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Effect of genotype, raw-material storage time and cut type on native potato suitability for fresh-cut elaboration

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ABSTRACT

The suitability for fresh-cut processing of three native colored-fleshed potatoes (i.e., Bruja, Michuñe roja and Michuñe azul) and one commercial non-colored-fleshed potato (i.e., Asterix) was investigated. The impact of the storage time of the raw material and the type of cut (i.e., cube and chip) **was** also examined. Fresh-cut potato from raw material stored 2 months at 12 °C and 90% relative humidity (RH) displayed 1 to 2.5 times higher respiration activity than potatoes stored 4 months under the same conditions. Lower CO_2 emission was only observed when potatoes stored 4 months were used. Fresh-cut potato shelf life decreased (less than 23 d at 5 °C) due to microbial growth. Approximately 7 log cfu g^{-1} for mesophilic and psycrophilic bacteria and *Enterobactericeae* when potatoes stored 4 months were used. Microbial growth was higher in chips than cube. The native colored-fleshed potatoes were rich in polyphenols, and total antioxidant capacity is 1 to 2 times higher than that of commercial potato. Total polyphenol content was not affected by the storage time of the raw material and remained stable under storage at 5 °C. However, fresh-cut potato processed from raw material stored 2 months had 1.5 to 3 times more total antioxidant capacity than that processed from raw material stored 4 months. For both parameters, Bruja exhibited values approximately 60% higher. Although all the analyzed varieties were suitable for fresh-cut elaboration, Bruja and Michuñe roja displayed higher metabolic activity and susceptibility to microbial deterioration and browning. To guarantee fresh-cut potato quality, raw material should be maintained no longer than 4 months in storage. From this moment some quality parameters alterations, that limited the fresh-cut shelf life, begin to be observed.

1. Introduction

Potato (*Solanum tuberosum* L.) is **globally** considered the fourth-most important food crop behind wheat, maize and rice and consumed nearly daily by more than one billion people (Devaux et al., 2014). Although it is a temperate-climate crop, potato grows in numerous countries on different continents under temperate, subtropical and tropical conditions (Hijmans, 2003). World production is approximately 365 million tons of fresh tubers from 19.5 million ha (FAO, 2014).

The **dietary** value of potato is related to its nutrient content, which includes high-quality protein, starch, fiber, minerals and a variable content of phytochemicals or phytonutrients, such as polyphenols, vitamins and pigments, which are believed to reduce chronic-disease development (Giusti et al., 2014; Ayvaz et al., 2016). These compounds become more prevalent in colored-skin and/or flesh potatoes that include red and purple pigments due to the presence of anthocyanins (Brown et al., 2003). Purple and red-fleshed potatoes represent a natural source of anthocyanins, which have been associated with health promotion (Lachman et al., 2009).

As a raw material, potato is of particular interest because it can be consumed in diverse forms, including elaboration in the form of cooled, frozen and fresh-cut products (Rytel et al., 2014; Wang et al., 2015).

Since innovation is a fundamental factor with respect to satisfying consumer expectations, one characteristic of the fresh-cut product industry is a constant need to introduce new varieties of raw material (Martínez-Sánchez et al., 2012; Putnik et al., 2016).

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Thus, colored potatoes constitute an interesting alternative for fresh-cut elaboration because they reflect several concepts attractive to consumers, such as the rescue of native genetic resources, the valorization of family farming and health benefits.

However, not all the varieties are adapted to fresh-cut elaboration and their improper use results in low-quality products that cause consumer dissatisfaction. Therefore, to ensure the quality of the final product, it is important to determine the suitability of such varieties for fresh-cut elaboration. However, it should be considered that the quality of a fresh-cut product is generally affected by pre and postharvest factors, including the raw-material storage conditions and the operations performed during processing (e.g., cut type, sanitization, packaging), as noted in the literature (Aguayo et al., 2004; Cabezas-Serrano et al., 2009; Silveira et al., 2013).

Among the storage conditions, temperature and relative humidity (RH) play key roles with respect to the storage effect on the dry-matter and phytochemical content of tubers (Lachman et al., 2012; Ezekiel et al., 2013).

Thus, the objective of this paper was to determine i) the suitability of native colored potato for fresh-cut elaboration and ii) the impact of storage time of the raw material and iii) of cut type on fresh-cut potato final quality and durability.

2. Materials and methods

2.1. Raw-material storage

The four potato varieties examined in this study were cultivated by a local producer in Chiloé (42.4° south latitude and 73.6° west longitude) in southern Chile and presented different flesh colors. The native potatoes: Michuñe roja, white and pale red flesh (variegated); Michuñe azul, blue and white flesh (variegated); and Bruja, dark purple flesh, were analyzed. Additionally, Asterix, a commercial variety of white flesh was also included (Fig. 1). After harvest, the potatoes were transported to the Centro de Estudios Postcosecha (CEPOC) of the Facultad de Ciencias Agronómicas, Universidad de Chile (Santiago, Chile), cured in a ventilated, shaded shed at 15 °C and 85% RH for 20 d. After that they were selected, discarding damaged and/or decayed, and subsequently divided in six groups of 20 tubers for each variety. Three of them were stored in darkness in a cold room at 12 °C and 90% RH for 2 months and the remaining during 4 months. Temperature and humidity were monitored daily by a data logger (KTL-508, Keytag, Netherlands).

2.2. Fresh-cut processing

Prior to processing, the tubers of the three biological replicates from the storage, were mixed, selected again and divided into two equal groups, one for cubes and the other for chips elaboration.

Processing was performed in a cold room (5 ± 1 °C) where work surfaces and implements had been previously cleaned and disinfected with a sodium hypochlorite (NaOCl, 0.2 g L^{-1}) solution (Clorox Chile SA, Chile). Prior, the potatoes were washed with tap water and brushed with a soft bristle brush to remove dirt.

Potatoes intended for cubes elaboration were peeled using a sharp potato peeler (Tescoma, Madrid, Spain) and placed in plastic containers with tap water to prevent enzymatic browning. Next, they were manually cut into slices of approximately 1 cm thickness and then cubes (approximately 1 cm x 1 cm). For chips, unpeeled potatoes were cut in slices of approximately 0.2 cm using a mandolin (Tescoma, Madrid, Spain). After cutting, they too were placed in water.

Each variety was separately immersed in a stainless steel container with 10 L of 5% citric acid (Sigma Aldrich, USA) solution at 5 °C per kg of potatoes for 2 min.

Then, the potatoes were centrifuged using a domestic centrifuge (Ilko, Santiago, Chile) to remove surface water. Samples of approximately 120 g were placed in 45 μm thick, high-density polypropylene bags (10 × 15 cm) with an O_2 permeability of 1900 mL m^{-2} d^{-1} (data provided by the supplier).

The bags were heat-sealed (FR400, Plastic Film Sealer, China) and stored 23 d at 5 ± 1 °C to simulate the storage and marketing period. At 1, 8, 14 and 23 d after processing, three bags of each variety and format were randomly selected and removed from storage to be analyzed.

2.3. Respiration-rate measurement

The respiration rate was determined under a static system, in which 60 g of potatoes (cubes and/or chips) were placed in 0.5 L resalable glass containers provided with a silicon septum on the top. The containers were closed until a CO_2 concentration higher than 0.2% was attained. Then, gaseous samples were taken from the headspace through the silicone septum using a 10 mL

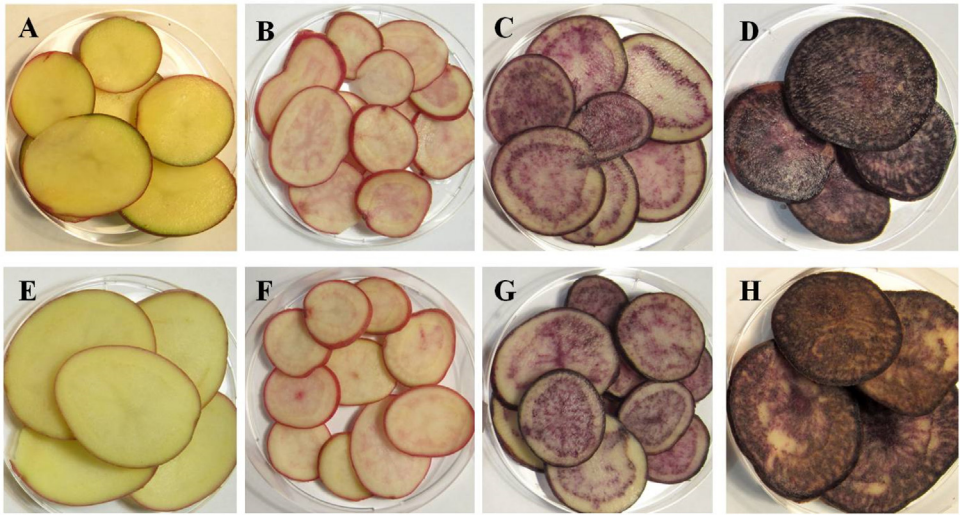

Fig. 1. Asterix (A) Michuñe roja (B) Michuñe azul (C) and Bruja (D) chips elaborated with raw material stored for 2 months. Asterix (E) Michuñe roja (F) Michuñe azul (G) and Bruja (H) chips elaborated with raw material stored for 4 months.