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Influence of Ascorbic Acid on the Color of Dehydrated Sweet Potatoes

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Abstract

The objective was to evaluate the production yield and influence of the action of ascorbic acid on the color of dehydrated white and purple sweet potatoes produced in a semi-arid region. The experiment was carried out at the Laboratory of Technology of Products of Plant Origin (TPOV) of the State University of Montes Claros, Janáuba, Minas Gerais, Brazil. Sweet potato roots of the cultivars Brazlândia roxa and Brazlândia branco were used. To determine the action of ascorbic acid on the color of dehydrated white and purple sweet potato, a completely randomized design with 4 replications was used. Analysis of variance was performed in a 2 × 2 factorial scheme, with two cultivars (Roxa and Branca) and absence and presence of ascorbic acid. The results were submitted to statistical analysis using the Sisvar Software. The average yield of white potato was 23% and purple 18.41%. For the variable of soluble solids, no significant differences were observed between the varieties. The sweet potato cultivar Brazlândia Branca showed better yield when submitted to the drying process. The sweet potato cultivar Brazlândia, when submitted to the dehydration process, presented a more yellowish color, however, with less intense coloration in the presence of ascorbic acid.

Keywords: conservation, post-harvest, white potato, purple potato

1. Introduction

Vegetables are commonly consumed in natura, marketed in minimally processed, cooked, dehydrated forms, or used as ingredients in the industrial preparation of other products and, among vegetables, sweet potato stands out due to its excellent nutritional profile, being a source of vitamins, minerals and rich in dietary fiber.

Sweet potato is an excellent source of nutrients and energy, essential for human well-being (Miranda et al., 1989; Azevedo et al., 2002). Therefore, they need techniques that increase the shelf life of this root and guarantee food safety, in addition to maintaining the specific flavor (Oirschot et al., 2003).

With the change in food trends resulting from the routines of large cities, the commercialization of dehydrated sweet potato in the form of snacks meets the growing demand for practical foods with a high nutritional content.

It constitutes a source of energy and nutrients of great social and economic importance, participating in the supply of calories, vitamins and minerals in the human diet (Oliveira et al., 2013).

Harvest, post-harvest and storage losses can reach 30% to 40% of the lot in developing countries (Jayaraman & Gupta, 2014). In this context, dehydration stands out among the post-harvest conservation techniques, as it allows greater stability to the final product, reduces enzymatic and oxidative degradation, reduces transport costs and collaborates with the availability of the product at any time of the year (Silva et al., 2008). It can also be an alternative for the use of sweet potatoes, as well as adding value to the product, resulting in higher yields for the producer.

Although it has numerous advantages, food dehydration can change one of the most important sensory aspects for the consumer, the color of the product (Ribeiro & Seravalli, 2007). This sensory characteristic, although subjective, is fundamental in inducing the global sensation resulting from other characteristics such as the aroma and flavor of the food (Constant et al., 2002). In view of the above, the objective was to evaluate the production yield and influence of the action of ascorbic acid on the color of dehydrated white and purple sweet potato produced in a semi-arid region.

2. Method

The experiment was conducted at the Laboratory of Technology of Products of Plant Origin (TPOV). Sweet potato roots of the cultivars Brazlândia roxa and Brazlândia branco acquired in the experimental horticulture area of the same university were used. The experiment was set up 10 days after the potatoes were harvested.In the laboratory, the roots were selected, using as a selection parameter the state of maturation, bark, presence of wounds and rot.

The potatoes were washed in running water with the aid of a brush and detergent to remove dirt, then they were immersed in a solution of chlorinated water (200 ppm for 10 minutes) to satisfactorily remove the impurities. washing in running water to remove the chlorine, and with the aid of paper towels they were dried.

After drying, the potatoes were manually peeled with a tuber and vegetable peeler, weighed and sliced into slices approximately 2 mm thick, in the form of a snack. To determine the yield, the experiment was established in a completely randomized design, with eight replications for each variety of sweet potato, and the values were submitted to analysis of variance (ANOVA), at a 5% probability level by the F test ($p \leq 0.05$).

Drying took place in a dryer with forced air circulation (Pardal brand, model PE14), whose samples were arranged in trays (Figure 1) and kept at 65 °C for 24 hours. The dehydrated samples were left to cool in aluminum trays, packed in transparent low-density polyethylene bags, and stored at room temperature (25 °C), protected from light, for 10 days.

The yield of production was determined by the ratio between the mass of the samples in natura and after drying, determined in a semi-analytical balance. In order to correlate a quality parameter with the production yield of the product, a chemical analysis was carried out, which corresponded to the determination of the total soluble solids content (by direct reading in a digital refractometer).

Figure 1. Processing flowchart for obtaining dehydrated sweet potato

To determine the action of ascorbic acid on the color of dehydrated white and purple sweet potatoes, a completely randomized design was used with 4 replications (3 samples per replicate and 2 readings per sample). Analysis of variance was performed in a 2×2 factorial scheme, with two cultivars (Purple and White), and absence and presence of ascorbic acid. The results were submitted to statistical analysis using the Sisvar Software, in which the F Test ($p \leq 0.05$) applied the analysis of variance in order to observe significance.

After the potatoes were sliced, they were subjected to immersion treatment in a 1% ascorbic acid solution for 5 minutes. Thus, the treatments consisted of with and without antioxidant, for the two cultivars. Subsequently, they were drained, placed in trays taken in a dryer with forced air circulation (Pardal brand, model PE14), with drying temperature set at 65 °C for 24 hours.

The color of the dehydrated sweet potatoes was determined by the instrumental method at two points of each sample, using a digital colorimeter (Hunterlab brand, Colorflex model), using the standard D65 illuminant and an observer at 10° (CIELAB System), with determination of values L* (indicates luminosity), a* (indicates color variation from green to red) and b* (indicates color variation from blue to yellow) (Papadakis et al., 2000). With the values of a* and b*, the Hue angle was calculated (ºH = tan 1(b*/a*)), which defines the color tone, and the chroma (C* = *)²(*)²(ba+), which defines the intensity of the color (Mcguire, 1992).

3. Results and Discussion

The results obtained by the analysis of variance indicate the influence of the varieties for this characteristic ($p \leq 0.05$). The average yield ([(Final product weight/Initial weight) × 100]) of white potatoes was 23% and purple potatoes 18.41%, showing a significant difference between the varieties (Figure 2). There was no statistical difference in the value of soluble solids of purple and white potatoes ($p \geq 0.05$) (Figure 2). For the variable of soluble solids, no significant differences were observed between the varieties, not being possible to obtain a correlation of this characteristic with the production yield (Figure 2).

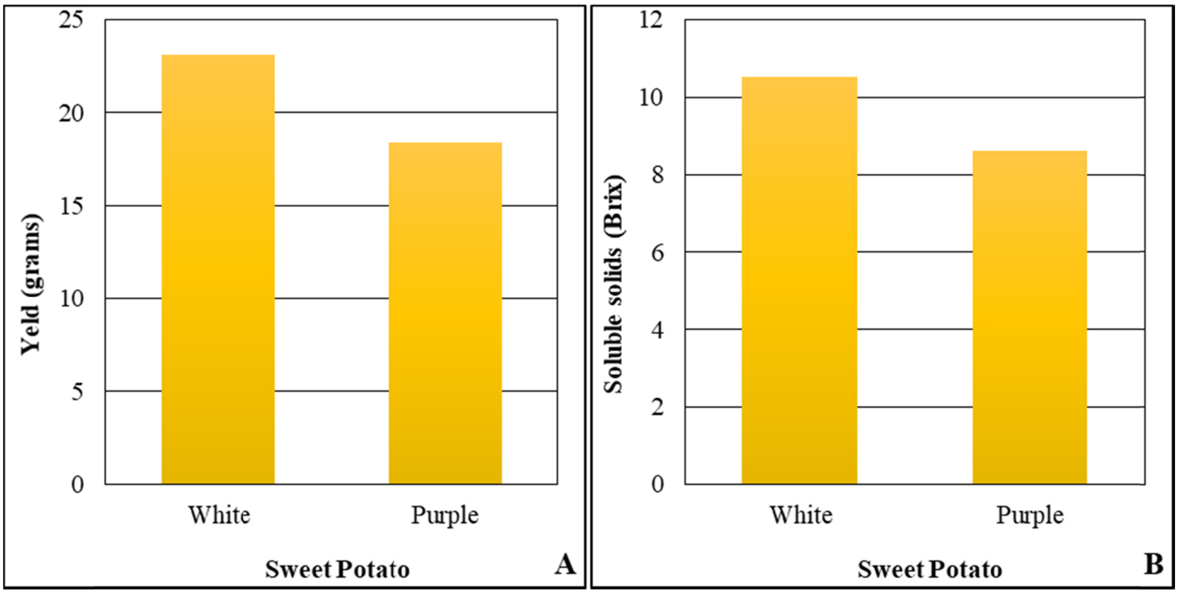

Figure 2. Yield [(Final product weight/Initial weight) × 100] and soluble solids (°Brix) of sweet potatoes processed from fruits of different varieties. Means followed by the same letter in the column do not differ from each other by the F test. Means of eight repetitions

These results were lower than those observed by Rogério and Leonel (2004) in parsley chips of different thicknesses, pre-cooked and fried, whose yield ranged from 25% to approximately 30%. However, it should be noted that the process used is different, because during frying, oil may be absorbed by the product, increasing its weight and, consequently, the yield. In addition, the loss of water by dehydration is greater than by frying.

The Luminosity parameter was not influenced by the cultivars or the ascorbic acid treatment (Tabel 1). The Angulo Hue parameter was influenced by the cultivar, but not by the use of acid ($p > 0.05$). As for the chromaticity, there was an interaction between the cultivars and the presence of ascorbic acid.

Table 1. Luminosity and Hue Angle of white and purple sweet potatoes with and without the presence of ascorbic acid produced in the semiarid region of Minas Gerais in Janaúba-MG

Variety	White	Purple	With acorbic acid	No ascorbic acid	Coefficient of variation (%)
Luminosity	59.74a	64.72a	54.40a	68.06a	6.70
Hue Angle	86.45a	79.41a	82.35a	83.52b	5.40

Note. Means followed by the same letter on the line do not differ from each other by the F test at 5% probability.

Table 2. Chromaticity of white and purple sweet potatoes with and without the presence of ascorbic acid produced in the semiarid region of Minas Gerais in Janaúba-MG

Variety	With acorbic acid	No ascorbic acid
White	14.90Bb	19.64Aa
Purple	19.59Aa	16.26Bb
Coefficient of variation (%)	2.80	1.90

Note. Means followed by the same uppercase column and lowercase letter in the row do not differ from each other at 5% probability by the F test.

Regarding luminosity (L*), a color coordinate that varies from 0 (black) to 100 (white), the varieties with and without ascorbic acid presented the same luminosity, with an average of 62.23. In potato chips after frying, Coleman (2004) classified the color as being of unacceptable quality ($L^* < 55$; acceptable ($L^* \geq 55$ and ≤ 70) and of high quality ($L^* > 70$). of a differentiated product (not fried), the dehydrated sweet potatoes obtained an acceptable color, according to the authors. extruded parsley, whose product presented brightness values ranging from 65 to 76.

This result indicates that the dehydration generated a darker product than those from the extrusion process. The color change during heating, dehydration, may be linked to the Maillard reaction, also known as non-enzymatic browning, which occurs between reducing sugars and amino acids and leads to the formation of melanoidins, dark compounds with high molecular weight. Other factors that can also influence the color and characteristics of the product are inherent to the raw material, such as the quality and varieties used.

As for °Hue, which can vary from 0° (red), 90° (yellow), 180° (green) and 270° (blue), the white variety was more yellow (°Hue closer to 90°) (Table 1). The literature mentions (Rodriguez-Saona & Wrolstad, 1997) that, for potato chips, the ideal color is between 75 °Hue (orange yellow) and 63 °Hue (reddish). in which both purple and white potatoes presented a more yellowish color (°Hue close to 90°). Ascorbic acid with 4-hexylresorcinol significantly inhibited the darkening of slices stored under vacuum, a result different from that observed in the present work, in which the presence of the aforementioned additive, at a concentration of 1%, did not influence the color of the sweet potatoes.

For the Chroma coordinate (C*), which varies from 0 (more neutral colors, white and/or gray) to 60 (more vivid and/or intense colors), it is observed that with the presence of ascorbic acid, the cultivar roxa showed more color intensity, that is, despite the two being yellow, the purple potato showed a more intense yellow color than the white one (C* 19.64 and 16.26 respectively). In potato chips, more intense coloration is more rejected by consumers (Pereira et al., 2007). Analyzing the isolated varieties, the white potato without ascorbic acid was more intense yellow than with the additive, an opposite result to the purple variety, whose samples were more yellow in the presence of the antioxidant.

4. Conclusions

The sweet potato cultivar Brazlândia Branca showed better yield when submitted to the drying process.

The sweet potato cultivar Brazlândia, when submitted to the dehydration process, presented a more yellowish color, however, with less intense coloration in the presence of ascorbic acid.

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