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RESEARCH ARTICLE

# EFFECT OF CHEMICAL PRE-TREATMENTS ON PROCESSING QUALITIES OF SWEET POTATO (*IPOMOEA BATATAS* L.)

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**ABSTRACT**

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 on different quality parameters of the chips and flour. The highest recovery of chips (22.20 %) and flour (22.60 %) was recorded in T7 (blanched slices soaked in 0.1% citric acid) and T8 (blanched pieces soaked in 0.5% sodium metabisulphite) respectively. Further the treatment T8 also recorded other beneficial characters like low moisture content (13.97), water activity (0.24), non-enzymatic browning (0.103). However, the treatment T4 (unblanched slices soaked in 0.5% sodium metabisulphite) had given beneficial results on sensory scores for texture (7.33) and overall acceptance (8.00) with chips and good quality parameters like color and appearance (8.92), taste and flavor (7.93) and overall acceptability (8.25) with floor. Hence the treatment T8 and T4 were proved to be the best ones for preparing chips and flour respectively.



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## INTRODUCTION

It has been reported that pre-treatments not only accelerate drying rate but also improve quality of dehydrated products by expelling intercellular air from the tissues, softening the texture, destroying the enzymes and microorganisms, or by dissociating the wax on the products skin and forming fine cracks in the skin (Jayaraman and Gupta, 2006). The chemical pre treatment could significantly accelerate the drying process and remarkably improve the quality of red peppers undergoing greenhouse and open sun drying (Gonzalez *et al*., 2008). The present investigation was carried out at Department of Post-harvest technology, Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak district of Karnataka state which is 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. Different chemical pre-treatments were imposed to determine the effect of chemical pre-treatments on processing qualities of sweet potato.

## MATERIALS AND METHODS

**Recovery of chips and flour (%):** It is the ratio of weight of dried sweet potato slices / flour to the weight of fresh sweet potato slices and per cent recovery of dried sweet potato slices and flour was calculated by using the following formula.

$$\text{Recovery (\%)} = \frac{\text{Weight of dried chips / flour}}{\text{Weight of fresh slices}} \times 100$$

**Water activity ($a_w$)**

Water activity of dried sweet potato samples was measured using a digital water activity meter. One fourth the volume of container was filled with dried chips or flour and it was closed with a lid containing sensor and left few minutes undisturbed. After stabilization the water activity was displayed by the digital water activity meter.

**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

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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). 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

## RESULTS AND DISCUSSION

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

**Recovery of Chips and flour**

In the present investigation, there was a significant difference in the recovery percentage of the chips. The treatment $T_7$ (blanched slices soaked in 0.1% citric acid) gave the highest recovery (22.20 %) which was on par with $T_8$ (blanched slices soaked in 0.5% sodium metabisulphite) with the recovery of 22.00 per cent. They were followed by $T_9$ (blanched slices soaked in 1 % ascorbic acid) and $T_4$ (unblanched slices soaked in 0.5% sodium metabisulphite) with recovery percentage of 20.00 and 19.50 per cent respectively which were on par with each other. The increase in recovery was due to the positive action of blanching and the chemicals like citric acid and sodium metabisulphite on the overall recovery. This result was found in line with studies of Jeevan *et al.* (2016). The treatment with lowest recovery (9.5%) in $T_2$ (blanched slices). The process of blanching without any pre-treatments led to disintegration of the cells therefore reducing the recovery of quality chips (Pavlos *et al.*, 2011). The treatment $T_8$ (blanched pieces soaked in 0.5% sodium metabisulphite) gave the highest recovery of flour (22.60 %) which was on par with $T_7$ (blanched pieces soaked in 0.1% citric acid) with the recovery of 22.43 per cent. The treatment $T_9$ (blanched pieces soaked in 1 % ascorbic acid) and $T_4$ (unblanched pieces soaked in 0.5% sodium metabisulphite) with recovery percentage of 20.10 and 20.03 per cent respectively were found next best but were on par. The results of lowest recovery (10.30%) recorded in $T_2$ (blanched slices). The results obtained were in confirmation with the results recorded by Akubor (2013).

**Moisture content of chips (%)**

It is desirable to dry the product in a short time in order to obtain product with desirable moisture content. In the present investigation, the lowest moisture content (13.97%) was recorded in $T_8$ (blanched slices soaked in 0.5% sodium metabisulphite) which was on par with $T_7$ (blanched slices soaked in 0.1% citric acid) with moisture contents of 14.00 per cent. 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) and Jeevan (2015) in sweet potato.

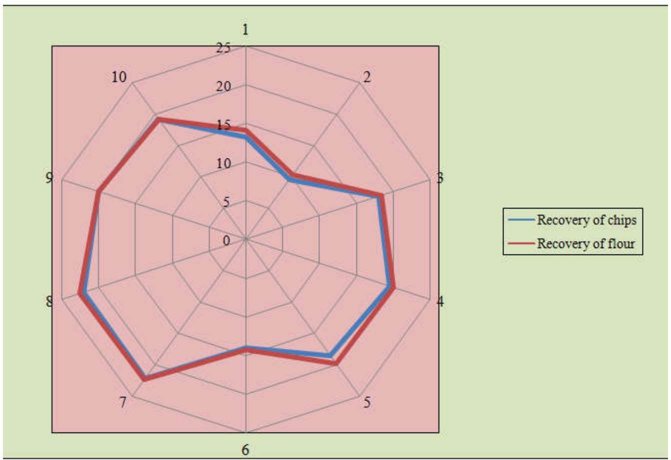


**Fig. 1. Recovery percentage of chips and flour**

**Water activity of chips ($a_W$)**

Water activity is an intrinsic product characteristic feature and it is free bounded moisture present in the product (Phisut *et al.*, 2013). Water activity plays an important role in the physical properties such as texture and shelf life of foods. In the present investigation the different pre-treatments had significantly different effect on water activity of chips. The lowest value for water activity (0.24) was noticed in $T_8$ (blanched slices soaked in 0.5% sodium metabisulphite) which was followed by $T_7$ (blanched slices soaked in 0.1% citric acid) and $T_3$ (unblanched slices soaked in 0.1% citric acid) with water activity value of 0.25 and 0.27 respectively. The blanching allowed uniform drying of chips and hence lower water activity in chips. Similar results were observed by Krishnakumar and Vishwanath (2014) in potato chips and in sweet potato chips (Jeevan, 2015).

**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). 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 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).

**Table 1. Post-harvest qualities of sweet potato chips as influenced by chemical pre-treatments**

| Treatments | Moisture content (%) | Water activity | Total ash content (%) | Non-enzymatic browning OD values) | Oil uptake (%) |
|---|---|---|---|---|---|
| $T_1$ | 18.40 | 0.39 | 1.33 | 0.188 | 10.04 |
| $T_2$ | 16.70 | 0.33 | 1.42 | 0.171 | 10.65 |
| $T_3$ | 14.30 | 0.27 | 1.56 | 0.166 | 9.90 |
| $T_4$ | 15.20 | 0.28 | 1.61 | 0.131 | 9.70 |
| $T_5$ | 16.20 | 0.32 | 1.46 | 0.506 | 10.27 |
| $T_6$ | 16.60 | 0.34 | 1.45 | 0.142 | 10.53 |
| $T_7$ | 14.00 | 0.25 | 1.64 | 0.158 | 10.53 |
| $T_8$ | 13.97 | 0.24 | 1.50 | 0.103 | 10.50 |
| $T_9$ | 15.90 | 0.29 | 1.41 | 0.256 | 10.50 |
| $T_{10}$ | 14.43 | 0.28 | 1.52 | 0.143 | 10.55 |
| Mean | 15.57 | 0.29 | 1.49 | 0.20 | 10.32 |
| S.Em± | 0.122 | 0.002 | 0.011 | 0.003 | 0.19 |
| C. D. @ 1% | 0.49 | 0.01 | 0.06 | 0.01 | NS |

NS: Non-significant

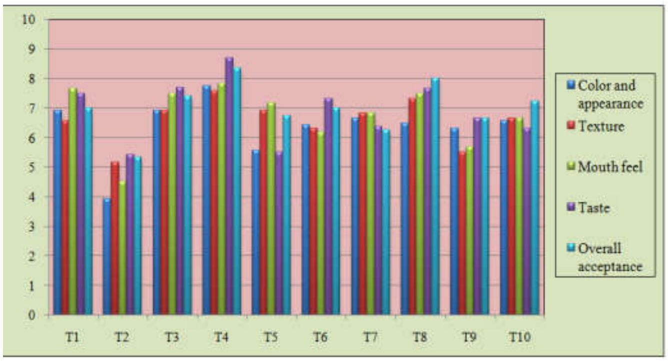


**Fig. 2. Sensory qualities of chips**

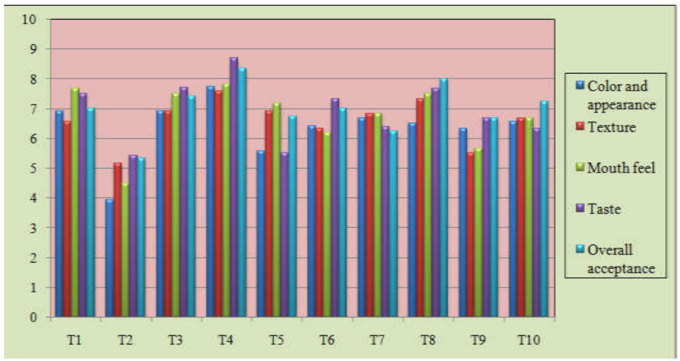


**Fig. 3. Sensory qualities of flour**

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). 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) 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 evaluation of sweet potato chips prepared using different pre-treatments**

Frying of foods is one of the most common processing techniques throughout the world. It is a simultaneous heat and mass transfer process where moisture leaves the food in the form of vapor bubbles, while oil is absorbed simultaneously (Lui *et al.,* 2005).

Moisture and oil content as well as colour and texture are important quality attributes of fried sweet potato products (Brigatto *et al.,* 2011). In the present investigation, the maximum scores for color and appearance (7.75), texture (7.58), mouth feel (7.83), taste (8.70) and overall acceptability (8.35) were obtained by $T_4$ (unblanched slices soaked in 0.5% sodium metabisulphite). It was followed by $T_8$ (blanched slices soaked in 0.5% sodium metabisulphite) with respect to texture (7.33) and overall acceptability (8.00). The favorable results might be attributed to the beneficial effects of sodium metabisulphite and salt as dicussed by Jeevan *et al.* 2016.

**Sensory evaluation of sweet potato flour prepared using different pre-treatments**

The result for sensory evaluation of flour was found similar to dehydrated chips as the flour was prepared by grinding the dehydrated chips. The treatment $T_4$ (unblanched pieces soaked in 0.5% sodium metabisulphite) secured highest score for color and appearance (8.92), for taste and flavor (7.83) and overall acceptability (8.25). The highest score for mouth feel (8.00) was obtained by $T_6$ (unblanched pieces soaked in 10% salt). The results might be attributed to the beneficial effects of sodium metabisulphite, salt, ascorbic acid and blanching on the above mentioned parameters. Similar results were reported by Aurelie *et al.* (2011) in sweet potatoes.

**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) for chips and the pre-treatment $T_4$ (unblanched pieces soaked in 0.5% sodium metabisulphite) for flour were selected as the best pre-treatment among all based on the qualities like high recovery, low water activity, moisture, non-enzymatic browning, etc.

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