeevan *et al.* 2016 [4].

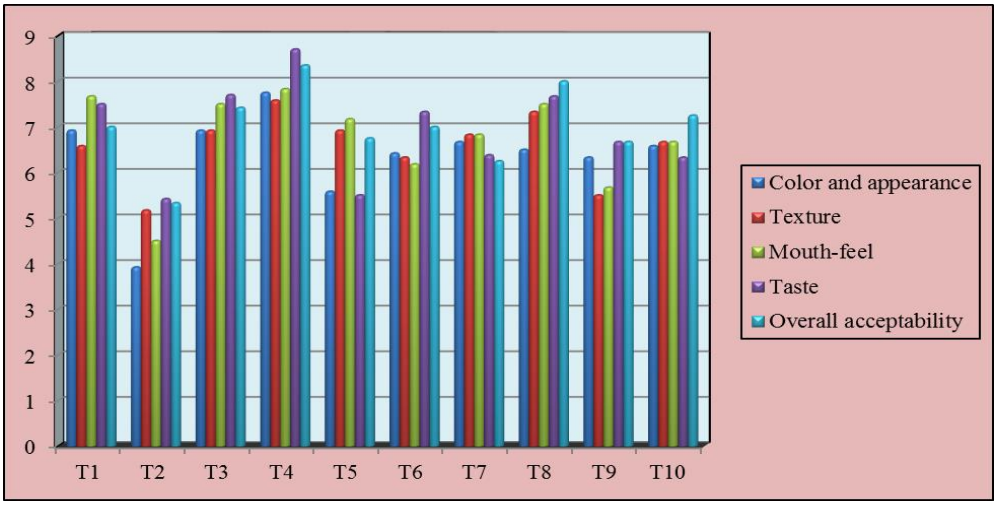

Fig 2: Sensory qualities if fried chips as influenced by chemical pre-treatments

Conclusion

As discussed above, the pre-treatments T_7 (blanched slices soaked in 0.1% citric acid) and T_8 (blanched slices soaked in 0.5% sodium metabisulphite) were selected as the best pre-treatments among all based on the qualities like low non-enzymatic browning, high total ash content and sensory scores in case of both dried and fried chips.

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