

Potato cultivars evaluation for processing industry

Avaliação de cultivares de batata para a indústria de processamento

Evaluación de cultivares de patata para la industria de procesamiento

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Abstract

Light color after frying and sprouting are the main quality parameters evaluated by the pre-fried potato processing industry. Therefore, the objective of this study was to evaluate the suitability for use by the pre-fried potato processing industry, the cultivars Asterix, Corsica, Edison, Lionheart and Markies through the sprouting and post-frying color of the sticks. For this, the tubers were stored at 8 °C (RH 90% ± 2) for up to 180 days. Sprouting started at 60 days with the exception of 'Lionheart', which started sprouting at 120 days. At 150 and 180 days, all cultivars showed large sprouts, but still suitable for the processing industry. Visually, the Asterix cultivar remained in category 3 and the most cultivars in 2. The parameter L* reduced with the storage time in all cultivars, indicating the browning of the sticks, which was accompanied by the reduction of parameter b*, indicating less yellowing. It is concluded that All cultivars can be used by the processing industry after storage at 8 °C for 180 days. These results are important to the process industry due to difficult from storage of tubers under refrigeration in reason of browning during fried.

Keywords: Sprouting; Maillard reaction; Non-enzymatic browning.

Resumo

A coloração clara após a fritura e a brotação são os principais parâmetros de qualidade avaliados pela indústria de processamento de batata pré-frita. Diante disso, objetivou-se com este estudo avaliar a aptidão para uso pela indústria de processamento de batata pré-frita as cultivares Asterix, Corsica, Edison, Lionheart e Markies através da brotação e coloração pós-fritura dos palitos. Para isso os tubérculos foram acondicionados a 8 °C (UR 90 % ± 2) por até 180 dias. A brotação iniciou-se aos 60 dias com exceção da 'Lionheart' que inicio dos brotos apareceram aos 120 dias. Aos 150 e 180 dias todas as cultivares apresentaram brotos grandes, mas ainda adequado à indústria de processamento. Visualmente a cultivar Asterix permaneceu na categoria 3 e as de mais cultivares na 2. O parâmetro L* reduziu com o tempo de armazenamento em todas as cultivares, indicando o escurecimento dos palitos o que foi acompanhado pela redução do parâmetro b*, indicando menor amarelecimento. Conclui-se que todas as cultivares podem ser utilizadas pela indústria de processamento após o

acondicionamento a 8 °C por 180 dias. Esses resultados são importantes para a indústria de processamento devido à dificuldade de armazenamento dos tubérculos sob refrigeração em razão do escurecimento durante a fritura.

Palavra-chave: Brotação; Reação de maillard; Escurecimento não enzimático.

Resumen

El color claro después de freír y brotar son los principales parámetros de calidad evaluados por la industria procesadora de papa prefrita. Por lo tanto, el objetivo de este estudio fue evaluar la idoneidad para el uso por parte de la industria procesadora de papa prefrita, los cultivares Asterix, Corsica, Edison, Lionheart y Markies a través del color de brotación y post-fritura de los palitos. Para ello, los tubérculos se almacenaron a 8 ° C (RH 90% ± 2) hasta por 180 días. La brotación comenzó a los 60 días con la excepción de "Lionheart", que comenzó a brotar a los 120 días. A los 150 y 180 días, todos los cultivares mostraron brotes grandes, pero aún aptos para la industria de procesamiento. Visualmente, el cultivar Asterix se mantuvo en la categoría 3 y la mayoría de los cultivares en 2. El parámetro L * se redujo con el tiempo de almacenamiento en todos los cultivares, indicando el oscurecimiento de las ramas, lo que fue acompañado por la reducción del parámetro b *, indicando menos amarilleo. Se concluye que todos los cultivares pueden ser utilizados por la industria de procesamiento después de envasados a 8 ° C durante 180 días. Estos resultados son importantes para la industria de procesamiento debido a la dificultad de almacenar los tubérculos en refrigeración debido al dorado durante la fritura.

Palabra clave: Brotación; Reacción de Maillard; Pardeamiento no enzimático.

1. Introduction

One of the main problems of the potato chip processing industries is the need for refrigerated storage of the tubers for the constant supply of the product. The low temperatures required to inhibit the sprouting and incidence of tuber microorganisms in the chambers (Chen, et al., 2012) cause the accumulation of sugars in some cultivars. In the United States, the accumulation of sugars causes up to 15% of potatoes to be discarded in processing units every year (Bhaskar, et al., 2010).

The amount of sugar produced varies beyond the genotype with the storage time (Abong, et al., 2009), and the accumulation in high levels promotes browning due to the reaction of reducing sugars, with amino acids such as asparagine, leading to production of

pigments, called melanoidins, which give the sticks after dark frying (Bastos et al., 2011; Brião, et al., 2011), leading to consumer unacceptance.

In addition to the visual aspect, the browning of the sticks correlates with the production of acrylamide (Parker, et al. 2012), a carcinogen, which has been verified in high concentrations in potato chips (Pedreschi, et al., 2014; McCombie, et al., 2016; Esposito, et al., 2017).

Therefore, it is necessary to evaluate the suitability of the cultivars for use by the processing industry, aiming at the search for materials that have less sprouting and light color after frying, which are the two main parameters of industrial quality.

The objective of this study was to evaluate the suitability for use by the pre-fried potato processing industry for the cultivars Asterix, Corsica, Edison, Lionheart and Markies through the sprouting and post-frying color of the sticks.

2. Material and Methods

Tubers of Asterix, Corsica, Edison, Lionheart and Markies cultivars were obtained from the commercial production area of Perdizes, Minas Gerais, Brazil (19° 21 '10 "S, 47° 17 '34" W and 1000 m). The tubers were manually harvested and cured in the field, then they were transported to the Post-harvest Physiology Laboratory of the Plant Science Department of the Viçosa Federal University, where they were stored at 8 °C (UR 90% ± 2) in the absence of light by up to 180 days.

Sprouting, visual color and parameters L * and b * were evaluated at 60, 90, 120, 150 and 180 days.

To evaluate the post-frying color, the tubers were cut into sticks, with a manual cutter and fried in an electric fryer, with a capacity of 3 L (Model: Ford®). Frying was carried out for 4 min at 180 °C, following the recommendations of the industries.

The color of the post-fry potatoes was determined visually based on the scale of notes recommended by the 'United States Standards for Grades of Frozen French Fried Potatoes' (USDA, 1967) and by the potato processing industry in grades ranging from 1 to 5. And using the Color Reader CR-10 colorimeter, Minolta, which has the components L *, a *, b *, c * (chroma) and the Hue angle, and for potato tubers the parameter L * was used which refers to the degree of brightness of the sample, varying from light (values close to 100) to dark (values close to 0) and the component b * varies from blue (negative values) to yellow (positive values) (Minolta Corp, 1994).

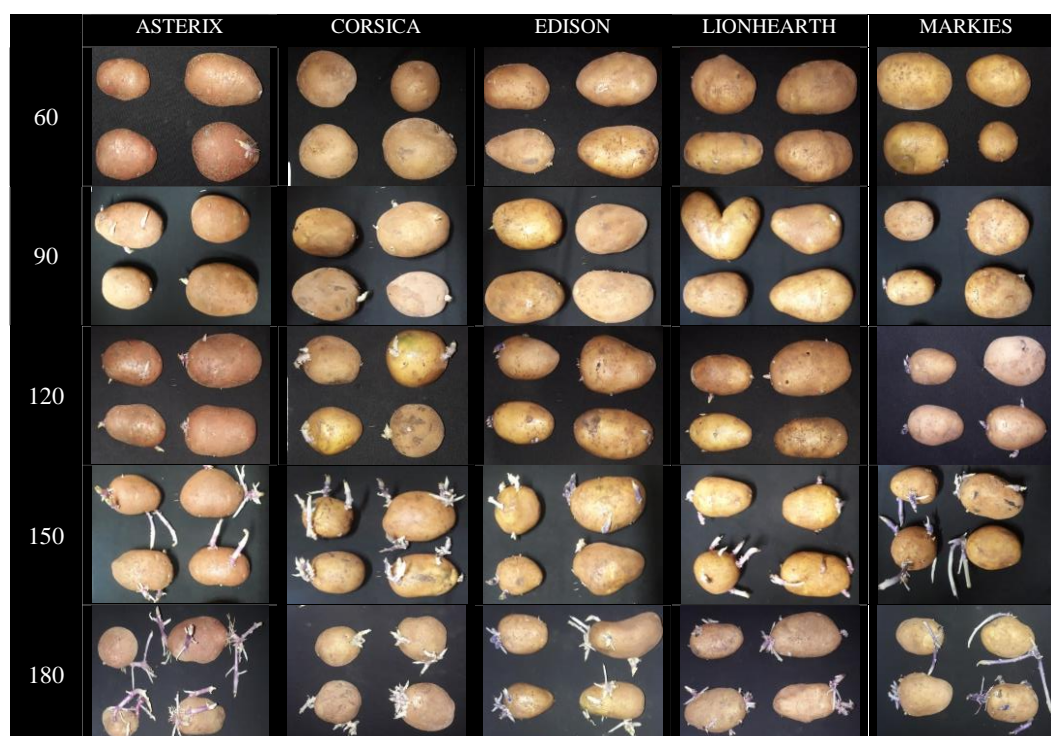
The experiment was carried out in a completely randomized design, in a split-plot scheme with five replications, each replication consisting of two tubers. For the parameters L * and b * the plots were the cultivars (Asterix, Corsica, Edison, Lionheart and Markies) and the subplots the storage times (60, 90, 120, 150 and 180 days). Data were subjected to analysis of variance a 5 % de probability and adjusting the model of regression linear to the parameters L * and b * using the System of Statistical Analysis and Genetics used at the Viçosa Federal University (Cruz, 2006).

3. Results and Discussions

Sprouting started at 60 days in all cultivars with the exception of 'Lionheart' (Figure 1). The sprout remained small at 90 and 120 days, with the beginning of sprouting of the Lionheart cultivar at 120 days (Figure 1). At 150 and 180 days, all cultivars had large sprouts and the largest sprouts were found in Asterix and Markies cultivars (Figure 1). Despite the delay in the beginning of the sprouting of the Lionheart cultivar at 150 and 180 days, it was already sprouted like 'Corsica' and 'Edison' (Figure 1).

These results show little effect of the variation of the cultivars tested on the sprout, and although the sprouts are large, the tubers are still suitable for processing up to 180 days. In tubers for processing, sprouts can cause physical damage during bulk storage leading to rapid deterioration by microorganisms, loss of water and increased breathing. For the in natura market, the beginning of sprouting already makes tubers unacceptable for commercialization, in this case 'Lionheart' is the most suitable cultivar, and can be sold even after 90 days of storage at 8 °C.

Figure 1: Sprouting of tubers of Asterix, Corsica, Edison, Lionheart and Markies cultivars stored at 8 °C for 60, 90, 120, 150 and 180 days.

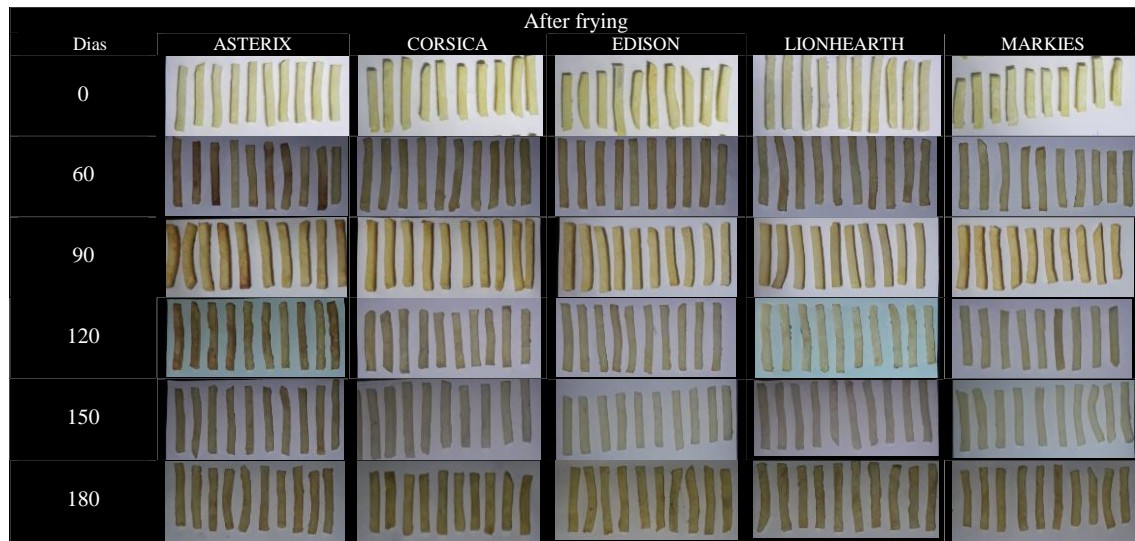


Fonte: Autores.

Before the tubers were stored (Day 0), the sticks were lightly colored, category 1. At 60 days, they were categorized into 2, with the exception of Asterix, which had darker colored sticks, classification 3. At 90, 120, 150 and 180 days there was little variation in color after frying, with the sticks remaining in category 2 for cultivars with the exception of Asterix which remained at 3. In all cultivars the color of the sticks remained adequate even after 180 days of exposure to the temperature of 8 °C, indicating low non-enzymatic browning, due to the small accumulation of sugars, therefore these cultivars are suitable for use in the pre-fried potato processing industry.

When potato tubers are exposed to low temperatures, a reduction in the starch pool occurs, due to the inhibition of their synthesis enzymes, such as AGPase and GBSS and increased transcription of the β -amylase genes, promoting starch degradation in sucrose (ANR) which is broken down into glucose fructose (AR) by vacuolar acid invertase preferably Susy in potato tubers (Wiberley-Bradford, et al., 2016). This accumulation of sugars has a high correlation with the color of the sticks after frying (Araújo, et al., 2016).

Figure 2: Coloring of potato sticks after frying at 180 ° C for 4 min for Asterix, Corsica, Edison, Lionheart and Markies cultivars stored at 8 ° C for 60, 90, 120, 150 and 180 days.



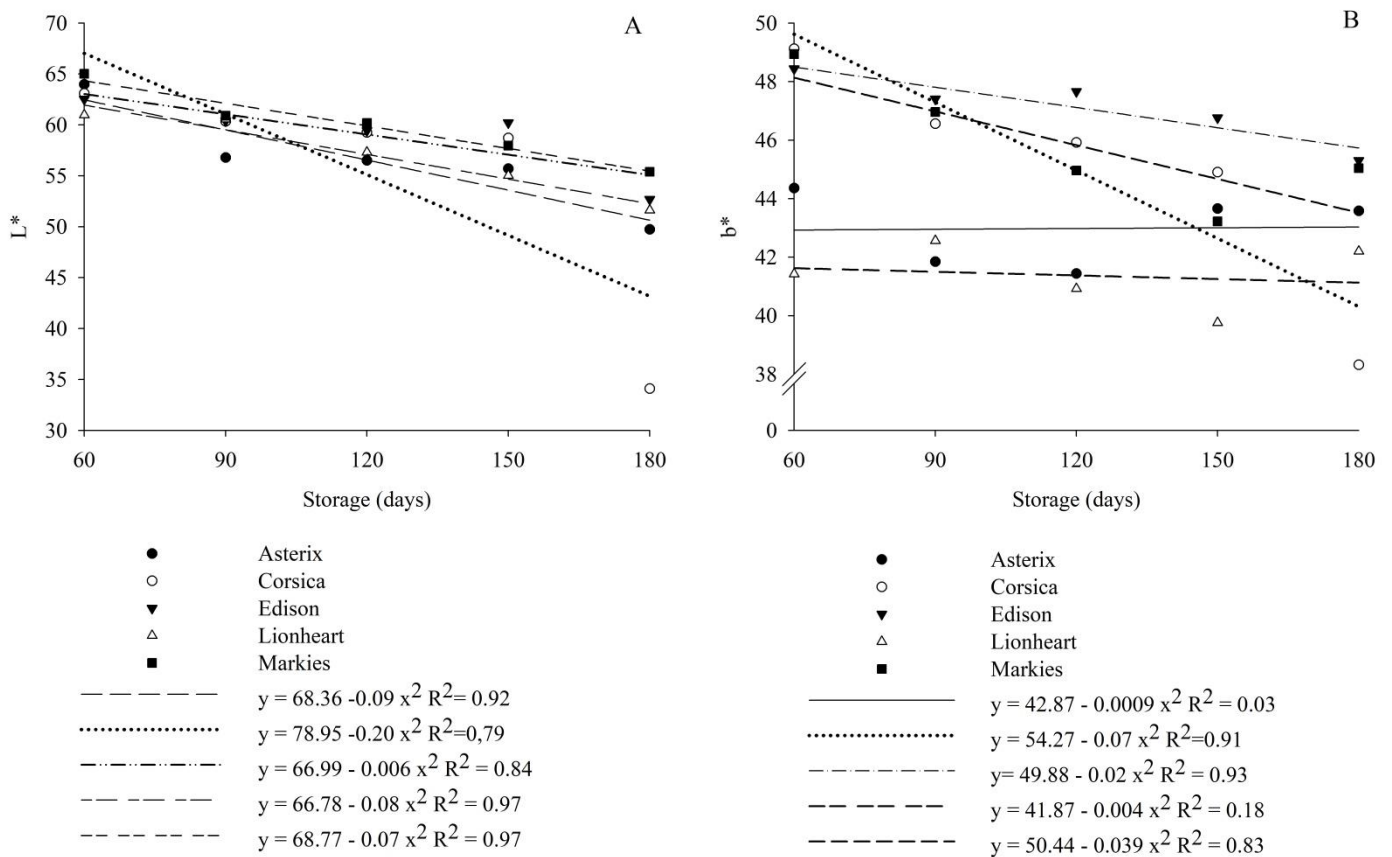
Fonte: Autores.

The L^* parameter decreased with the storage time in all cultivars, indicating the browning of the sticks (Figure 3A). However, the cultivar Edison has the lowest slope of the line, indicating less browning with storage time, different from that observed for the cultivar Corsica, which presented the highest inclination. When ‘Corsica’ and ‘Edison’ were evaluated, there was no visual difference, as observed with the colorimeter. These results show the importance of using objective evaluation parameters, since the simple observation of the color can present errors when the intensity of the color.

The parameter b^* also decreased with the storage time in all cultivars (Figure 3B). The reduction in the yellow color of the sticks occurs due to the increase in browning, as observed in L^* .

Based on the color scale and parameters L^* and b^* it is suggested that sticks with good coloring for industry meet L^* above 45.0 and b^* greater than 40.0.

Figure 3: L* and b* parameters of the potato sticks of Asterix, Corsica, Edison, Lionheart and Markies cultivars stored at 8 °C for 60, 90, 120, 150 and 180 days. (p < 0.05).



Fonte: Autores.

4. Conclusion

All cultivars can be used by the processing industry after storage at 8 °C for 180 days. These results are important to the process industry due to difficult from storage of tubers under refrigeration in reason of browning during fried.

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