Poverty Reduction Through Native Potato Chips

By Jason Held, International Potato Center, Lima, Peru

My name is Jason Held and I completed an internship program at the International Potato Center (CIP) in Lima, Peru during the summer of 2001. In May of 2000, I received notice that I would represent my school, Central High School in Davenport, Iowa, at the World Food Prize Youth Institute in October of 2000.

Before I attended the Youth Institute, I knew nothing about agriculture or food security. After researching the safety of crops whose genes are modified unconventionally and presenting a paper at the Youth Institute, I became interested about the subject of crop improvement and increasing food production to decrease malnutrition and starvation.

I listened to presentations from former youth interns who had traveled to research institutes in Kenya, India, Mexico, and Peru, and I was motivated to apply for an internship. I had always wanted to work in a research center, and learning about agriculture and food security at the Youth Institute interested me enough to pursue a summer internship where I would be able to learn more.

After finding out that I would be going to CIP, I was excited, but I was also unsure of what I would be doing at the Potato Center and what it would be like there. I also needed to do some research on potatoes.

I found that the Peru is where the potato originated. There are over 100 potato species and over 3,500 varieties. The potato's importance in Peru is very visible. Almost

all regions grow potatoes for either sustenance purposes or commercially. On a global scale, potatoes are the fourth most important crop, trailing behind wheat, corn, and rice.

Potatoes also are very healthy. A medium-size potato contains half the daily required amount of Vitamin C. It also contains only 5 percent of the fat content of wheat, and one-fourth of the calories found in bread. For the research and studying of potatoes, there is no greater institute than CIP.

CIP is a non-profit research institute that works toward the improvement of quality, production, management, and utilization of potatoes, sweet potatoes, and other root and tuber crops. CIP operates under the organization Future Harvest, whose goal is to increase food security, reduce poverty, and increase environmental awareness. CIP has the largest genebank in the world, carrying thousands of wild, traditional, and improved varieties of potato and sweet potato.

Stationed in the district of La Molina in the city of Lima, Peru, CIP carries out the majority of its research and testing there, however in order to test out improved and experimental varieties, it's necessary to have farmland in many different parts of the country. There are satellite research stations located in Huancayo and San Ramón, Peru, and regional offices in India, Kenya, and Indonesia.

On the CIP compound are departmental buildings, greenhouses, fields for growing potatoes and sweet potatoes, cafeterias, and a recreation area, including a basketball court, four racquetball courts, a volleyball court, and a weight room and a gymnasium with aerobic classes in session daily. Many people use their one hour lunch break to play sports or card games.

During my first week at CIP, I didn't pay much attention to games. I had the serious task of finding a department to work in where I felt comfortable and a project that interested me. Finding a department was tough. My favorite science subject has always been chemistry, so I searched for a department where I could do something in that field. I didn't have much luck. The basic jobs I could handle weren't directly involved with any projects, and ones that were involved with projects required the help of persons with more experience. I abandoned looking for a project involving chemistry and focused on selecting one of the projects at CIP that suited me.

I was briefed on many of the Potato Center's projects. The most highly regarded and most funded project dealt with research on resistance for Potato Late Blight disease, the

A farming community in Aymara, a city on the outskirts of Huancayo. The dark areas are where potatoes are grown and harvested.

cause of the Irish Potato Famine and the largest threat to potatoes around the world. A major part of the problem is the amount of herbicides and other sprays that are needed to combat the disease. Sometimes sprays can't even control it, because the fungus-like organism keeps mutating. I was introduced to other projects that consisted of discovering genes for resistance against viruses or pests; finding better ways to grow potatoes, such as using True Potato Seed, seeds that come from potato berries, instead of tubers; and creating a database to share information with universities throughout the world.

While these projects seemed interesting, there didn't seem to be much I could do to assist their development. There were many people working on those projects and I didn't feel that my help would be needed or wanted. I wanted a project that I could work on and see my results. When I saw the native potato project, I knew I found what I was looking for.

"Added Value for Andean Communities from Native Potatoes" is a project that promotes biodiversity and genetic resource conservation while attempting to reduce poverty. I chose to work on this project because it touched on a variety of the center's activities, which gave me the freedom to change my daily duties while continuing to work toward the main objectives.

The primary goal of the Added Value Project is to reduce poverty in the Andean region of Peru. Many families live in rural communities that practice sustenance farming and live in the poorest conditions. Potatoes are their main source of food, and are usually consumed for breakfast, lunch, and dinner. Other families sell one or two potato varieties commercially, but earn very little money. The key to making more money for these

farmers is to find markets where the potatoes that currently are used solely for sustenance purposes can be sold.

In Peru, processed foods are becoming increasingly popular. If several native potato varieties can be found to possess excellent qualities for post-harvest production as potato chips, and if they will produce sizable yields in varying conditions, the income generated from selling the potatoes to chip producers will help reduce poverty.

By giving farmers incentives to keep growing native potatoes, the farmers are also encouraged to stay in their rural communities. In addition, the diversity of the native potato varieties will be maintained. This is beneficial to CIP researchers who are looking for genes that determine desirable genetic traits in potatoes.

Throughout my internship, I traveled to farming communities to get opinions from the farmers who grew potatoes. I also took part in a biodiversity fair in order to conduct interviews with farmers to find out what characteristics they look for in potatoes, how they use potatoes, what types of potatoes they grow, and what types they enjoy.

Biodiversity fairs are celebrations of cultural diversity among the different Andean communities. This cultural diversity includes food, dress, handiwork, and dance. There are usually three or four held every year in different communities. Due to travel expenses, usually only communities surrounding the site of the event participate.

The biodiversity fair that I attended was held in Yauyus, Peru. On the day of the event, representatives of their communities arrived by bus, horse, and burro. They brought many items that were unique to their community and set up stands to display and sell their goods. This particular fair celebrated typical meals of the communities. I had the opportunity to eat guinea pig and alpaca, a cousin of the llama. Native potatoes were

found at a majority of the stands, because potatoes are such an important part of the lives of the people in the rural communities. Several farmers brought over a dozen native potato varieties. They take pride in the colorful tubers and the interesting shapes.

By talking with the farmers at the biodiversity fair, I found that they prefer native potatoes over the normal white potatoes because native potatoes have better flavor and texture. They feel that native potatoes have a "mealy" texture that the white potatoes don't have. I also found that the farmers continue to increase the size of their white potato plots only because of the white potato's commercial value. Although they grow many white potatoes, they recognize the value of the diversity of the native potatoes.

When I went to the small village of Aymara to see the farms and community, it hurt me to see the conditions that they were living in. I was accustomed to seeing poverty in Lima, where poor people sit in the streets begging for food and money or peddle trinkets for a few dollars a day. The rural poverty is different. In Aymara, like in many Andean rural communities, there is no running water. Water is taken from a stream or well and boiled. Men, women, and children do backbreaking labor from sunrise to sunset in the fields. They earn very little. When I asked a man how he felt about his living situation, he said its not very comfortable but it's life and there's not much he can do about it.

Interviewing the farmers helped me with my task for the project, which was to help identify potatoes that would be good to make chips. The project supervisor, CIP Scientist Walter Amoros, assigned me to work in the processing laboratory. The first day in the lab, I met Faviola del Villar, the woman with whom I would be working on the selection process. I was surprised when I realized that Mrs. del Villar did not speak a

word of English. From the time I left the airport up to that moment, I had spoken with everyone from CIP in English. It was my turn to show off my foreign language proficiency. When I tried to speak, I managed to screw up almost every word I said. With the best intentions, Mr. Amoros arranged for me to take Spanish lessons for an hour a day. After a few lessons, I realized that after taking four years of Spanish in school, I had a decent vocabulary. The only thing I needed to do was speak more in Spanish. So I quit the lessons, spoke the best Spanish I could, and started to work on the Native Potato Project.

350 native potato varieties were pre-selected from 11 different species. The first step of the process was to give each potato sample a number, labeling the size, shape, skin color, flesh color, and distribution of color. Giving the potato an identification number categorized the potatoes by their visible characteristics, allowing for easy identification.

Flesh color was the most important characteristic observed. This was because in native potatoes, pigments such as yellow carotenoids and red and purple anthocyanins produce a wide variety of flesh colors. While primary flesh colors ranged from white to dark yellow, secondary flesh colors included many hues and intensities of red and purple. Looking at a cross section of a native potato that has secondary colors, the colors can be found as rings of varying thickness, or spots of varying size located centrally or sporadically throughout the cross section. The secondary colors and the patterns that they make give the potatoes a particular appeal that might help chips made from these potatoes sell.

After each potato was numbered, testing the post-harvest production qualities began. The first trait tested was dry matter content.

Dry matter content is the percentage, by mass, of dry matter of the fresh weight of a potato. In general, potatoes that have a higher dry matter content will have a firmer texture, better quality after processing, and less oil absorption during the frying process, making it less fatty after frying.

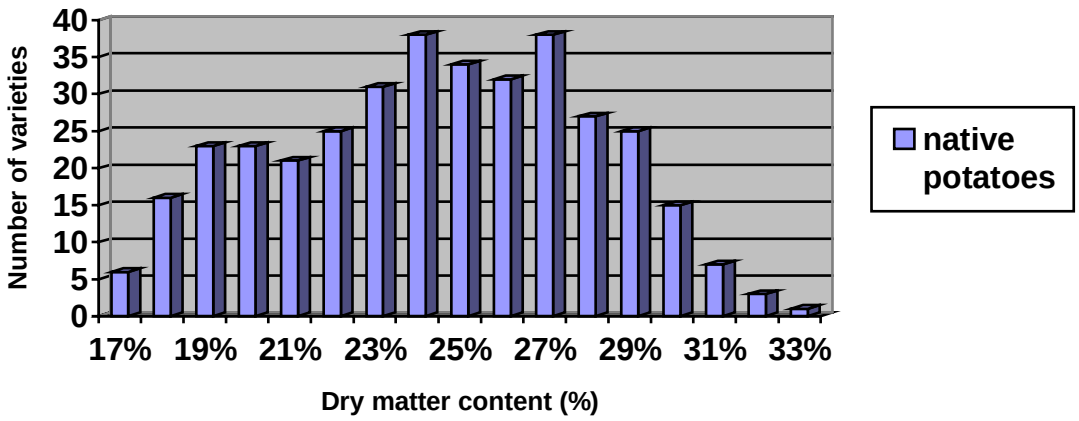
Testing for dry matter content was rather simple. First, a 300 to 400 gram sample of the potato was diced by machine. Then, the sample was divided in half, and each half was massed individually and recorded. The sample was then dried in an oven at 100° C for 72 hours so that

Potato chips made from the variety Chuncho (s. goniocalyx).

no moisture was left in the sample. After drying, the sample was massed again and recorded. To determine the dry matter content, the mass of the dried potato was divided by the mass of the original fresh weight of the potato and multiplied by 100. Potatoes had a wide range of dry matter contents, from 17-33%. Potatoes with dry matter contents of 24% or higher were considered to be suitable for post-harvest production as chips.

Frying the potatoes was the next step in determining which of them would be good for chips. This allowed for observation and testing of characteristics like reducing sugar content and taste.

Frequency distribution for dry matter content in native potato samples



Preparing the potatoes and frying them was a job that required several people to work at the same time in order to finish in a timely fashion. The whole job was carried out like an assembly line. The first person operated the potato slicer and sliced three potatoes of each variety, placing separate varieties in separate tubs along with the identification number. The tubs were passed on to the second person, who washed the potato samples. Washing the potatoes took a substantial amount of time. It was necessary to rinse the potato slices in water at least four or five times to eliminate any dirt. After

washing, the potato slices were passed on to two to three people who dried the slices on towels, placed them in fryer baskets, and fried them.

The frying process was carried out using a commercial deep fryer and vegetable oil. The potato slices were placed in the fryer heated to 180° C for 1 ½ to 2 minutes or until bubbling ceased. The potato chips were removed to dry and placed on trays to cool. After frying, it was possible to view the reducing sugar content of the potato sample.

Reducing sugar content in potatoes was also a major factor in deciding which chips were good to make into chips. Potatoes with a high content of reducing sugars turned a dark brown color after frying, giving the chip a more bitter and "burnt" taste. This makes the chip undesirable on the chip market, so potatoes with less reducing sugars were sought.

Reducing sugar content was not measured directly, but determined through observing the darkness of the fried chip. Chips were rated on a scale from 1 to 5, with 5 being the darkest coloring. Chips that were labeled with a 4 or 5 were not regarded as quality chips.

Even though dry matter content is a decent indicator of the amount of oil that will be absorbed in a potato after it is fried, oil absorption tests were still done. A 10 to 20 gram sample of each variety of chip was taken and crushed using a mortar and pestle. The crushed sample of chips was massed and recorded. Then the sample was placed in a metal chamber and pressurized under high pressure for two minutes until the oil completely separated from the potato chip sample. Then the chip sample, a thick circular disc, was massed and recorded. To determine the amount of oil absorption, the mass of the circular disc sample was subtracted from the mass of the original chip sample. The oil

absorption tests were not valued much because it was not possible to test every chip produced due to time constraints.

Using information obtained from lab testing and surveys, 20 of the 350 native potato varieties were selected as having excellent qualities for producing potato chips. This completed the selection process.

Although the selection was finished, there was still a great deal of work to be done before the Andean farmers could start making money. Further testing and selecting was needed because the potatoes were selected from tests done on harvested potatoes. Results were needed from tests in the field to see how well the potatoes would yield.

Potatoes varieties with superior qualities for post-harvest production as potato chips

variety name	id number	specie
Yana Rucunag	**701531**	**s. goniocalyx**
Sapa Negra	**700532**	**s. goniocalyx**
Muru Warmi	**701076**	**s. goniocalyx**
Yana Shucre	**703197**	**s. goniocalyx**
Puca Mama	**706675**	**s. stenotomun**
Unknown	**706910**	**s. goniocalyx**
Unknown	**700425**	**s. chaucha**
Chuncho	**705946**	**s. chaucha**
Papa Chonca	**703495**	**s. goniocalyx**
Llipucha	**705514**	**s. goniocalyx**
Ojosa	**704143**	**s. goniocalyx**
Chaucha Rumpa	**706809**	**s. stenotomun**
Pulupapa	**704970**	**s. goniocalyx**
Ambar	**703741**	**s. goniocalyx**
Añil Papa	**703844**	**s. goniocalyx**
Puca Micush	**702736**	**s. chaucha**
Chimbina Colora	**701013**	**s. goniocalyx**
Chaucha Naranji	**706829**	**s. goniocalyx**

The next step of the project was figuring out how to store and display the chips. The chips were sealed in individual air-tight baggies so they would not decompose. Mrs. del Villar designed a way to display the chips that were made from the selected varieties of native potatoes. Individual chips were sealed in along a long, narrow plastic baggie. Display is very important for gaining support from companies, or for obtaining government funded grants. Almost always they are looking for something visual to understand the concept.

When a Frito-Lay representative from Wisconsin came to CIP on the last day of my internship, I got a chance to explain to him why I thought Frito-Lay should sponsor the native potato chips. I showed him a chip that had a purple secondary color that appeared to form the shape of a bicycle. My suggestion was to advertise the native potato chips as “chip art”. While it might not have been a great idea, it shows that many times, researchers must use creative thinking skills in order to complete a project.

The Added Value Project, however, was by no means complete, but, because of my contribution to the project, the task of selecting promising varieties of potatoes to make into chips was accomplished. This was a big hurdle that needed to be jumped before further progress could be made. The 20 varieties that I helped select are being planted in varied locations throughout Peru. After being tested, the ones with high yields will be distributed to farmers to grow. With the potatoes identified, it will be easier to obtain corporate sponsorship from companies like Frito-Lay or one of its subsidiaries. With corporate sponsorship, chip production can begin, farmers can earn money, and poverty can be greatly decreased in Andean rural communities.

During my internship, I learned that projects aren't completed rapidly. They proceed slowly and many times there are setbacks, sometimes major ones. I learned that goals are never reached by giving up. No matter how big of a project is being undertaken, whether it's finding the right combination of genes to fight off Potato Late Blight, or the right characteristics in a potato to make it into a potato chip, determination and perseverance lead to success. By learning this, I've also changed my outlook on food security.

Before working at CIP, I didn't think that there could be food security throughout the world. I didn't think that enough food could be produced and distributed to where it was needed. Through my internship at CIP, I realized that there are many people that are coming up with new ideas to increase food security and decrease poverty, malnutrition, and starvation. As long as these people persevere and young people with the same general ideals continue to work for an in increase in food security, suffering due to the lack of food will be eliminated.