Low storage temperatures are necessary for the preservation and extended shelf life of prepeeled potatoes. During low temperatures, reducing sugars accumulate and often the finished fried product will be darker than desired. The necessity for the low temperature storage and resultant shelf life has been shown by Anderson (5). Ceponis and Fried- man (6) showed length of shelf life and the influence of hydrocooling. Feustel and Harrington (10) found that processors refrigerate the bisulfite solution to cool the potatoes prior to packaging. A solution held at 34°F will effectively reduce the temperature of French-fry cuts to 40°F.

Various treatments have been used to prevent enzymatic discoloration but some form of sulfur is used either alone or in combination with other chemicals. Smith (19, 20, 21) has shown that potato slices for chipping may be treated and held in cold storage until ready for frying. Slices of Katahdin tubers held in one per cent solution of NaHSO₃ for two minutes and stored at 40°F fried to a much lighter chip color during the following seven weeks than slices from similar potatoes stored whole at 40°F for the same length of time. Similar results were obtained with Florida grown Sebago potatoes when slices were treated for four minutes in two per cent NaHSO₃ solution. Anderson and Zapsalis (4) used ascorbic acid in combination with sulfur dioxide while Dubois (8) used ascorbic acid alone. Greig and Smith (13) determined commercial storage life and the influence of numerous chemicals in addition to the sulfur compounds. Anderson et al. (3) found that none of the chelating agents used was as efficient as the sulfite treated. Amla and Francis (2) used phytic acid treatments and obtained shelf life of 16 days at 40°F storage.

The influence of pH and possible exudate of the tissue from too strong a dipping solution was shown by Amla and Francis (1). They recommended a pH range of 5 to 6. In order to prevent exudation completely, Mapson and Wager (14) found that the pH had to be adjusted to 6.5 or above, but under these conditions sulfite was only about half as efficient as at pH 5.3. Olson and Treadway (17) discuss some of the problems of prepeeling and preliminary research showed that the package used and storage conditions after peeling had an influence on surface hardening.

Matarazzo (15) patented the use of a sulfur dioxide dipping solution and now most commercial processors use this method or a slightly modified process. Francis and Amla (11) studied the residual effect of sulfur

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dioxide. Sulfite uptake of the potato pieces was shown by Furlong (12). Ross and Treadway (18) found different rates of sulfite uptake, comparing whole versus the cut potato.

Ewell (9) patented a process using \( \text{SO}_2 \) to prevent enzymatic discoloration followed by a dip in water that was \( \text{CO}_2 \) saturated. The treated vegetables were then enclosed in air-tight containers. Thornton (22, 23) showed the influence of \( \text{CO}_2 \) on the acidity of plant tissue. He also found increased respiration rates when tubers were stored in an atmosphere of \( \text{CO}_2 \). Treadwell and Hall (24) outline procedures for determining carbonic acid. Mullins et al. (16) also give details for this determination.

The present experiments were conducted with modified Ewell’s (9) procedure but both sulfite and carbonic acid were used. The purpose was to use low storage temperatures (32-40 °F) after treatment and to prevent the accumulation of reducing sugars which cause increased darkness in the processed product from the Maillard reaction.

**Materials and Methods**

Katahdin potatoes grown under similar conditions and stored at 50 °F were used for both the French-fry cuts and the fresh potato slices. The tubers were washed, peeled, sliced and rinsed prior to treating. To prevent enzymatic browning, the fresh slices were dipped two minutes in a 0.048M solution of sodium bisulfite (NaHSO\(_3\)). The slices were randomly mixed during slicing, rinsing and dipping.

Carbon dioxide was bubbled into distilled water held at 40 °F. The pH was maintained at 5-5.2 with additional gas being added when pH indicator paper showed a change. Slices were immersed for two minutes in the solution alone and in combination with the bisulfite solution.

After removal from the dipping solution, the slices were drained and packaged in Kordite polyethylene bags. The bags had a carbon dioxide transmission of approximately 1200-1400 cc/mil/24 hr/100 sq. in. Non-perforated bags were used for the fresh slices and some treatments included the use of bags charged with carbon dioxide gas after filling with 30 pounds of slices. Both perforated and non-perforated bags were used for the fresh French-fry cuts.

Kitagawa gas detector tubes were used to determine the concentrations of carbon dioxide and of sulfur dioxide. Where the concentration of carbon dioxide was greater than 5%, the Fyrite gas analyzer was used. The Kitagawa glass detector tubes were inserted into bags at daily intervals and the small puncture was sealed with transparent tape after a gas sample was removed.

Each Kitagawa detector tube contains a carefully measured amount of fine grain activated alumina impregnated with a bluish purple chemical which is sensitive to \( \text{CO}_2 \). When air containing carbon dioxide is drawn through the detector tube, the activated alumina at the inlet turns a pink color, with the total length of discoloration being proportioned to the air concentration.

The pH of the solutions were recorded with a Beckman model G pH meter at the beginning of the dipping procedure. The pH of the solution