POST HARVEST DISCOLORATION OF CHIPS FROM EARLY SUMMER POTATOES

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Studies to determine and maintain chipping quality have been directed mainly towards problems concerning late-crop potatoes. However, in many areas during the period from May through September the chip processor uses potatoes that have been newly harvested. These potatoes frequently go out of condition for chipping within a few days, resulting in poor quality chips or temporary loss of supply. Since these months are a period of peak demand for potato chips, the problem becomes accentuated.

Recent investigations (3) showed that early-crop potatoes stored at 50-55°F for 7 to 10 days caused sugars to build up and dark chips resulted. Potatoes exposed to low temperatures (32-40°F) for 1 to 5 days maintained acceptable chip color. But following this exposure, when the potatoes were placed at 70°F for two days, the chips produced were dark and unacceptable. Continuous storage at 70°F produced good quality chips. Potatoes shipped by rail, van, or truck from Alabama to Wisconsin chipped darker after transit than at harvest and still darker after 70°F storage than following the transit period (5). However, the color of all the samples chipped was satisfactory.

The present study was conducted to determine the causes of this after-harvest darkening of chips from early-summer potatoes (1). The variables considered were maturity, storage temperature, storage period, fertility level, and injury.

MATERIALS AND METHODS

The early maturing variety, Cobbler, used in this study, was grown near Gilcrest, an early producing area of Colorado. Three, one-tenth acre plots were planted. One plot (Linden farm) was planted April 14, and two plots (Love farm) were planted April 18, 1960. From previous cropping history, fertilizer practices and soil tests, the plot on the Linden farm was considered to be of high overall fertility (Treatment I) and the two plots on the Love farm of low fertility. Of these latter two plots, one was maintained without fertilization (Treatment II), while nitrogen was applied to the other plot at the rate of 120 lb per acre at planting time (Treatment III). All cultural practices were carried out by the co-operators.

Duplicate 100 lb samples were harvested from each plot July 7, 11, 18, 25, August 1 and 8, and taken directly to the laboratory. Each 100 lb sample was divided into three equal size lots and stored at 50, 70, and 90°F in slatted wood crates. A 1 kg sample from each plot was placed in each storage for respiration determinations.

The potatoes were stored for a period of three weeks. At harvest time and at three-day intervals thereafter 4 lb duplicate samples were taken from each storage for chipping purposes and reducing sugar analysis.

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An additional 100 lb sample was harvested on July 25 from the Linden farm to study the effects of mechanical injury. The sample was dropped from a height of approximately four feet, four times, turning the bag to a different side each time. The tubers were badly bruised and skinned by this treatment. The sample was then handled like the others harvested on the same date.

Method of cooking potato slices. Approximately four pounds of tubers were sliced with a motor-driven vegetable slicer. The slices were mixed and a sample of 200 g was weighed, washed in cold water and allowed to drain. The slices were cooked in pure vegetable fat (VeO), in a thermostatically controlled two-tray Hotpoint deep fat fryer. A starting temperature of 375°F was used and cooking continued until bubbling ceased. New fat was added to maintain a constant level as the chips absorbed fat during cooking. Once each week or after seven beatings, the fat was changed.

Chip color. The color was determined by crushing the chips and pressing them into flat tin lids which were 2½ in. in diameter and ¾ in. deep. A Hunter-Gardner color difference meter, standardized with a light yellow plaque (Rd = 61.7) was used to determine the color difference values. An Rd of 30.0 is considered the lower limit of acceptable color, as determined by periodic color measurements of 5 brands of commercial potato chips.

Reducing sugars. The remaining potato slices from which the 200 g chipping sample had been removed were chopped and a 25 g sample weighed. Enough 95% ethyl alcohol was added to the chopped sample to make a total volume of 150 ml. The mixture was then blended with a Waring blender for approximately one minute. Reducing sugars were determined in a 1 ml sample of the supernatant. The method used was essentially that of Hassid (2). Clarification of the extract with neutral lead acetate was omitted. The amount of reducing sugars was expressed as per cent on the wet weight basis.

Respiration. A kilogram sample of tubers was placed in a 4.4 liter jar in each storage compartment. On the days that samples were chipped, each jar was aerated with atmospheric air using an air pump. The carbon dioxide content of this air was assumed to be negligible. Lids were placed on the jars, and, after an eight-hour period, carbon dioxide was determined with an Orsat gas analyser. The amount of carbon dioxide obtained was then converted to milligrams of carbon dioxide per hour per kilogram of tubers.

RESULTS

Maturity. Chip color was not significantly different on the day of harvest for the various dates (Table 1). The colors ranged from an Rd value of 30.2 to 33.3 which is above the acceptable limit. Reducing sugars ranged from 0.15 to 0.24% but no general trend was apparent.

During storage, regardless of temperature, reducing sugars increased and the potato chips became darker (lower Rd values—Table 2). This reaction occurs more rapidly and progresses further when the potatoes