Feeding the World

Improving the quality and nutrients of soy products through scientific research

Lazarus E. Lynch

The World Food Prize Borlaug~Ruan International Internship

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS

This life-changing experience is a result of the hard work and dedication of so many exceptional individuals. I am eternally indebted to their gracious support throughout this entire journey with me because I realize that without them, I could not have been accomplished. Therefore, I would like to thank them all here.

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I would like to thank Mrs. Dongfang Pan for accepting, yet another Borlaug~Ruan International Intern to study at the Chinese Academy of Agricultural Sciences. Thank you for treating me as a son and looking out for me. Thank you, Dr. Shi Bo for working so diligently with me on my experiment and explaining difficult procedures to me. I appreciate your attentiveness to me when I was at my low points. I would like to thank Solomon for guiding me through each step of the way and helping me in conducting this incredible research. Thank you for introducing me to Beijing International Christian Fellowship and for being a constant friend. Thank you, 4-H for inspiring me as a young person to take on these food-related challenges and endeavor to make a difference even within my local community.

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THE NATIONAL FEED ENGINEERING AND TECHNOLOGY RESEARCH CENTER OF THE CHINESE ACADEMY OF AGRICULTURAL SCIENCES

The Chinese Academy of Agricultural Sciences (CAAS) was established in 1957. Unlike other provincial agricultural research institutes, CAAS is China’s national agricultural research institution, under the administration of the Ministry of Agriculture. CAAS has a strategic task of serving nation-wide agricultural and rural development and empowering farmers with science and technology. Its major mandates focus on strategic and applied research solving determinant and key scientific problems which are of national or regional importance. CAAS has about 10,000 staff members and 38 research institutes located across 17 different provinces, national municipalities and the autonomous regions. In 1996,the Ministry of Agriculture conducted an assessment of agriculture science and technology research organizations nationwide. 17 CAAS institutes were among the top 100.

As the only agricultural research academy in China that can confer Ph.D. degree in agricultural sciences, CAAS has a Graduate School, five State Key Crop Variety Improvement Centers and subcenters, 22 national and ministerial level Key Open Laboratories, and 17 national and ministerial commodity quality supervision and testing centers. Meanwhile, the academy owns about 100 scientific and technology based enterprises with nearly 2100 personnel engaged in science and technology business development. CAAS is representing China's agricultural science and technology for international collaboration. CAAS has extensive international cooperation relationships with more than 40 countries and international organizations including the Consultative Group for International Agricultural Research(CGIAR).

By the year 2030, the Chinese population will reach 1.6 billion. The problems of population pressure, food security, environment and the stress on resources are becoming most acute. China's annual food grain production should, compared with the present level, increase another 150 million kg, reaching the level of 680 million kg per annum. Seriously constrained by arable land and irrigation water, the breakthrough of science and technology is the only way to realize our nation agricultural development objectives. This is reflected in President Jiang Zemin's call for a "new revolution in agricultural science and technology."

In this modernization drive, CAAS is developing an overall strategic plan that positions fundamental research, applied research, bio-technology and industrial business development as its main thrusts. Continuously optimizing these disciplinary combinations, CAAS will open new research fields with clear priorities. CAAS will also pay great attention to capacity building for the 21st century, in order to strengthen the academy itself as well as its efforts to empower the sustainable rural and agribusiness development with science and technology .With the growing trend of globalization of science and technology, CAAS looks upon international cooperation as a corner stone for advancing China's agricultural research, upgrading people's welfare and optimizing the management of natural resources. We would like to share our vision, our efforts and our sincerity with friends of the North and South, to embrace a challenging and promising 21 century.

FAREWELL AMERICA

Standing there on the airport line, hugging my family and saying good-bye was emotionally stirring for me. I thought of my family and my friends, my church and my school, and everything and everyone else I was leaving behind to embark upon a journey I had never known. Ready to do something I had never done before and to call a new place home for two months, I set out on a new journey to Beijing, China. The unprecedented challenges of food security struck me while I was on the plane. I began to ponder the distinguishable statistics regarding hunger in China. I thought about a recent study directed by the Food and Agriculture Organization on "*The State of Food Insecurity in the World" which* shows that in 2005-07, undernourishment still affected 130 million people in China, about 10 percent of the population - most of them living in the countryside in central and western regions. I knew that the challenge ahead of me would be great. In retrospect, I can epitomize my feeling while taking those steps onto the plane and leaving America to experience not just a new culture, new people, a new language and different foods, but also the experience in helping to feed the world. This was the best "life-challenge" that I could have ever taken.

UPON ARRIVAL

After a long and tiresome flight, I had arrived in China. I was happy to meet two university staff members who were waiting for me, Solomon, who would be my teacher and good friend throughout my internship and Oliver, a secretary at the research institute. I greeted them with a hug and "Ni hoa!" The excitement of being in a new country came over me and the thoughts of my project and the work I would be doing made me anxious to begin. Solomon had to remind me that we would get to the project but first I needed to become oriented with my surroundings and meet all the people who I would be working with.

That evening, I met Wang, who worked at his family restaurant that cooked for the entire dormitory. He would soon become my friend for two months. We exchanged in simple conversation, recognizing our difficulties to communicate in the others language. What began as a friendly gesture in conversation became the start of a tutoring class that would persist throughout my two month tenure.

BEFORE MY RESEARCH

The university is comprised of many research institutes such as the Institute of Animal Science, Institute of Agro-food Science & Technology, and the Feed Research Institute. Solomon explained to me that I would be working at the Feed Research Institute conducting food science and soy bean related research. I met some of the graduate students at the Feed Research, who were studying for their masters in food science, plant protection, animal nutrition, human ecology and crop sciences. They each began to tell me about the research they were conducting and the courses they were studying. I was surprised how many of them could actually speak English.

Over the first few days, Solomon showed me around the Feed Research Institute and introduced me to Dr. Shi Bo, the head professor in feed additives by means of chemical synthesize and biology engineering department. I noticed that everyone referred to him as Master, as an act of respect. Dr. Bo was very glad to have me working in his lab amid his other graduate students. He asked me what my interests were and what kind of science background did I have. I proceeded to explain my how I wanted to go to Cornell University to study nutritional sciences. I also talked with him about my background experience working in a hydroponic and aquaponic lab which integrated chemistry, biology and food science. He seemed very excited about my interest and told me that he would try to accommodate my interest. He explained to me that I would be working with Solomon conducting research on a soybean experiment.

The fact that I would be working with Solomon gave me some assurance that I would understand everything because he spoke English well. He took me on a tour of the university; showing me the different equipment and machinery that are used in the feed research school. He specified the type of machines we would use for our soy bean experiment such as the auto clave, the ultrasonic cleaning machine, the rotary evaporator, the magnetic stirring apparatus, the pH meter, the small and large centrifuge, the High-Performance Liquid Chromatography (HPLC), the High-Speed Counter-Current Chromatography, the UV spectrophoto meter, and more.

Throughout my first few days at the university, I was still meeting new people. One of the new people I met later on during my first week was Mrs. Dongfang Pan. Mrs. Pan greeted me like I was one of her sons. She seemed really happy to be receiving a new intern at CAAS. I noticed that Mrs. Pan's English was especially clear as she welcomed me to the university. She mentioned to me that Solomon goes to church and if I was interested, I could attend with him. I thanked her for that offer and told her I would go and visit. After a formal introduction, she invited me out to dinner with her and her son Joe. She mentioned that Joe and I were the same age and that he always likes to socialize with the interns from America. I was looking forward to seeing Mrs. Dongfang Pan again and meeting her son Joe. Over the two months, Mrs. Pan became my China mother and Joe my China brother.

My first week in China was a fast one, full of interaction and smiling faces and language confusions. After spending a week in the dorm at CAAS and in the lab, I spent time reflecting on the day and journaling my daily experiences. I looked forward to what the next week would bring. I wondered if the science would be too difficult for me to understand. I also wondered how my project would relate to global food security. Although food security is such a broad topic, I wondered what people were doing in China to combat the epidemic against hunger. I wondered how Dr. Shi Bo's research of feed additives could possibly establish a ground for food security. I was eager to find out how my experiment could help end world hunger by the year 2050.

BEGINNING MY RESEARCH

During my first week, Solomon gave me research papers to read over to prepare for the project. I spent the second week skimming through those difficult papers and researching every other word I could not understand. These research papers provided a succinct background on the history of isoflavonoid research and soybeans at large.

For the first few days of my second week of the internship, I met with Dr. Shi Bo in the lab to discuss the research that his students were conducting on feed additives. He told me that each year he sensibly selects a different research project for each of his master's students that overall relate to food additives. He began to explain to me that the soybean experiment is a fairly new one but that there has been research conducted on this topic by many other scientists. That week, Dr. Shi Bo hosted a seminar and allowed his students to share their findings about their experiments throughout the week.

I spent the next several days observing Solomon's work in the laboratory. The first experiment I embarked upon in the lab was preparing a potato dextrose agar culture media. Preparing this kind of culture media began with mixing three main components: potatoes, dextrose, and agar. I learned that there are a plethora of different types of culture media such as liquid medias that one can use in supporting the growth of bacteria. The type of culture media we were using contain the type of bacteria we were growing. The culture media begins as a liquid then sets as a gel to support the growth of the given bacteria and fungi; aspergillus sojae and aspergillus oryzae.

While I was in the lab, I regressed back to my 10th grade biology class preparing a culture media PDA *(Potato Dextrose Agar)* in a petri-dish. It was refreshing to begin this exciting project being that I spent the first few days observing and taking tons of notes. It was exciting because my knowledge of science was growing and I was ready for the challenge.

I was inspired and gained lots of insight that day while in the lab because I realized that as a researcher and/or scientist, you are privaleged with the wonderful opportunity to create new hypothesis, try experiments again and again, innovate new procedures and be in control of your research. I think chefs are researchers and scientists too. We are always thinking of new ways to develop new recipes, enhance our skills, and the quality of the food we serve for others to enjoy and benefit from! To me, having this understanding makes science a lot more extraordinary and this is what I think should be better emphasized to students in all learning institutions!

For my experiment, we used the PDA formula as a growth media to culture two specific classes of microorganisms such as aspergillus sojae and aspergillus oryzae; types of fungi. Solomon said I would have a better perspective on the project at large if I made PDA myself rather than buying it pre-made from a science company. PDA is traditionally used for growing clinically significant yeast and molds. The nutritionally rich base (potato infusion) encourages mold sporulation and pigment production in some Dermatophytes.

Dermatophytes are simply types of fungi that cause common skin, hair and nail infections such as athlete's foot and ringworm. There are many steps for preparing the growth media PDA. The formula is initially in the form of a liquid, and then becomes a solid as it sits, by way of the agar. After we prepared the solution, we poured it into the petri-dishes in the culture chamber, and allowed them to solidify. After the culture media solidified in the petri-dish, I began to apply the fungi, aspergillus sojae to the PDA.

A few days prior, I prepared the elicitor; aspergillus sojae, according to how Solomon showed me. I applied the elicitor to the solidified culture media, wrapped it tightly and placed in the incubator. After a few days, this fungi grew on the culture media and formed colonies. Once these colonies had been formed, I had enough fungi to begin preparing the elicitor. Preparing the elicitor is quite a simple task, but it required a great deal of focus.

Before we could begin this experiment, we would have to use a machine called the culturing chamber. The culture chamber was used to provide safe and sanitary conditions for performing laboratory tasks. Thirty minutes before I began the experiment, I turned on the culture chamber's fan and UV light, to sterilize the chamber. This process became habitual in my mind the more I used it. In the meantime, I would pour 15µl of distilled water into two 50ml cronical flasks. I took out my culture media from the refrigerator and brought it over with the two flask to the culture chamber. When 30 minutes had elapsed, I turned off the UV light and turned on the white light in the chamber.

I now needed to sterilize the surface of the chamber and my hands with a cloth submerged in acetic acid. After sterilization, I lit the light burner with a lighter. This will be used to sterilize my wire loop. I sterilized the wire loop until it was a bright orange. After allowing it to cool, I gently wiped it on the surface of the culture media, making sure to pick up a little bit of the aspergillus sojae. Then I placed the wire loop into one 50ml cronical flask and stirred it around with the wire loop until it appeared clean of fungi. I repeated this process twice for each 50ml flask. Essentially, each 50ml flask is to have two wire loop servings of fungi. Once this was done, I covered the top of the 50ml flask with newspaper and tied it up with a rubber band. Once they were covered, I turned off the culture chamber and brought the flask to the culturing chamber incubator. This machine is used for spinning the sample tubes, allowing the liquid to have far more contact with air. This increases the percentage of oxygen within the liquid. I placed the flask in the incubator and it spanned at 150rmp for 3-4 hours. Once my elicitors finished spinning in the incubator, my soybeans received 20µl of elicitor. When the elicitor is applied, I covered my soybeans with the top of the petri-dish and wrapped it in newspaper and placed it into the Labonce Stability Chamber (large incubator) at 25°C for 3 days!

After 3 days, we were ready to move forward in the process of extraction. The process of extracting the soybeans is both interesting and involved. I looked forward to opening up the newspaper to see what the soybeans looked like and what changes they had undergone in the last 3 days. I removed the newspapers from around the Petri-dishes, containing the soybeans and noticed that the soybeans had undergone both a physical and chemical change. The beans changed in a physical way because they now appeared slightly black and greenish. They had changed chemically because now the glyceollin and other isoflavonoid components that were lying dormant in the soybeans had become activated by way of the elicitor. Again, the elicitor functions as an *activator* of chemical compounds in the given food item; soybeans.

The first step in extracting the soybeans is weighing the soybeans on the super sensitive magnetic scale. Once they have been weighed, you have to place it in a mortar pestle and crush them until it resembled a paste. After they have been crushed, I dropped a magnet into a 50ml glass and added the soybeans. Then I covered the crushed beans with 45µl of 80% ethanol and then covered it with clear plastic wrap so that the ethanol would not evaporate. After that, I placed the 50ml glass onto the magnetic stirring apparatus. This magnetic scale is really au courant to me because it not only stirs components, but it also heats and regulates temperatures. The magnetic stirring apparatus is designed with a small 6 inch plate that is both a magnet and a heater. When you place the glass with a magnet in the glass onto the surface of the plate, the magnets connect and the magnet inside of the glass begins to spin and warm up.

For stirring the crushed soy beans, the temperature needs to be set at 50°C. So, I set the temperature to 50°C and waited until the temperature of the soybean mixture reached 50°C. Once it came to temperature, I allowed it to stir for one hour. When the hour elapsed, I turned off the machine and allowed my samples to cool down. In the meantime, I set up a few plastic test tubes to pour my samples into after the soybean mixture cooled, I used four plastic test tubes. I marked the four test tubes: A, B, C, and D. Now, it was time to centrifuge my samples.

The high-speed centrifuge machine is a separation machine used to separate solids from liquid. I used this machine as a way to separate my soybean solution. After placing my samples into the high speed centrifuge machine in opposite directions to balance the weight, I closed its door, powered it on and set the time for 10 minutes then pressed start. The soybean solution spun for 10 minutes at a speed of 12,000 rpm.

Once the time has elapsed, I pulled out my samples and noticed that the soybeans were settled at the bottom of the tube and a light golden-brownish liquid floated at the top of the tube. Before I can store the tubes, I wanted to measure it in the volumetric flask. This will make sure that I have enough solution for the next step of the experiment; HPLC. I poured the samples into a volumetric flask until it reached the line. If the sample did not reach the line, I poured in ethanol to reach the line. Once all samples were measured, I placed them into new plastic test tubes and labeled them once more and placed them into a zip lock bag. I marked the date and each sample: A, B, C, and D on the bag and placed it into the fridge until I am ready to use it for High Performance Liquid Chromatography machine.

Occasionally, I would spend my mornings in the lab preparing an acetic acid solvent system for the High-Performance Liquid Chromatography (HPLC) machine. The HPLC machine is used for separating, detecting and analyzing data. The first time, Solomon gave me an entire lesson on how to use the HPLC machine to collect some data to find out which solutions contained glyceollin. He told me that the next time he would test my knowledge and allow me to operate the HPLC machine. We used a filter machine to ensure that the solutions had no impurities before it went through the HPLC machine. Everything done in the lab had to be extremely sanitary to ensure accuracy or else it would interfere with our results. Using the correct column was also very important for this type of experiment. We used a Multiring C18 reverse phase column, a specific column used for analyzing our soy bean samples.

As I began to carry out the experiment on the HPLC machine, we went through several stages of set up prior to actually using it to gather data. After turning on the machine, the first step was preparing two standardized sanitizing solutions, A- Acetri Acid Water and B- Acentonitrile. We had to test the pH for each of them and adjust them with ethanol if necessary. We then filtered our solutions to keep them free of microorganisms before we used it for detecting samples. We then connected pipeline A to solution A and pipeline B to solution B. After making sure each solution was connected to the correct line, I turned on my UV- detector which would soon produce the needed results for the experiment. I placed my samples of inoculated and un-inoculated soybeans into the sample tray and began detecting each sample.

RESULTS

I did not completely understand the process of the HPLC machine and how it calculated data. However, as the column pushed with pressure each individual sample into the UV- detector, they began to show on the computer screen. We set the HPLC machine to run for about 24 hours and would come back the next day to check our results. The next morning we would arrive, our results would be displayed on the computer screen and we would write down the retention time that glyceollin was most present in which samples. We also placed this data into a chart on the computer for future reference. Our results showed us that isoflavonoid glyceollin I, II and III were most present at an average of 33 minutes. Throughout my research work, I learned how soy isoflavones glyceollin work as a functional ingredient for mammalian health. Functional ingredients are components in foods that are proven to have nutritious qualities. According to this research, when our beans were stressed or inoculated, they were shown to produce higher levels of isoflavonoid glyceollin than un-inoculated soybeans. Isoflavonoid, glyceollin has been reported to lower levels of cardiovascular disease, osteoporosis and certain types of cancers. The result of this has raised the question amid many researchers and scientist whether this “functional ingredient,” glyceollin, can be added to other soy products such as miso, soy sauce and soy milk in a way that will be safe and beneficial to its consumers. Such an answer is still held in ambiguity between researchers as procuring the safest and most nutritious solution may take much time and dedicated research.

WHAT HAVE I LEARNED?

I would have never thought in a million years that I would be helping to feed the world by being in a laboratory. I was really into culinary arts and nutrition as a high school freshmen, but I did not give thought to the feed additive scientific aspect of research until this summer in Beijing working with Dr. Shi Bo and Solomon. He was so knowledgeable about feed additives and how they can be used to benefit mammals. Many times we spoke about the extensive research work he was involved such in by way of his interest. What I realized by working in the lab this summer is how critical the science is to the farmers. Using my expertise to empower farmers with science and technology is now at the forefront of my passion to help end world hunger. I always knew that food insecurity existed at the hands of poor farmers who could not afford adequately provide for seeds, or land or who had access to the global market to make more profit. However, the scientists could provide what the farmers could not provide. And the farmers can provide what the scientist could not provide. The symbiotic relationship between the farmers and the scientist is crucial to the advancement of food security. Understanding this relationship that the farmers can provide the food for the entire world to enjoy, yet the scientist can provide the education about the food being consumed was a great moment of awareness for me.

In my spare time, I would research a lot on the nutritional content in soybeans and what they provide for the human body. I will never undermine the fascinating research that it took to produce those papers with that in depth information. Science changes the world and the way that people of the world looks at things.

Another thing I learned while in China is that we live in very interconnected and symbiotic relational world. Therefore, there are not many things that make us extremely different. This is the lesson I learned after one experience I had while in China. One day after making a presentation to my lab mates about my family and life in America, we all went out to lunch and they ordered this delicious type of blackened fish with hot Chile peppers. I loved ordering fish in China because they would bring you live fish prior to cooking it for your approval. The fish was so succulent and tasty that I asked the waitress for the recipe. They could not understand recipe or its concept so I carefully scrutinized every flavor I tasted and every aroma I smelled and wrote it down. Out of curiosity and a genuine desire to be immersed in the culture, I planned a cultural exchange party with my lab mates.

We had all planned to cook a few dishes that were culturally symbolic and of course, tasty. I searched high and low for American products such as Hunt’s barbeque sauce and a potato masher for mashed potatoes. That afternoon of the cultural party, we gathered up all of our ingredients and headed upstairs of my dormitory to begin our cooking. Some of my lab mates had never cooked a day in their lives and were ready to give it a try under my supervision. Once we had exchanged our recipes and learned how to cook different food, we went down to my room to begin the feast.

As we sat there at the table, we took turns sharing what we were most thankful for and exchanged stories and some of our greatest memories. As we shared stories, the room grew silent and some of us began to express our emotions by crying and laughing. What was so impactful about that moment was that I realized how similar we all were and how, despite our cultural differences, religious persuasions or language barriers, we all were connecting through something deeper than ourselves. This experience has taught me the power of humanity and the strength that lies in our unity.

ADVENTURES

One of the most exhilarating experiences I had while I was in China was climbing the Great Wall; one of the wonders of the world. We drove for about one hour to reach the Badaling part of the Great Wall. Prior to that experience, I thought that the Great Wall was one continuous wall; however, I learned that the Great Wall is actually sections of walls that make up “The Great Wall.”

As we worked our way through the crowds of people, my friend Joe told me that there is a saying in China that goes “You’re not a real man until you’ve climbed the Great Wall!” Through great toil and snare, we finally reached the top of the Wall. With a slightly accelerated heart rate and my clothes sticking to my body, I stood at the top feeling triumphant. Many stood there with an ostensible cheerfulness concealing their tiredness and taking pictures of the mountainous view. There was a tranquility and serenity that I embraced as I stood there imagining the hard work of those who labored and lost their lives building this Wall to protect their country!

MY JOURNEY

China has greatly impacted my view of humankind and our world in many ways. Learning how to connect with others of a different nationality, religious persuasion and culture was something I better developed while being there. There were days when I would be done in the laboratory and would go to my room and watch the English version of CCTV (Chinese Central Television News Network), learning of international news and thus becoming more aware of the world and myself. During my last few weeks, I spent a great amount of time with my new life-long friends whom I met at church. One thing I got from each of them was taking the time to enjoy the beauty of simple things like reading a book, for example. Although initially I thought that this was an unrealistic occurrence for me, due to always being busy, I now incorporate that leisure time for myself of enjoying a good book. We would often sit in café’s for hours reading and then sharing our favorite parts of the books we read so far. I found that to be both very stimulating and inspiring.

My view of humanity has also been greatly impacted in a number of ways. Being in China has taught me the importance of values. I can recall having conversations with some of my Chinese friends about what their value system was and what were the principles they lived by. The most often stated answer I got was honesty. The purity of honesty, for many of my Chinese friends was at the core of their value system and I learned what that meant. It did not just mean always telling the truth but also that I would take responsibility for my behavior and be true to myself first.

I also learned the importance of hope. I grew to know so many of the people through conversations. I remember having one conversation with a good friend about our futures. He told me things like “One day, I hope to get a chance to go to America,” or “If I am lucky, I will do this or I will do that.” The usage of those words if and lucky showed me how based their culture is in dreaming of a potential reality, that may or may not happen. To me, this sounded more like recognition of their present conditions and a hope for a brighter future, rather than a defeated testimony. What I learned from that was remaining hopeful for a better future is the key to the enjoying this path called life.

This internship experience was not simply a vacation or a nice reward for writing a research paper. Nor did I view it as a mere external transition from one country to another. Rather, it was a growing opportunity to better learn about the world and myself. This was an internal transition of getting to connect to my authentic self more. While being in a developing country, I was synchronized in that development of self every single day. I remember when Ambassador Quinn spoke with all of the interns before we left to our internships and he said that we would not be the same person when we returned. I invincibly thought to myself that it wouldn’t happen so dramatically to me. Admittedly, I did not anticipate these social, interpersonal, and paradigm changes. I have always had a desire to travel and see the world and learn about other cultures, food and religions but never did I think that I would also be learning of me as well. My internship has given my life deeper meaning and a profound love for knowledge and learning not only the science of food but also the science of life.

Ultimately feeding the world does not just refer to there being enough food to adequately and nutritiously satisfy generations to come, but it is also means sharing in the love and joy that it takes to provide that food for people in a way that would restore the hopelessness and struggle in their lives. It is taking on the responsibility of empowering those who cannot sufficiently access quality food to take charge of their lives and begin to rise up as self-sufficient individuals and nations. Self-sufficient by definition of able to do for themselves without sole reliance on other nations for sustenance. This sustenance refers not only to a temporal physical fulfillment but also a perpetually internally-sustaining foundation that will produce advancement within communities and networks of people.

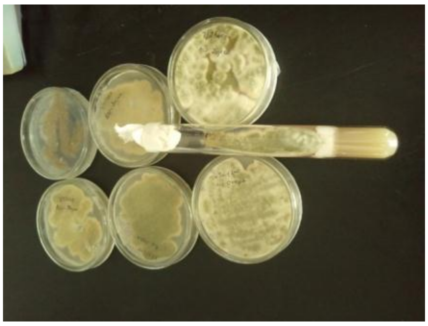
While working in the laboratory this summer on improving the quality of soy products for better food security, I learned this research is wholly devoted to development of nutrition and health for people all over the world. I am grateful for the knowledge I gained every day when speaking to Professor Shi Bo and Solomon, seeing that those conversations enlightened me on the relationship that applied scientific research has to the farmers all over the world. I was also able to effectively apply my previous research education received at school in hydroponics and aquaponics to conducting this caliber of scientific research.

Behind all of the science and deep within my heart is the motivation to improve the quality of food worldwide, which in turn will enrich the lives of people. I have made a new commitment to sharing this same passion of feeding the world with other young people to cause them to be inspired and provoke them to act as catalyst in response to the crisis. As a 2011 Borlaug~Ruan international intern, I think not only about the privilege and adventure of traveling to another country and experiencing that pleasure that stems from that, but I also think about the honor to be considered an ambassador of the World Food Prize Foundation and to their legacy.

Responding to the challenges of the small-holder farmers and those who lack security to safe and nutritious food has given my life a deeper meaning. I will no longer underestimate the power of myself in addressing these global crises. I greatly esteem the honor to touch the hands and hearts of other people through research. Although only time will tell what my assistance in this research project has directly done for people suffering with osteoporosis, cancer and cardiovascular diseases, I do know that in the words of the late Dr. Norman E. Borlaug, “Man can and must prevent the tragedy of famine in the future instead of merely trying with pious regret to salvage the human wreckage of the famine, as he has so often done in the past… Almost certainly, however, the first essential component of social justice is adequate food for all mankind.”

PICTURES

Preparing a culture media (PDA)

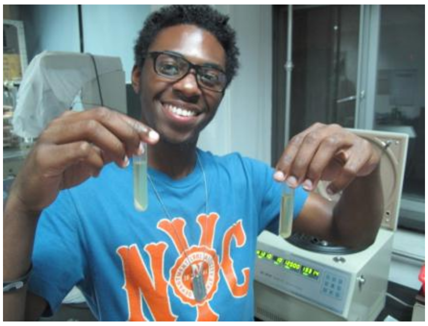


Bacterial Growth after 3 days in the incubator

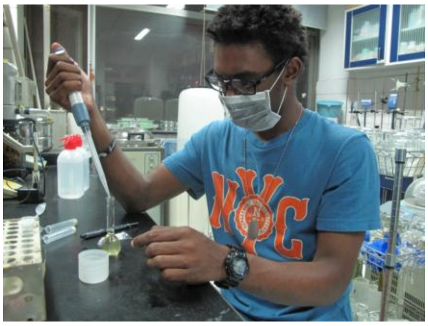
Preparing an elicitor (aspergillus sojae)

Wounding soybeans to apply elicitor

Crushed soybeans after they were wounded



Centrifuged soybeans to separate the solids



Adding ethanol to liquid samples

Detecting and graphing glyceollin of liquid samples

Further detection of samples in HSCCC

Climbing the Great Wall of China

Eating the fresh corn from a local farmer

Sorting through Chinese breed of soybeans

ABSTRACT

1. THE TOPIC IS SPECIFICALLY ON EXPLORING SOY

My topic is biotic means of activating phytochemical glyceollin from soybeans. I will analyze from cultured soybeans its antifungal effects and cancer preventive properties. The objective of my study is to identify the health benefits of soy-based foods dependent on their hormonal and phytochemical properties. The study will address the unique soy phytochemicals that were not previously monitored for estrogenic and ant estrogenic properties. My mentor is a graduate student at the Chinese Academy of Agricultural Sciences.

2a. THE IMPORTANCE OF THE TOPIC AND WHY IT WAS CHOSEN.

Soy bean has long been consumed as an important protein source to complement grain proteins in Asian countries and other part of the world. Besides proteins, they contain various nutritious and functional components such as isoflavonoids, which help protect against metabolic diseases. The wide range knowledge about plant crop foods has arisen two fold. For example, many researchers have finally begun to investigate the healthful properties of plant molecules, especially phytoestrogens, in mammalian species, and the food industry has tried to expand its marketing and sales of products based on the potential health benefits provided by the natural ingredients.

Phytoestrogen research over the next few decades should provide increasing understanding of the benefits of the components of plant foods that have estrogen-like effects at doses that can be readily obtained by the consumption of foods in reasonable amount. That soy food is the only nutritionally relevant dietary source of these phytoestrogens has certainly heightened interest in isoflavones because soy foods have recently been the subject of considerable investigation. Although soybeans do contain numerous biologically active constituents, including phytic acid, phenolic acids, saponins, oligosaccharides, protease inhibitors, glyceollin (stressed soybeans only), phytosterols, linolenic acid, vitamins, and soy protein/peptides. Unquestionably, it is the presence of isoflavones that is overwhelmingly responsible for the interest in soy. Research on the health effects of isoflavones has become more important because soy foods are no longer the only means by which consumers can ingest these phytochemicals.

2b.WHY WAS IT CHOSEN?

The increased incidence of endometrial cancer, and other related cancer cases paved way for the chosen topic. Studies have shown that these compounds have positive health effects on metabolic diseases such as obesity, inflammation, and cardiovascular diseases. Recent studies have found that glyceollin are candidate cancer preventative compounds for hormone-dependent tumors. Glyceollins have also been reported to mediate anti-hormonal effects through estrogen receptor-R and -β in MCF-7 cells. Glyceollins are known to suppress the proliferation of breast cancer cells in Postmenopausal female monkeys through their antiestrogenic action when estrogen activated proliferation. However, antiestrogenic compounds can disturb homeostasis.

3a. EXPERINMENTAL DESIGN AND METHODS:

There are four steps designed in the method of experiment.

a. Sterilization and culture of soybeans

b. Application of elicitors and elicitor effect.

c. Incubation process for 72 hours.

d. Extraction and detection by HPLC

3b. THE EXPERIMENTAL DESIGN AND METHODS USED IN THIS EXPERIMENT ARE SHOWN BELOW.

1. Preparation of biotic elicitor
2. Soy bean treatment
3. HPLC analysis

3c. DATA PRODUCED

Although no experiment has been performed, this is the anticipated results.

Data that will be produced from the experiment includes-

1. Chromatograph of elicited soy cotyledons
2. The retention time for each chromatograph
3. Peak area of the detected sample
4. Height and level of peaks observed
5. Detection of samples differentiating the control (A) expands the main experiment (B) which has elicitor applied to it.

The experimental procedures are in stages. Each stage of the experiment and all procedures are to be precisely followed in order to accurate good data.

RESULTS:-

In a summary, the anticipated outcome of the result will give a more understanding about the experiments, and a broader view about the phytochemical compounds glyceollin.

The results was feature the following

a. The seeds were elicited
b. The seeds that were not elicited
c. The wounded and unwounded seeds to show the level of accumulation of phytochemicals.
d. The healthy seeds to show if glyceollin is present in non- elicited seeds.
e. The level of peak area in detected and confirmed samples.

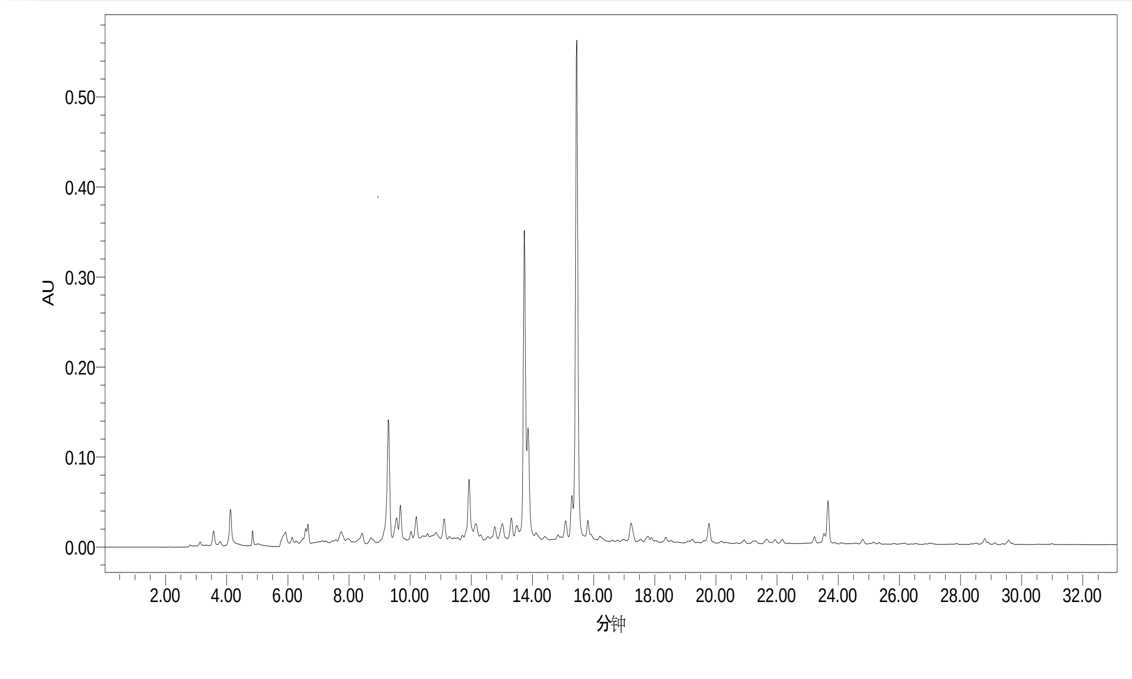
CONCLUSION

The summary of the above listed features that will be looked out for will help in determining the outcome of the experiment and to confirm if this compound can only be gotten in stressed seeds or healthy seeds. I project that the soybeans will prove that they contain preventive properties against osteoporosis, breast and prostate cancers and cardiovascular disease. In addition, the soybeans will prove to have low and high concentrations in estrogenic activity in the biphasic activities.

High Performance Liquid Chromatography

Un-inoculated seeds of soybeans with elicitor applied.

Figure 1.



Healthy seeds which served as control of the experiment

Figure 2.

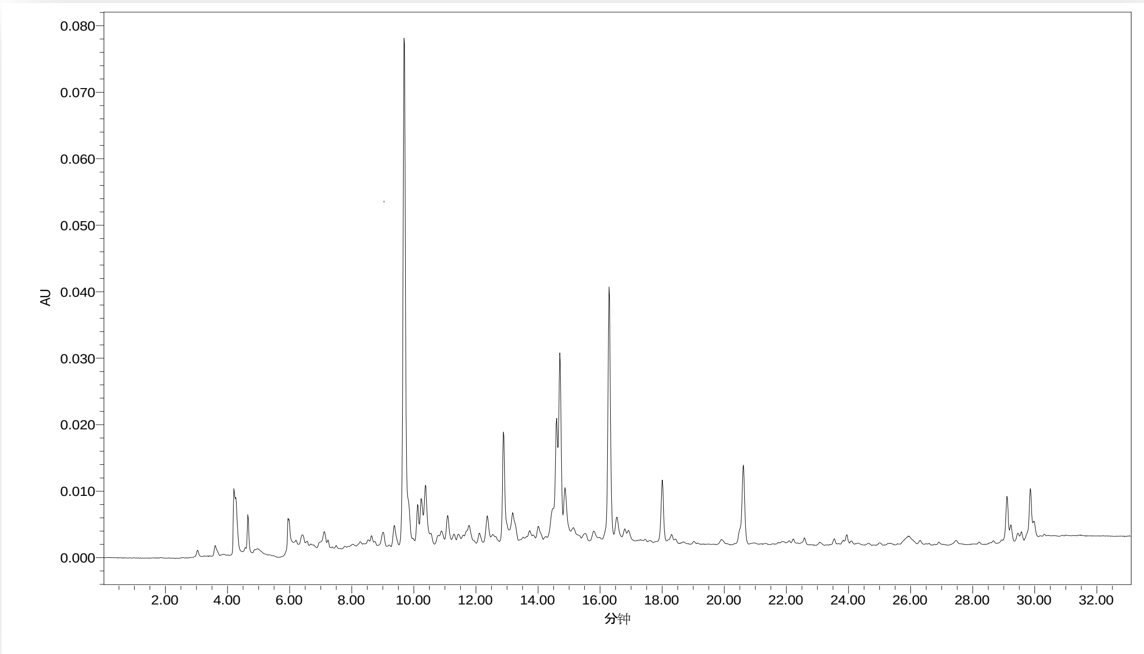
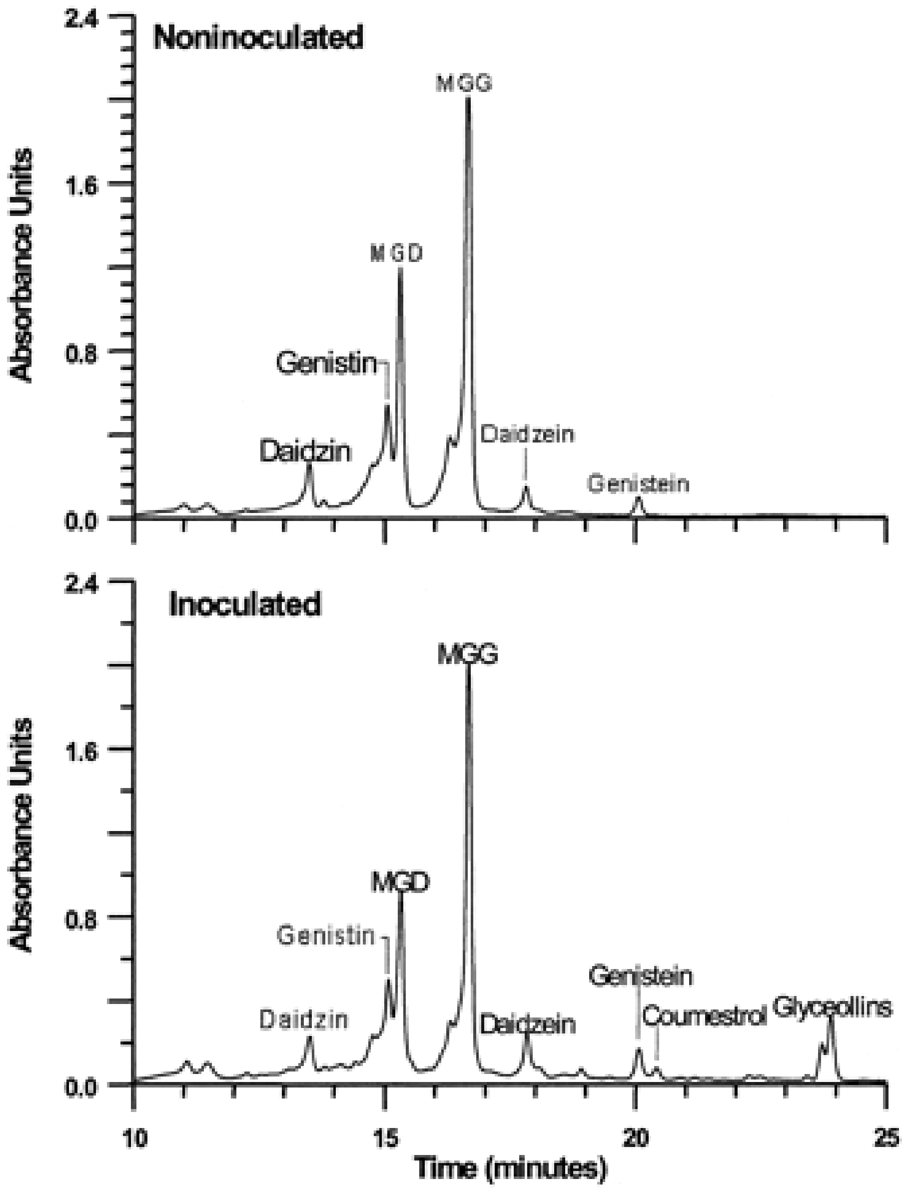


Figure 3.



The data represent steady state amounts of glyceollins I-III and coumestrol at or near their peak levels after 3 days at 260 nm.

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