

PROCESSING QUALITY IN STORAGE

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INTRODUCTION

Managing processing quality in storage is not just an after harvest concern, but rather needs to be an integration of both the in-field and storage influential conditions. Cultural and environmental conditions during the growing season influence processing quality of the harvested and stored potatoes. One major field factor that can affect quality and fry color is stress either due to management or environmental conditions. Any physiological or disease-induced stress in the field can also diminish quality relating to the ability to store and process.

Storage conditions need to compliment the field conditions from which the harvested tubers were exposed. These include assessing the physiological status, such as sucrose content, maturity level of the vines and tubers, temperature the tubers may have been exposed to, and disease exposure and pressure. Many of these factors will dictate storage curing and final holding temperatures, and also duration in storage.

Primary concerns involved in managing for processing quality are to minimize sugar accumulation, weight loss, sprout development, and disease problems. The association between one of these concerns and another needs to be assessed and integrated into your storage management.

When it comes to sugar accumulation, sucrose and/or reducing sugars, it can occur in the field or can occur in storage due to low temperatures, sprouting, a change in tuber physiology, or physiological age ('senescent sweetening'). Understanding how each of these factors can affect fry color and quality can aid in minimizing quality reduction problems that can occur in storage. The relationship between sugar content and fry color is primarily due to the reaction of reducing sugars (glucose and fructose) with amino acids in the presence of heat to form the darkened color of fried products. Although sucrose is not directly involved in this non-enzymatic darkening, it is a pool or source for reducing sugar accumulation.

RECENT UNIVERSITY OF IDAHO STORAGE RESEARCH

The University of Idaho is fortunate to have a unique potato storage research facility that allows directed research at these major quality concerns for the fry processing industry. About 60% of Idaho's potato crop are utilized in the processing industry. The Potato Storage Research facility is equipped with 9 computerized bins, patterned after

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commercial storages, which have independently controlled environments. Our research team at the University of Idaho addresses many of these fry quality and storage relationships and incorporates in-field factors and physiology of the tubers.

Research has looked at an in-field association with tuber storability and quality maintenance. Tuber maturity is an important consideration as it is related to vine kill and vines senescence at harvest. Late season applications of nitrogen can also delay maturity. Immaturity and over maturity have been shown to influence processing quality. Stress during the growing season can influence quality, physiology and maturity of the tuber. Environmental conditions are always implicated in the seasonal and field differences in processing quality although exact conditions that promote degeneration of quality are not known. These are some of the in-field factors we are currently evaluating at the University of Idaho.

VARIETIES AND STORAGE MANAGEMENT

An important change in the french fry industry is the recent utilization of other cultivars besides 'Russet Burbank'. Accumulation of knowledge over the past many years regarding the processing quality and storability of 'Russet Burbank' is great, but there is limited knowledge and history with other processing cultivars such as 'Ranger Russet,' 'Shepody' and 'Umatilla.' Research emphasis has been directed at these newer cultivars especially since not all cultivars respond the same in both the field and storage.

Typically 'Russet Burbank' is stored at 45°F or higher to qualify for french fry processing quality. A major component of the Potato Storage Research Facility is to evaluate storage at 42°F, 45°F and 48°F to observe best storage temperature effects for the various cultivars. Seasonal differences are evident in how the cultivars respond to the storage temperatures, but general observations regarding cultivars that process well at cooler storage temperatures and that may hold acceptable quality for duration in storage is an important research component (See Figures 1, 2, and Table 1). Cooler storage temperatures promote greater glucose accumulation with time in storage, but some cultivars such as 'Gem Russet' and 'Umatilla' maintain lower concentrations compared to 'Ranger Russet'.

Sprouting differences in terms of apical dominance and timing among the cultivars are quite pronounced. For example, 'Umatilla' and 'Ranger Russet' tend to break dormancy at all the eyes in comparison to 'Russet Burbank' that has stronger apical dominance and breaks dormancy first at the bud end.

Curing temperatures are very important for wound healing and typically extend for 2-3 weeks at 50-55°F. Sprout inhibitors are typically not applied during this time to avoid interference with wound healing. Some storage managers have lengthened curing time to 'pre-condition' the potatoes and respire off unwanted glucose units to help decrease reducing sugar accumulation and subsequent quality reductions. Preconditioning can also be accomplished by decreasing temperature daily down to the final holding temperature at a slower rate. After a one-year study with green-vine potatoes, there was

no significant difference in glucose concentration or fry color with potatoes that were decreased 0.2°F/day compared to 0.5°F/day. In some seasons when sucrose or reducing sugars are high early in the storage season or among different cultivars a difference may be observable between the ramping (rate of decreasing storage temperatures) rates on fry quality.

Fry color problems can be due to high reducing sugars due to field conditions and/or low storage temperatures, senescent sweetening, or due to color variability or mottling. Senescent sweetening can be cultivar dependent and can occur late in the storage season. This sweetening is irreversible, and therefore, the fry color cannot be altered with reconditioning. Color variability or mottling are cultivar dependent, can occur early or late in storage, and may be associated with a stress response. The causal factor or exact physiological mechanism of this mottling is unknown. In some situations it may be senescent sweetening. Color variability appears to be more prominent in the processing cultivar 'Ranger Russet' making long-term storage of this cultivar restricted.

Associated with maintaining good processing quality and fry color is the importance of controlling sprout development in storage. Inhibiting sprout development will aid in minimizing weight loss and reducing sugar accumulation. Physiological changes in a potato upon initiation of sprouting will cause increases in reducing sugar and potential for unacceptable fry color. Sprout development can impede airflow and affect temperature, thus reducing overall quality of the potato. Sprout suppression is a very important aspect of maintaining processing quality.

One major component of maintaining processing quality in storage is the type and amount of disease present. If disease is present, depending upon the pathogen, storage temperatures and duration appropriate to processing quality may not be applicable. Storage management for processing quality also needs to address disease management.

SUMMARY

Producing and maintaining processing quality for fries is a combination of many factors. In-field conditions, cultivar, physiological state of the tuber, disease pressure, storage management, sprout suppression, and storage facility can all influence processing quality.

Figure 1. Glucose (% fwt) content of cultivars stored at 42F for 2 seasons

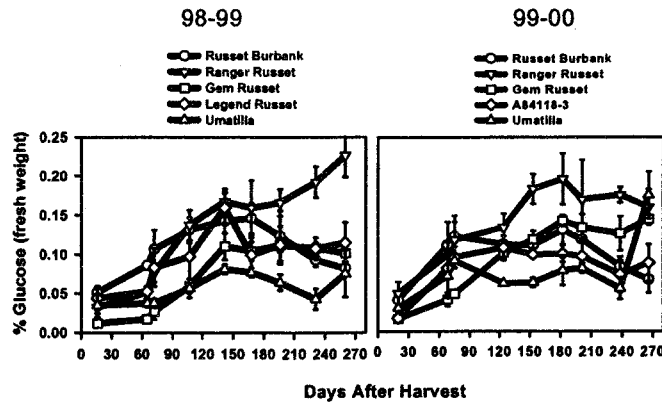


Figure 2. Glucose (% fwt) content of cultivars stored at 48F for 2 seasons

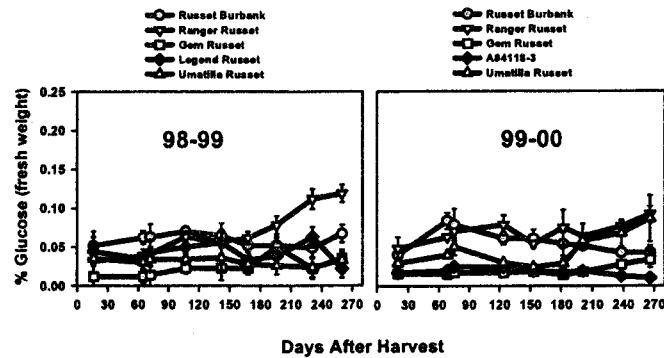


Table 1. 2000-01 Initial Processing Quality Data

| Variety | Specific Gravity | 21 days after harvest Glucose (% fwt) | Sucrose (% fwt) |
|-----------------|------------------|---|--------------------|
| Russet Burbank | 1.076 | 0.054 a | 0.083 |
| Ranger Russet | 1.082 | 0.043 a | 0.098 |
| Gem Russet | 1.083 | 0.012 b | 0.109 |
| A84118-3 | 1.077 | 0.022 b | 0.110 |
| Umatilla Russet | 1.083 | 0.026 b | 0.090 |
| Bannock Russet | 1.087 | 0.020 b | 0.108 |