Potential of Use of Potato Genotypes by the Industry

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Authors’ contributions

This work was carried out in collaboration between all authors. The authors AMP, MESG, MPG, RRPC and FLF designed the study, performed the statistical analysis and wrote the protocol. The authors AMP, AGSG, MESG, RRPC, AIF and DNG managed the analyses of the study. All authors read and approved the final manuscript.

ABSTRACT

Aims: Evaluate four potato genotypes in terms of sprouting and coloring depending on the storage time at 8 °C and their potential for use by the potato processing industry.

Study Design: The experiment was carried out in a completely randomized design, in a split-plot scheme with five replications, each replication consisting of two tubers.

Place and Duration of Study: Tubers were obtained from the production area of Perdizes, Minas Gerais, Brazil (Latitude 19º 21’ 10” N and Longitude 47º 17’ 34” E and 1000 m).

Methodology: The genotypes Alibaba, Arsenal, Antartica and Babylon were stored at 8°C for up to 180 days, with the analysis of sprouting, visual coloration before and after frying, parameters L*, b* and c*.

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Results: All potato genotypes were light colored before frying, category 1 (USDA). Babylon obtained the best parameters of b * and c *. Antartica and Babylon potato genotype showed low sprouting.

Conclusion: The Arsenal and Antartica potato genotype have potential for use by the processing industry due to the color of the sticks before and after frying and low sprouting. The Alibaba potato genotype was darkly colored after frying. Babylon was the potato genotype with the best color of the sticks after frying and less germination.

Keywords: Sprouting; maillard reaction; colorimeter; browning.

1. INTRODUCTION

The potato is important food crop because of the nutrition composition, high starch content, protein, low fat, high levels of vitamin C and calcium [1].

In addition to the requirement for potatoes for fresh consumption, the production of potatoes for processing has been growing along with the expansion of fast food and restaurant chains, mainly for the consumption of potato chips [2]. In the USA, Canada, the Netherlands, Germany, Belgium, the United Kingdom and France the consumption of processed potatoes varies from one to two thirds of the total potato consumption in these countries [3].

However, in many countries, such as Brazil, the expansion of the processing industry is limited by the low availability of genotypes with suitable shape and size for slicing, absence of browning before and during frying, adequate crispness and good storage potential, which is assessed mainly by the sprouting incidence.

The browning of the sticks during frying occurs due to the occurrence of the Maillard reaction, which affects, in addition to the visual aspect, the sensory, nutritional and toxicological properties [4,5]. This reaction occurs at high temperatures and the browning correlates with the content of amino acids, ascorbic acid, phenolic acids and sugars [6]. The occurrence of this reaction depends on the composition of the different potato genotypes and is influenced by temperature and storage time [4].

Temperatures of 8 and 10 °C have been used to maintain quality for processing [7], reducing sprout growth, water loss and infection by microorganisms [8], however, the storage potential in this condition depends on the genotype.

The objective of the study was to evaluate the potential use of the potato genotypes Alibaba, Antartia, Arsenal and Babylon for the processing industry, through the evaluation of the color of the sticks and sprouting.

2. MATERIALS AND METHODS

Tubers of four potato genotypes, called Alibaba, Arsenal, Antartica and Babylon were obtained from the production area of Perdizes, Minas Gerais, Brazil (Latitude 19º 21' 10'' N and Longitude 47º 17' 34'' E and 1000 m) (not yet registered). The tubers were manually harvested and cured in the field and transported to the Post-harvest Physiology Laboratory of the Plant Science Department of the Viçosa Federal University.

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 (Alibaba, Arsenal, Antartica e Babylon) and the subplots the storage times (0, 60, 150 and 180 days). Data were subjected to analysis of variance at 5 % de probability and adjusting the model of regression linear to the parameters L *, b * and c * using the System of Statistical Analysis and Genetics used at the Viçosa Federal University [9].

Tubers of four potato genotypes, called Alibaba, Arsenal, Antartica and Babylon were stored at 8 °C (UR 90% ± 2) on wooden countertops in the absence of light for 180 days. Sprouting, visual color and parameters L* and b* were evaluated at 0, 60, 150 and 180 days after storage. However, the sprouting was evaluated at 60, 90, 120, 150 and 180 days.

To evaluate the post-frying color, the tubers were cut into sticks equal to that of the fastfood industries with a manual cutter and fried in an electric fryer, with a capacity of 3 L (Model:
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' [10] and by the potato processing industry in grades ranging from 1 (lighter color) to 5 (darker color).

The Color Reader CR-10 colorimeter, Minolta, which has the components L*, a*, b*, c* (chroma) and the Hue angle.

In 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), the component b* varies from blue (negative values) to yellow (positive values) and c* or chroma refers to the intensity or purity of the color [11].

3. RESULTS AND DISCUSSION

Regardless of the storage period, the sticks of the Alibaba, Arsenal, Antartica and Babylon potato genotypes were light in color, with no dark spots indicative of enzymatic browning (Fig. 1), therefore, their appearance is suitable for the processing industry.

The enzymatic browning may be due to the activity of peroxidase, an enzyme that uses phenolic compounds as electron donors, and hydrogen peroxide as an oxidizer [12] forming o-quinones that produce melanin, resulting in brown, reddish or depending on the phenolic compound present in the tissue [13]. In addition, o-quinones react with amino acids, peptides and proteins, causing structural and functional changes that reduce the nutritional value of foods [13].

On day 0, Arsenal and Antartica classified as 1 (USDA) (Fig. 2) and parameter L* Alibaba presented lower value (Fig. 3A), darker color, category 2. Babylon was categorized as 2 (USDA), not differing from Alibaba and Antartica (Fig. 2). In parameter b* Alibaba has the lowest value, having a less yellow color than Arsenal and Babylon (Fig. 3B). While evaluating c*, it appears that Babylon has the highest value, with the most intense coloring, differing from those of more genotypes (Fig. 4).

At 60 days after storage, Arsenal and Babylon have higher values of the parameter L* (Fig. 3A). The visual classification was 2 and 3 respectively (USDA) (Fig. 2). The genotypes Antartica and Alibaba did not differ from each other and presented lower L* (Fig. 3A), however, in the visual classification, they were categorized as 3 and 5 (USDA) (Fig. 2).
Fig. 2. Coloring of potato sticks of the alibaba, arsenal, antartica and babylon genotypes after frying at 0, 60, 150 and 180 days after storage

Fig. 3. Parameter L* (A) and b* (B) of the potato sticks of the alibaba, arsenal, antartica and babylon genotypes after frying at 0, 60, 150 and 180 days after storage

At 150 days, Babylon had a higher L*, differing from Arsenal and Alibaba (Fig. 3A). Arsenal, Antartica and Babylon were classified in category 3 (USDA), while Alibaba in 4 (USDA) (Fig. 2). At 180 days, Babylon had a higher L*, differing from Alibaba and Antartica (Fig. 3A), however, the
visual classification was the same as for 150 days (Fig. 2).

At 60, 150 and 180 days after storage, Babylon had the highest value of the b* and c* vestments, the most yellow and intense color of the sticks, differing from those of Arsenal, Antartica and Alibaba (Fig. 3B, Fig. 4). Through the visual analysis of color and the parameters L*, b* and c*, there is a very dark coloration of the Alibaba genotype sticks, therefore not indicated for use by the potato chips industry. Arsenal, Antartica and Babylon showed good coloring for industrial use, with Babylon being the genotype that obtained the best parameters.

In a study with the potato cultivars Asterix, Corsica, Edison, Lionheart and Markies, the authors suggested that an adequate coloration of the sticks was found when the parameter L* was above 45.0 and b* above 40.0 [10]. In this study, L* values greater than 49.32 were considered adequate and the best values of b* and c* were above 48.30 and 49.64, respectively (Fig. 3, Fig. 4).

The Arsenal genotype started to sprout at 60 days of storage, while Alibaba started 90 days and Antartica and Babylon at 120 days after storage. (Fig. 5). At 150 and 180 days, Antartica and Babylon had small shoots, while for tuber of Alibaba and Arsenal genotypes the sprouts were very large (Fig. 5). In view of this, Antartica and Babylon potato genotypes showed better sprouting results, with greater storage potential, with 180 days, the sprouts of Babylon potato genotypes were smaller size than of ‘Antartica’.

Sprouts make the tubers physically unsuitable for processing and can induce the accumulation of sugars, which is not suitable for processing potato chips [14].

![Parameter c* of the potato sticks of the alibaba, arsenal, antartica and babylon genotypes after frying at 0, 60, 150 and 180 days after storage](image)

Fig. 4. Parameter c* of the potato sticks of the alibaba, arsenal, antartica and babylon genotypes after frying at 0, 60, 150 and 180 days after storage
4. CONCLUSION

The Arsenal and Antartica potato genotype have potential for use by the processing industry due to the color of the sticks before and after frying and low sprouting.

The Alibaba potato genotype was darkly colored after frying.

Babylon was the potato genotype with the best color of the sticks after frying and less germination.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


Fig. 5. Sprouting of potato sticks of the alibaba, arsenal, antartica and babylon genotypes after frying at 0, 60, 150 and 180 days after storage
10. USDA. United States standards for grades of frozen French fried potatoes. Washington. 1967;16,

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