LEACHING OF FRENCH-FRIED POTATO STRIPS

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ABSTRACT

Potatoes with high-reducing sugar content taken directly from cold storage (4.5 C) and cut into 3/8-inch-square, 3-inch-long strips, were immersed in liquid nitrogen or dichlorodifluoromethane (--30.5 C or --79 C) for 3 to 15 sec and then leached for 5 min in water at 50 C. It was found that by using this method of freezing and leaching light colored strips could be finish-fried from Red La Soda, Russet Burbank, and Norchip varieties without conditioning. Finished-fries prepared by water-leaching only were usually too dark.

During storage the reducing sugar content of potato tubers increases. The increase is associated with color of finish-fried products (14, 15) and is usually greatest at temperatures below 4.5 C and least above 10 C. However, at higher temperatures the period of storage during which tubers can be kept in peak processing condition is greatly reduced. Most processors now seem to prefer a storage temperature of 7.0 C to the 4.5 C previously used because of lower reducing sugar accumulation at the slightly higher temperature (15). A conditioning period of from 1 to 3 weeks (or longer in some instances) at or above 21 C is usually used to lower the reducing sugar content sufficiently to give light-colored products when the potatoes are finish-fried (7, 8).

Some varieties of potatoes condition well, others poorly (7, 15). But in even the best conditioning varieties, the reducing sugar content may not be uniformly reduced (16). Also, even if the potatoes condition well, there are expensive losses in water and in weight of raw material due to respiration of solid constituents (5, 11, 13). Operating costs for maintaining the conditioning structure at the higher temperatures can also be excessive.

Even with conditioning, it is often necessary to further lower reducing sugar content of potato strips by leaching with water (4, 6). However, the techniques of leaching vary almost as widely as the number of processing plants, and no one treatment is adequate for all varieties or even for one variety subjected to different cultural treatments and/or environments during growing and storage. Also when excessive leaching is required, there is often a corresponding loss in finish-fry flavor.

This paper reports a method of rapid, uniform leaching of a minimum of chemical constituents from surface potato tissue so that light-colored finish-fried strips can be made from potatoes processed directly from cold storage without conditioning.

MATERIALS AND METHODS

Russet Burbank, Red La Soda, and Norchip potato varieties stored for approximately 7 months at 4.5 C were used for all trials.

Potatoes taken directly from cold storage were cut into 3/8-inch square,
3-inch long strips and then leached. After leaching, the strips were finish-fried for 4 min at 190 C. Color was judged by comparing the fries immediately upon removal from the frier with the U.S. Department of Agriculture chart of color standards for frozen French-fried potatoes (1). Ratings were from 0 to 4, with 4 being the darkest brown color. Sensory appraisals of finished-fry texture were made.

**Leaching treatment after air-blast freezing**: Potato strips were placed in an air-blast freezer at —34 C for periods of 5, 10, or 15 min. Immediately upon removal from the blast freezer the strips were immersed for 5 min in water at 50 C. Finish-fry color and texture were recorded.

**Depth of freezing in liquid nitrogen and dichlorodifluoromethane (Refrigerant-12, R-12)**: Potato strips were immersed in liquid nitrogen for periods of 10, 15, 20, or 25 sec and the depth of freezing and incidence of cracking were recorded.

R-12 was cooled with solid CO₂ (—79 C), and potato slices were immersed in the liquid for 3, 4, 5, or 10 sec. Potato strips were also immersed for 5, 10, 15, 20, and 25 sec in R-12 at —30.5 C (slightly for periods of 10, 15, 20, or 25 sec and the depth of freezing and incidence of cracking were recorded.

**Leaching after liquid nitrogen and R-12 freezing**: Potato strips of Russet Burbank and Red La Soda varieties were immersed in liquid nitrogen for 15 sec; strips of Red La Soda in R-12 at —79 C for 3 or 5 sec; and strips of Red La Soda and Norchip in R-12 at —30.5 C for 15 sec. Each treatment was followed by immersion in water at 50 C. Finish-fried strips were evaluated for color and texture.

**Analysis of leached material**: Slabs of tissue 2 mm thick were cut from each of the four sides of unleached, freeze-leached, and water leached potato strips and freeze-dried. The dried tissue was powdered in a mortar and mixed thoroughly. One gram samples of each were extracted for 1 hr in 100 ml of boiling 70% ethanol. Following vacuum filtration, the solution was analyzed for reducing sugars (10) and total nitrogen (2). Total sugar was determined by the reducing sugar method above (10) after invertase was used to convert sucrose to reducing sugars (3).

**Results and Discussion**

Freeze-thaw leaching of potato chips has been previously described (9, 12), but the finished product had a poor texture and flavor compared to that of non-leached chips. Preliminary trials at this laboratory applying the procedures proposed for chips to French-fry strips were inconsistent and nonreproducible.

In one experiment it was found that Russet Burbank potato strips given 5-min of air-blast freezing and 5-min immersion in water at 50 C had a desirable light color, a crisp outer surface, and a mealy baked potato interior texture when finish-fried (Table 1). A 5-min immersion in water at 50 C without freezing did not produce acceptable colored finish-fried strips. Strips held in the air-blast freezer for 10 min or

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2Reference to a company or product name does not imply approval or recommendation of the product by the U. S. Department of Agriculture to the exclusion of others that may be suitable.