Abstract

Precise measurement of tuber stem-end fry color is necessary to determine the fry quality of potatoes (*Solanum tuberosum* L.). Changes in fry color as influenced by small variations in measurement location, delays between slicing and frying, and delays between frying and measuring were examined. Variations in time between frying and measurement, and variations in the location of measurement contributed more to changes in observed color than delays between slicing and frying. The standard visual method for determining stem-end fry color was compared to objective methods using a Photovolt reflectance meter. Photovolt reflectance readings of two types of transverse stem-end tuber slices were compared with those from longitudinal strips. All methods produced closely related results. Optimum sample size and applications for each method are discussed.

Introduction

Stem-end fry color has become an important quality criterion for frozen french fries. Processors require a light, uniform fry color. Tubers from plants exposed to heat and water stress often accumulate reducing sugars in their stem-ends, resulting in a condition known as “dark-end” or “sugar-end” in which the stem-ends of the french fry strips develop a dark brown color when fried (3).

Several methods for measuring french fry color have been developed. Traditionally french fry color has been based on subjective visual comparison of fried potato strips with a standard USDA color chart (1). An objective measurement of fry color based on the light reflectance of fried potato

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strips was reported by Iritani and Weller (3). This technique was modified to specifically measure stem-end fry color (4).

Although potato processors and researchers are increasingly relying on reflectance-based methods, a number of potential problems and errors need to be resolved. Iritani and Weller (3) demonstrated that fry colors became darker with time between frying and color measurement, but the effect of time could vary depending on the distance from the stem-end of the tuber. No information on the effect of delays between slicing and frying on fry colors is available. Fry color reflectance measurement methods are not standardized among laboratories. Standardization and precision in stem-end fry color determination is essential to pay growers fairly and to compare research treatments between locations.

Potato breeding in Idaho, Oregon, and Washington resulted in 210,000 single-hill evaluations in 1992. Selection of single-hills based on tuber type and appearance results in the retention of one or two percent of the lines (2000 to 4000 selections) for further evaluation each year. Light fry color is a necessary attribute for new lines for processing, yet the fry color is often determined only after several years of further evaluation and considerable expense. The determination of fry color early in the breeding program using longitudinal strips destroys the tubers, which are also the only source of plant material for propagation (the tubers could be cored for fry strip but coring could reduce storability). Frying transverse stem-end tuber slices could allow rapid and accurate fry color determination without destroying the entire tuber. The use of sterilized equipment and fungicides can prevent disease transfer between tubers before returning them to storage and subsequent field evaluations.

The purpose of the present study was to evaluate alternatives for objective tuber stem-end fry color determination. Changes in fry color caused by delays between slicing and frying or by delays between frying and measurement were examined. Fry color differences based on reading location were quantified for longitudinal strips. Also four methods of fry color determination were compared. Within a fry color procedure, small changes in protocol could lead to significant differences in fry color. Standardization of procedures, fry color reflectance, and tuber sample sizes are discussed.

**Materials and Methods**

**Time Delay Between Cutting and Frying**

The effect of time delay between tuber cutting and frying was measured at the Malheur Experiment Station, Oregon State University, Ontario, Oregon, using Russet Burbank tubers (Figure 1). The tubers were chosen from a research sample exhibiting a wide range in stem-end fry