Potato Progress

Research and Extension for Washington's Potato Industry
Published by Washington State Potato Commission **www.potatoes.com**
Andrew Jensen, Editor. Submit articles and comments to: ajensen@potatoes.com
108 Interlake Rd., Moses Lake, WA 98837; Fax: 509-765-4853; Phone: 509-765-8845.

Volume V, Number 8 *May 19, 2005*

Exploring Potato Phytonutrients

Roy Navarre and Roshani Shakya
USDA-ARS and WSU, Prosser, WA

Popular diets and potato consumption

The recent popularity of low-carbohydrate diets has impacted consumption of traditional staples such as potatoes, rice, bread, and pasta. This year the National Potato Promotion Board initiated a 4.5 million dollar marketing campaign to promote the nutritional advantages of potato. Likewise, falling sales in Britain, prompted the British Potato Council to launch a "Fab not Fad" marketing campaign and to aggressively criticize "fad diets."

Recent years have shown that consumer perception about the nutritional value of potato impacts sales. The spectacular success of modern agriculture in the developed world has led to a plentiful and inexpensive food supply for the first time in human history, consequently changing how people think about food. Given this, what food traits are most valued by modern consumers? While yield and disease resistance are hugely important to the agricultural industry, such traits may be only indirectly important (i.e. inexpensive food supply) to the consumer strolling down the supermarket produce section. Important criteria to shoppers are perhaps a combination of price, appearance, ease of preparation, and taste. Recently a new factor seems to be becoming increasingly significant, that of perceived nutritional value of a food. In light of these criteria, potato is in a strong position to remain a staple on the dinner plate.

Potato phytonutrients

With so many food choices available to people, competition will likely be fierce for a place on the dinner table. Last year, a few prominent scientists made negative statements about the nutritional value of potato. These remarks were perplexing because potato has many nutritionally desirable qualities, including high amounts of Vitamin C and potassium. Remarks like these, combined with the negative opinion about carbohydrates espoused by those promoting low-carb diets, emphasize the importance of ensuring the public is well aware of the many nutritional benefits of potato, lest potato consumption come to be seen as a "guilty pleasure."

The nutritional content of potato could be the single most important trait to maximize in the next generation of mainstream potatoes because no other trait may have as big an impact on sales. Generally, crops have been bred and selected primarily for traits such as yield, disease resistance, and appearance. Historically, little effort has been directed towards increasing the nutritive value of any crop for reasons including that there were more pressing issues, plus the daunting technical difficulty of such an undertaking. With most crops, including potatoes, nutrient profiles are available only for a few varieties. Thus, surprisingly little is known about how much vitamins and phytonutrients naturally vary amongst different varieties. Consequently, we have little idea whether there is potato germplasm "out there" that has dramatically more of a particular vitamin or phytonutrient than another variety. Knowing this would tell us how much we could reasonably expect to increase phytonutrient/phytochemical levels in new varieties. If

phytonutrients levels can be increased in future varieties or if novel phytonutrients are found in existing varieties, then this would help in promoting the nutritional value of potato, help the public keep a positive perception of potato and undermine any who claim potatoes are just "carbohydrates or empty calories."

When food is more than food

The perception of food is changing and the term "functional food" is an increasingly trendy label. This term refers to looking beyond foods as just sources of basic nutrition, but as sources of chemicals that have health promoting effects. A functional food guide pyramid was developed that classifies foods based on multiple health promoting categories, such as vision, immunostimulant, heart health, anticancer etc. American consumer interest in compounds that have such effects is evident in the $2-3 billion a year spent on vitamin/phytochemical supplements. Phytochemicals are simply non-nutritive substances in plants that possess health-protective effects. Red wines and tea have been in the news lately, receiving widespread favorable coverage because of some of the putative health-promoting effects of their phenolic compounds.

Potato phenolics

Phenolics are a broad class of compounds with 1000s of different types, some of which have known health benefits. These are amongst the first class of compounds we have chosen to examine because potato can have abundant phenolics. Preliminary results (**Figure 1**) show the total phenolics and total flavonoids in 3 potato varieties, amongst which Norkotah had the most total phenolics and total flavonoids. This is part of a larger study with more replicates and many more varieties which will tell us which genotypes have the most of these compounds and how much amounts vary.

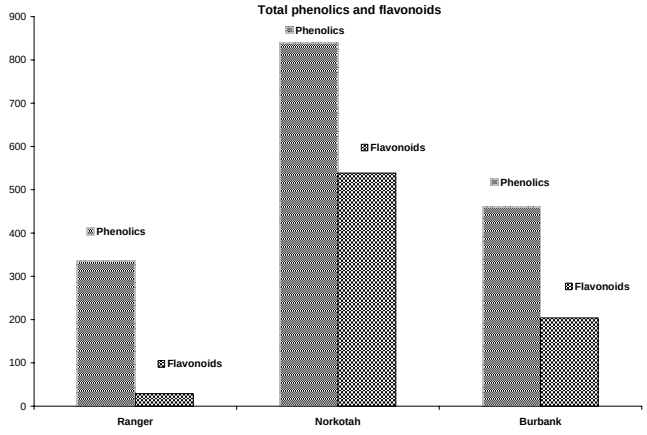

Figure 1. Total phenolics and total flavonoids in 3 russets.

Many potato nutrients differ in the amounts that accumulate in the skin versus the flesh. **Figure 2** shows the distribution of total phenolics or flavonoids amongst the skin or flesh of Ranger Russet. The majority of phenolic compounds are found in the skin, but sizeable amounts are also present in the flesh. Potato skins are well known to be nutritious and consumers who realize this can choose recipes which include skins. Depending on the types and amounts of phenolics we find, this may suggest new uses for the potato skins generated during French fry processing, as these compounds are typically water extractable and thus might be easily recoverable from the skins and be a potential "value added" product.

The data in **Figure 1 and 2** were collected by a simple assay that gives a crude overview of potato phenolics. We are conducting a much more sophisticated analysis using HPLC and mass spectrometry which allows us to quantitate individual phenolics and even identify novel compounds. We are using HPLC-MS to screen potato germplasm to identify phenolics known to have health benefits. We are focusing on colorless phenolics that can be used in mainstream white-fleshed potatoes.

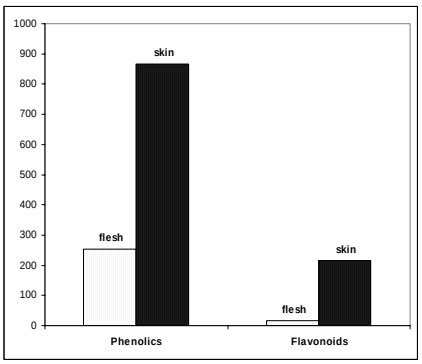

Figure 2. Comparison of phenolics and flavonoids in skin or flesh of Ranger Russet.

Amongst the most abundant phenolics we find in tubers are caffeoyl-esters. One of these caffeoyl-esters is chlorogenic acid, shown in **Figure 3**.

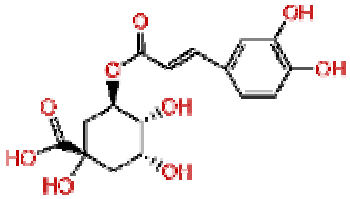

Figure 3. Structure of chlorogenic acid

Chlorogenic acid is a compound with several beneficial properties and was recently the "molecule of the week" by the American Chemical Society. Chlorogenic acid is an antioxidant, reported by some to be 5 times more potent than vitamin C and is also thought to boost vitamin C activity. It is also reported to have anti-cancer properties and be anti-viral and anti-bacterial. Fascinatingly, chlorogenic acid has been shown to slow the release of glucose into the bloodstream after a meal, a trait that could be important to those seeking to follow a low glycemic diet. Chlorogenic acid supplements are widely available in health stores. Interestingly, a patent application has been filed for the use of chlorogenic acid as an additive that can confer a pleasant sweet taste to non-sweet foods or mask bitter tastes or off-tastes imparted by artificial sweeteners.

Potato has many other phenolic compounds besides chlorogenic acid, some more abundant than others. **Figure 4** shows the output from HPLC analysis of phenolics extracted from Norkotah tuber flesh. Chlorogenic acid and vitamin C are labeled in the top panel. Also seen in these profiles are other abundant peaks, as yet unidentified, while additional peaks that are lower abundance are shown in the bottom panel of **Figure 4**.

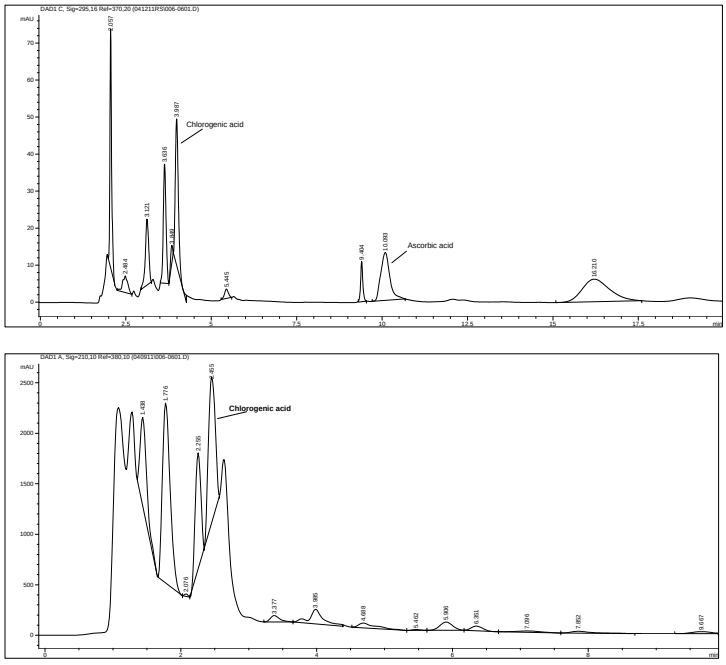

Figure 4. HPLC chromatograph of phenolics from Russet Norkotah tubers.

Potatoes are eaten in larger quantities than many vegetables, thus the potential exists that even the lower abundant phenolics in potato may be relevant. Upon completion of this study, we will have extensive knowledge of potato phenolics and know which ones are the best candidates to increase in future varieties.

Additional possibilities

Some of the biochemical pathways that make phenolics are inducible—that is they can be made to make more. We are exploring methods that might be used post-harvest to increase the amounts of tuber phenolics. If these methods are successful, then they might be an easy way to even further enhance the nutritional value of potato. Interestingly, some of the same compounds we are interested in for nutritional reasons are known to be involved in plant pathogen and pest resistance. Pathogen infection can change the phenolic content of tubers, as we found different phenolic profiles this summer in PVY infected Ranger versus uninfected Ranger.

Beet Leafhopper Flights Getting Started

Andy Jensen, WSPC

Regional beet leafhopper trapping is just getting underway, and the first traps coming in are showing beet leafhopper is active already. We will be reporting leafhopper numbers from a subset of the trap sites we are using for the tuber moth trapping system. Leafhopper counts will be reported on the WSPC website within a few days at: www.potatoes.com/research.cfm.

Everyone should remember that the regional leafhopper reporting system that we implement each year is not meant to be used as a guide for treatment actions on individual fields. **The only way to be sure you are treating your fields appropriately is to monitor each field.** Yellow sticky traps should be placed among weeds surrounding your fields, about 2-3" above the ground or plant canopy. Put traps among broadleaf weeds, especially where they are sparse or mowed regularly. These cards should be checked and replaced at least weekly. If you are unsure about identification of beet leafhopper, send or bring your traps to me at the commission office or to other persons who can recognize beet leafhopper for you.

Join us for a discussion of

Potato Tuber Moth: Prospects for Control and Current Research

Sponsored by:
Oregon State University and the
Washington State Potato Commission

Experts at Hand:

- George Clough, Sandra DeBano, and Phil Hamm, OSU, Hermiston
- Andrew Jensen, Washington Potato Commission
- Joseph Munyaneza, USDA-ARS, Wapato
- Alan Schreiber, Agricultural Development Group, Inc.

Two Times and Locations for Your Convenience:

June 1, 2005, 10:00 AM - Noon
OSU Hermiston Agricultural Research and Extension Center
and
June 2, 2005, 10:00 AM – Noon
Red Lion, Pasco, WA

Topics Covered:

- PTM Monitoring Data: Winter and Spring Trends
- PTM Biology and Suggested Practices for Control
- Current and Future Research

WSU Potato Field Day – June 24

Mark J. Pavek
Washington State University, Pullman, WA

This year's annual potato field day will be held on June 24, 2005 at the Washington State University Research Farm near Othello. A major attraction of the field day is the commercial seed lot trial. For the fourth year in a row, the total number of seed lot samples submitted for evaluation has increased. This year, 376 seedlots were planted in the trial; compared with 343 in 2004, 335 in 2003, and 312 in 2002. In addition to viewing the seed lots, you will be able to participate in one of three concurrent sessions (see page 6). Sessions I and II will allow you to view a sample of this year's in-field research. We anticipate that all three sessions will offer CCA credits, and that Sessions II and III will offer pesticide applicator recertification credits. The potato field day will begin at 8:30 am on Friday, June 24. A hosted-lunch, offered between 11:30 and 1:30, will complete the field day.

WSU Potato Field Day – June 24, 2005

Located at WSU Othello Research Unit

(6 miles East of Hwy. 26/17 Junction, On Booker Rd, ¼ Mile South of Hwy. 26)

8:30 - 9:00 am Coffee and rolls

9:00 - 10:20 am Visit Seed Lot Trial

Concurrent Session I

Potato Cultural Practices Field Tour

10:30 am **Effects of Reduced In-Season Nitrogen on 8 Potato Varieties**
Mark Pavek, Ed Driskill, and Zach Holden - Washington State University, Pullman

10:45 am **Effects of Seed Maturity, Pre-Plant Handling and In-row Spacing on Tuber Set and Size Development**
R*ick Knowles, Lisa Knowles, and Nora Fuller* - WSU, Pullman

11:00 am **Moderating Tuber Size Development in Norkotah Selections Through Stem Number Manipulation**
Rick Knowles, Lisa Knowles, and Nora Fuller - WSU, Pullman

11:15 am **Early Harvest Ranger – Economics of Seed Piece Spacing**
Mark Pavek, Ed Driskill, and Zach Holden - WSU, Pullman

11:30 am **Crop Growth & Storability Profiles for Newly Release Cultivars**
Rick Knowles, Mark Pavek, Lisa Knowles, Ed Driskill, Nora Fuller, Zach Holden – WSU, Pullman

11:40 am **Are Some Potato Cultivars Really More Susceptible to PVY and Why?**
Dan Hane and Phil Hamm - OSU, Hermiston

11:50 am - 1:30 pm **HOSTED LUNCH**

Concurrent Session II

Potato Pest Management Field Tour

10:30 am **How Fulfill (pymetrozine) and Novodor (B.t. tenebrionsis) Affect Insects in Potatoes**
Gary Chang and Bill Snyder - WSU, Pullman

10:45 am **Conserving Beneficial Nematodes**
Ricardo Ramirez II and Bill Snyder - WSU, Pullman

11:05 am **Application Timing of Fungicides for Black Dot Control**
Tom Cummings and Dennis Johnson - WSU, Pullman

11:20 am **Predator Diversity and the Biological Control of Potato Pests**
Cory Straub and Bill Snyder - WSU, Pullman

11:35 am **Beneficial Insects (and Spiders) in Potato Fields**
Bill Snyder - WSU, Pullman

11:55 am - 1:30 pm **HOSTED LUNCH**

Concurrent Session III

Potato Pest Management Workshop

10:30 am **Management summary for Sclerotinia stem rot, Bacterial Stem Rot, Verticillium Wilt, and Black Leg**
Dennis Johnson and Tom Cummings – WSU - Pullman

11:00 am **Management of Beet Leafhoppers and Potato Purple Top**
Joseph Munyaneza – USDA-ARS Yakima, *Andy Jensen* – WA Potato Commission

11:30 am **Wireworm Field Studies at the Wapato Laboratory: 1) Baiting to Predict Damage, and 2) Depth of Soil Profile**
Dave Horton, USDA-ARS, Wapato

2:00 pm **Potato Tuber Moth: Biology and Potential Control Methods**
Sandy DeBano – OSU, Hermiston

12:30 - 1:30 pm **HOSTED LUNCH**