Oral History of Illinois Agriculture

Catalog Number:	ALPLM_28_WeingartnerKar
Interviewee:	**Karl Weingartner**
Interviewer:	Mark R. DePue
Interview Date:	September 17, 2008
Interview Location:	National Soybean Research Center on University of Illinois Campus
Recording Format:	Digital Video (.mpg)
Recording Length:	76 min (including 15 minute walk & talk)
Recording Engineer:	Mark Suszko & Il Information Services
Repositories:	Oral History Archive, Illinois State Museum, Springfield, Illinois; Oral History Archive, Abraham Lincoln Presidential Library, Springfield, Illinois
Transcript Length:	19 pages
Transcriber:	Tape Transcription Center, The Skill Bureau, Boston, Massachusetts
Editor:	Michael Maniscalco and
Indexer:	James S. Oliver

Abstract:

Karl E. Weingartner was born on December 12th, 1946 in New York City. Karl attended Clemson University in South Carolina and graduated in 1968 with a degree in food technology. After graduating, he served four years in the Peace Corp on the island of Fiji in the South Pacific. There he served as an agricultural extension advisor to local farmers. After returning to the states in 1973, he worked on an advanced degree in food technology at the University of Florida. In 1975 Karl transferred to the University of Illinois, where he focused his research on soybeans. Following his graduation in 1981, he worked as a food technologist in Nigeria for the International Institute of Tropical Agriculture, then returned to the University of Illinois in 1988 to work at the National Soybean Research Center, specifically at the International Soybean Program (INTSOY), where he now serves as its director. During the bulk of the interview, Weingartner illustrated the various ways that soybeans are processed to be used for human consumption, animal consumption, or industrial use. Specifically, he discussed the basic components of the soybean, primarily oil, protein and fiber. He demonstrated how soymilk was made, as well as soy yogurt and tofu. He also demonstrated how soy oil was extracted from the beans, leaving soy meal as its by-product. He further discussed the de-gumming process, which removes sediments from the oil.

Keywords:

International Soybean Program (INTSOY); National Soybean Research Center; soybean components; processing soybeans for soymilk; soy yogurt production; tofu production; soy oil production; de-gummed soy oil; soy meal

Citation:

Oral History Archives, Illinois State Museum and Abraham Lincoln Presidential Library and Museum, Springfield, Illinois

Interview with Karl Weingartner

ALPLM_28_WeingartnerKar

September 16, 2008

Interviewer: Mark DePue

DePue: Today is Tuesday, September 16, 2008. My name is Mark DePue. I'm the director of oral history at the Abraham Lincoln Presidential Library, and this is a continuation of our series of interviews at the National Soybean Research Center. We have Karl Weingartner—is that how it's pronounced? Am I saying your name right?

Weingartner: Weingartner.

DePue: Okay. Karl, I want you to tell us a little bit about yourself, starting with when and where you were born.

Weingartner: I was born in 1946 in New York City, and I guess that makes me a Baby Boomer—one of the earlier ones. I attended school and high school in New York City, and then after that, I attended an agricultural school similar to the University of Illinois. I attended Clemson University in South Carolina, and it was there that I majored in my field, which is food technology.

DePue: How is a boy, a young lad from New York City suddenly get an interest in agriculture and the food industries?

Weingartner: Well, when I was a high school student, I think I might have been very similar to many of my colleagues and buddies. I didn't know exactly what I wanted to do. I liked engineering and I liked science, and looking through the college course books, I noticed a field called food technology that was very heavily onto chemistry, microbiology, and sciences, but it was very applied. I went down to Clemson after I'd been accepted, and looked the school over, and talked to the department head. And he said to me, amongst other things, "If you do a good job and keep your nose clean and graduate, I can guarantee you you will get a job." And that sounded pretty good to me. So I went to Clemson, majored in food technology, and I continued that on throughout my life, that is, working with food processing and food technology.

DePue: When did you graduate from Clemson?

Weingartner: I graduated in 1968.

DePue: And what happened after that?

Weingartner: After that, I joined the Peace Corps, doing agricultural work in the South Pacific, in the country of Fiji. And in fact, it was there that I met the young lady that later agreed to become my wife. And we are still married. And it's gone very quickly.

DePue: Well, perhaps when that professor said he could guarantee you a job, he wasn't thinking of the Peace Corps. What drew you to the Peace Corps?

Weingartner: It was something that seemed exciting. The chance to go to a faraway place to make a contribution just seemed to be something really, really neat, really different.

DePue: What exactly did you do?

Weingartner: I worked with agriculture Extension. I was involved with working with farmers, doing things very similar to what our Extension agents would do here: helping them with recommendations,

if they needed it, on planting or information on insecticides. I later did some work with the Fiji Research Department, working on developing new varieties of rice.

DePue: How long were you with the Peace Corps, then?

Weingartner: I was with the Peace Corps for four years.

DePue: And I would assume that's an important part of your life. Tell us the most important thing you learned coming out of that experience.

Weingartner: I think one of the things that struck me after four years in Fiji—when I first got to Fiji, everything seemed different; everything seemed strange. After four years, I was able to appreciate how similar—people who look different and act different, how similar their wants and needs are to us in America and to us in a developed country.

DePue: A life-changing experience for you, then?

Weingartner: I think so. Based on that, I still was interested in food technology, but I had much more interest after that in being involved with things to do with international agriculture.

DePue: When did you come back to the United States?

Weingartner: I came back to the United States in 1973. I studied for an advanced degree in food technology at the university of Florida. It so happened at that time, between 1973 and 1975, there was a lot of interest in the United States in soybeans, a crop that I was not familiar with. But after being at Florida, I read a lot about soybeans, and I decided I wanted to learn more about them, especially with regard to food processing. I checked around, and the place to study about this was in fact the University of Illinois. There were several professors working on it at the time. I came up in 1975, and I worked at the University of Illinois towards my degree and graduated in 1981.

DePue: And that was still in food technology?

Weingartner: That was in food technology related to processing and nutrition of soybeans.

DePue: I don't want to put words in your mouth, but I'm guessing that one of the thing that drew you to soybeans is because of your experience in Fiji, you saw the applications for third-world countries with soybeans?

Weingartner: Actually, it was something very, very rooted to economics. During the period that I was at Florida, the price of soybeans... Our American crop didn't do well, and we had contracts—the United States had contracts with the Russians. And the price of soybeans went way, way up—we're talking in the seventies. And it went up, if my recollection is right, somewhere around to eighteen dollars a bushel. The amount might be wrong, but it was a very large amount. So there was a lot of interest in soybeans. And it was then that I read about them and read about their potential as a huge protein source, oil source, and great potential for applications in the field that I am in, which is to use as an ingredient in foods.

DePue: Excellent. Tell us how you ended up here in this research lab, or INTSOY, I believe you said.

Weingartner: Yes. After getting my degree, I worked for an international research institution in Nigeria. It was called the International Institute of Tropical Agriculture. I was a food technologist for them, involved with food processing, and I worked in the grain legumes department. Grain legumes includes such things as black-eyed peas, bambarra nuts, and soybeans. I stayed at that job for a while. I maintained my contacts with the University of Illinois because it's the premier place to go for soybean processing and research. After working in Nigeria for a while,

I was offered a job here at INTSOY as a food technologist working with soybeans, and that's how I came to come here in 1988.

DePue: What does INTSOY mean?

Weingartner: INTSOY is an acronym which stands for International Soybean Program. And it was started at the University of Illinois in 1972. Right now, our mandate is to work to develop processing and utilization of soybeans—that is, to expand the use of soybeans. If we can help people develop more processes and more uses for soybeans, it is our thinking here in Illinois that there will be more people interested in either growing soybeans or importing soybeans.

DePue: But part of the name of the acronym is 'international.' What's the international aspects of it?

Weingartner: The international aspects is to promote the processing and utilization of soybeans all over the world. We have quite a bit of knowledge here in North America, Canada, and the United States, and it's quite possible for us to take that for granted, for us to think that perhaps all the things that we know, folks in other countries don't know. It is true that nowadays, with the help of the World Wide Web, there's a lot of information that's available, but back in the 1970s and then in the eighties, information dissemination was much different than it was today.

One of the things that's interesting about soybeans with its application for international processing is that in the United States, the processes that we use and the capacities that we use are very large. We process in hundreds if not thousands of tons of soybeans per day. It turns out that if you were in a country in perhaps Europe, Russia maybe, maybe in Africa, you might be interested in processing soybeans to use as an animal feed or a food, but the capacities you're going to use may be much smaller. And what that means, if you're going to be a businessman, is you have to find equipment that is sized smaller so that you can make these products but still end up having a profitable business. And that is where INTSOY comes in. We either develop technology or we supply technology or put people in touch with technology that meets their particular needs. We're going to see today some technology that will give examples of what we have been discussing during this interview.

DePue: While you and I are talking, if I can get the camera to just kind of scan the room here real quickly, and then we'll get back to the meat of this. And from what I understand, we're going to go through the various steps of how you can process soybeans, from the very beginning all the way to the end stage. Correct?

Weingartner: Yes.

DePue: Let's go ahead and bring it back here if we can, and start with the basic soybean, right in front of you. If you just want to pick it up and hold it in front of you, perhaps. Just some soybeans. Great. (pause) OK, tell us a little bit about the basic soybean. What does the average person need to know about it?

Weingartner: Soybeans, often when we read articles about them in the magazines and the newspapers, they're called a 'wonder bean' or a 'super bean,' and it is really true. The soybeans, in terms of its composition, is really, really special. When we talk about soybeans, we usually talk about their composition in terms of what is good for either humans or animals. Soybeans are usually classified as an oil seed, which means it is a product where we can extract oil from it. Soybeans contain about eighteen percent oil, and if you take the soybeans and crush it and squeeze it and process it, you can remove that oil, and that can be used as an edible oil.

DePue: And that's something we're going to be able to see today?

Weingartner: Yes. In addition to that, and soybeans, of course, are not the only crop that is used for oil; there are many others. There's cotton seed; there's peanuts. Soybeans are of interest to us because it turns out that for our producers, our farmers, they work very well in part of our crop rotation, along with corn.

DePue: Okay, The soybeans that you have in your hand right now, do they still have the hull on them?

Weingartner: Yes, they do.

DePue: So one of the first steps would be to remove the hull, is that correct?

Weingartner: Yes.

DePue: What happens to the hull after it's removed? Are there any applications for that?

Weingartner: Yes, there is.

DePue: You can probably go ahead and put that down, if you like.

Weingartner: I think I'd better mention something else before we get to the hulls. I tend to get too slow, so I'll try to speed it up. But in addition to the oil, the soybeans contain a large quantity of high-quality protein, and this is unusual. Usually if you have a crop, it has a lot of one component, either it be oil, or it be protein, or it might be starch if it's corn. But soybeans contain a lot of oil, and they also contain a lot of protein. When we say "a lot," if we sit down and eat a nice T-bone steak, we're talking about a product that has about 20-22 percent protein. Our soybeans, which we just looked at—which are dry; they haven't yet had water added to them—these soybeans contain about 38 percent protein. So this is a huge quantity, and it turns out the quality of the protein is very, very good. So when we are doing our work, our utilization, we stress the fact that you can get oil from your soybeans, and in addition to that, you can get protein.

To get back to the processing, what we try to do with our soybeans is we try to take every component of the soybean and use it for one purpose or another. If we had 100 pounds of soybeans and we took the skins off, we would be left with about eight or nine pounds of skins and about nine pounds of—I'm sorry, this is wrong. You're going to have to edit. This is what I wanted.

DePue: That's fine, that's fine.

Weingartner: We would have eight or nine pounds of skins and about 92 pounds of what we cotyledons. These are just two halves—what is left of the soybeans when we remove the skins.

DePue: And that has not been rehydrated, then?

Weingartner: This has not been rehydrated. This is hard. You can put it in your mouth and sort of crack it, and it's kind of crunchy. But these haven't been cooked, and usually you're going to want to cook your soybeans before you want to eat them.

DePue: Well, can I go back to the question about what happens to the hulls or what applications you can have for that?

Weingartner: The hulls consist of a large quantity of high-quality fiber. We take those hulls and use it as an ingredient in animal feed. "We" means the soybean processors.

DePue: Now what we see here that you just talked about, though, is there much fiber that remains?

Weingartner: About 50 percent of the fiber that is in soybeans is in the hull, and about 50 percent of the fiber remains on the cotyledon.

DePue: So this is sounding like the perfect food: high in protein, it's got oil, and it's still got a lot of fiber.

Weingartner: Yes. Yes, it does.

DePue: And why did you soak these beans?

Weingartner: Depending on the process that we're going to use will depend on whether or not we're going to soak soybeans or not. If we soak the soybeans, it will soften them, and for some processes, it turns out that that is a good thing. For some other processes, it turns out that we don't soak soybeans ahead. When we do all of our processes that we're going to look at today, we are always considering three things in our process. We're considering the nutritional parameter of the final product after we process it—that is to say, we want to process it in such a way that we improve the nutrition. That's the first thing. The second thing we want to do is we want to do something that we food technologists refer to as improve the functional properties, and that has to do with such things as protein solubility. But all this is to say that after we process the protein, we want to mix it with other food, and we want it to have all the properties that will make it good to mix with other foods. The third thing that a food technologist always considers when they're working on a process is the taste and the texture of the final product. And depending on what our final food product is going to be, it's going to depend on how we're going to process the soybean.

DePue: When you're actually soaking these soybeans that we're looking at here, how much weight do they gain? How much water can they absorb?

Weingartner: When we soak a soybean—and very often, we might soak it overnight, before we go home, and then work with it the next day we can expect—after it's been soaked for eight hours, we can expect one pound of soybeans to double in weight—that is, it will weigh about two pounds after it has soaked overnight.

DePue: And I think the first thing that we're going to look at, and you can correct me if I'm wrong, is to how you extract soy milk. Is that right?

Weingartner: Yes. The first thing we're going to look at is soy milk, and while we're going to go through that process, we're going to get an idea of how we can make soy milk that will be nutritionally sound, have good functional properties, which we'll discuss as we're doing the process, and then third, that has good flavor and texture.

DePue: Excellent. I think it's right around the corner, isn't it? Can we just walk right over there?

(pause in recording)

DePue: Karl, I think we've got the equipment that you're going to be using to extract the soy milk. Why don't you go ahead and talk us through the process.

Weingartner: If one is a food technologist, it is exactly what you said. We talk about process. And if one is going to work with soybeans and one is a food technologist, one, in fact, as you said, talks about processes. We're going to do some processing now using equipment, but the important thing is the process. That is to say, we can be using different equipment; in fact, we could be doing a lot of this stuff in our own kitchen. Now, we wouldn't be using a kettle like this, but we would be doing the same process—that is, we would be boiling water.

DePue: Now, this is part of what you were saying that—obviously if we were to go drive down the road and go to ADM, they would be doing this kind of thing on a massive scale, but a small African village could use this scale of technology. Is that right?

Weingartner: That is exactly right. If one understands the process one is doing, not only can one do it in an African village, but one can modify it to work in the conditions that one is in. What we have done is we have taken our soybeans and removed the skin—we've dehulled them. There is nothing wrong with using whole soybeans; we have removed them simply because we want to take the skins off and remove the fiber. Since we're making a beverage, we want something that is going to be similar to milk. We don't want it to be thick. If we made this with whole soybeans, we would end up with an excellent nutrition product, but it would be a little thicker because we have a little bit more fiber. It would taste more like an orange juice, which has fiber in it, or a mango juice, rather than a cow's milk, which has very little fiber.

DePue: Now, this process, is this going to be focusing on the protein side of the soybean, or does it also include oil?

Weingartner: This process is going to be involved in making a beverage similar to cow's milk. We're going to use the whole soybean, except in this particular example, we've removed the skins, and we're going to end up using everything in the soybean. So we're going to use that oil, which is an excellent source of energy; we're going to use that protein, which is an excellent, excellent vehicle used to help people grow, including kids.

DePue: Okay. And this is the type of soy milk, oftentimes if somebody's lactose intolerant, this is what they're going to be using instead, right?

Weingartner: Absolutely right. The other thing that we can see that is so neat and so exciting is that if you have milk and you're at your farm or you're in Africa, you're going to either need to do one of two things: you're either going to need to drink that milk immediately, or else you're going to have to process it and then refrigerate it. Here, we can keep these soybeans out, we can bring them in from Iowa, from Illinois, or they can grow them on their own farm, and when they're ready to go, they can immediately take their soybeans, which are dry and safe, and turn them into milk in the matter of an hour or so. It's very exciting.

DePue: Let's go ahead and see what we've got, then.

Weingartner: The first step that we're going to do in making soymilk, the first step in our process, is we're going to take these soybeans and drop them into rapidly boiling water. (pause, beans pouring)

DePue: Now, how long are they going to have to be in the boiling water solution? I assume you're turning up the heat, so to speak.

Weingartner: Yep.

DePue: Karl, it looks just like any cook at home; you've got to get it just right.

Weingartner: No, no, no, you just want the water to be rapidly boiling. What we're doing now with the soybeans is very similar to what people do all over the United States, especially in the Midwest, this time of the year. We are blanching the soybeans. Same thing as what we would do if we had lima beans or green beans—we're going to give these soybeans a heat shock for a very few minutes, and we're going to have boiling water. The purpose is going to be to inactivate enzymes that are in the soybean. These are not enzymes that are going to make one sick; these are enzymes that can either lead later to spoilage, or else they can lead to off flavors. It is very, very common to do this in many vegetable (break in audio) products.

Blanching, by its nature, is a process that's very short. It is different from cooking. It's just to retain the color and to inactivate the enzymes. In this particular case, we're going to blanch the soybeans for either five minutes twice or ten minutes once. It is not cooking them; it will soften them, and it will inactivate the enzymes in there which could lead to bad taste. And taste is one of the three things we food technologists always think about. We think about taste, nutritional value, and functional properties. As we cook these soybeans, the heat will inactivate the enzymes—and I'll turn the water up a bit. The heat will inactivate the enzymes, and in addition, the water will actually go into the soybeans.

DePue: So the process will help them absorb even more moisture, then.

Weingartner: Yes, it will. Yes, it will.

DePue: Now, this is something you'd have to do for ten minutes?

Weingartner: We probably want to turn this off and...

DePue: Let's go ahead and cut until we get to the next step, then.

(pause in recording)

DePue: Okay, Karl, it looks like we're ready for the next step here.

Weingartner: We have finished our blanch, and if we look, we can see that our blanch water has some color to it, and that is good. What we've done is we've extracted some of the natural pigments in the soy—the chlorophylls and some of the other ones—and what that is going to mean is that since they have been leeched out, it's going to help us have a whiter soymilk, and in addition, the soymilk is going to have less flavors, planty flavors like chlorophyll flavors.

So we have finished blanching. Scott, I'm going to ask you to help me pour this thing so I don't get it all over myself. (pause, pouring) That's what I was hoping. Okay.

DePue: And obviously that's hot water, so you've got to be careful doing this step.

Weingartner: Where's the hose? There's our blanched soybeans. (pause) Our next process—and it may not seem like a process; it may seem too simple—but our next process in making soymilk will be to rinse the soybeans, just to rinse off, in case there's anything that is remaining in there. Normally when we make soymilk—and I didn't show it today—we normally add a small quantity of sodium bicarbonate—that is, baking soda. Probably the one we're all most familiar with is Arm and Hammer. We add a pinch of that. The reason for that is, when used with soybeans, and also used with vegetables when you're blanching, it increases the penetration of the water, which means it allows the water to get into your soybeans quicker, which is something that we want. In this process that we're doing today, we blanched the soybeans for ten minutes, and later on, we're going to cook them a little more. Okay, we'll let these drain for a minute or so before we get to our next process.

DePue: Okay. You know, a lot of this doesn't look too much different from what a cook at home would be doing with her vegetables.

Weingartner: That's exactly right. We have a kitchen here in our lab, and we actually do make soymilk using kitchen equipment, such as a waring blender, and using cloth for filtering. So we can do that, as well. We're doing this just to give our viewers a chance to see that there's commercial aspects as well. Let's turn off the...

DePue: Okay, we need to take a quick break here?

Weingartner: Yes.

(pause in recording)

DePue: Karl, what's the next step we've got?

Weingartner: We have taken our drained soybeans, and we have gotten some clean water. In this case, we've gotten, for every pound of dry soybeans, we've gotten seven pounds of water. In this case, we have two pounds of soybeans, so we have fourteen pounds of water. The water is hot—not boiling, but hot. We've mixed it together, and now we're going to grind the soybeans' water in this simple grinder. Now, this is way too fancy; we wouldn't be using this at home, but for a commercial operation, this grinder is very, very simple. We're going to put soybeans and water in here, and the product that is going to come out of here is the soybeans ground up with the water. And this is what we food technologists refer to when we say "soy milk."

DePue: And there's no way that that's not going to be loud, but that's fine; it's all part of the process. (pause, machine noise) It really is a very simple process, isn't it?

Weingartner: It is. And since we're talking about process, we need to remember that we're using this grinder, but we could be using a waring blender, or we could be using a very sophisticated grinder that is able to do much larger capacities. The product that we have here, this soy milk right now, is sometimes called soy milk. We at the University of Illinois refer to it as soy milk base, and by that, we mean that this is the base product that we use to make many other products from soy. We can make soy milk from it; we can make ice cream from it; we can make yogurt from it. And we're going to see some examples of a product when we continue. If we were going to make soy milk from it—because we said this is our base—we would do things to it. We might adjust the quantity of water we're going to add, because we would probably want the protein content of our soymilk to be equivalent to that of the protein content of cows' milk. We might want to add flavors. We might want to add some sweetener. We might want to add other ingredients, such as a pinch of salt. So this is our soy milk base, and we're going to continue on from here, and we're not going to go any more for soymilk.

If we were going to go to soy milk, what we would do is we would formulate this. We would add some sugar; we would add some flavors. And then we would cook it—because we have not yet cooked our soymilk; we have just blanched it. But we would need to cook it, and cook it far enough so that when we were finished, we have a product that is pasteurized, that is free from organisms that would cause harm to people, cause illness. Most products that are refrigerated still have microorganisms in there, but they're a small quantity of microorganisms that can lead to, in fact, spoilage.

DePue: Does this mean that we wouldn't be able to drink this now?

Weingartner: We would not drink this now. This is not a finished product; this is our basic product that we use to make other products from: soy milk, yogurt, and ice cream.

DePue: Okay, so what's the next step, Karl?

Weingartner: We can turn this off.

(pause in recording)

DePue: Karl, go ahead and take us through the next step.

Weingartner: We have completed our grinding, and we have our soymilk base. The next process that is going to be done is we're going to do a filtering process.

DePue: And what are we filtering out?

Weingartner: We had said earlier that the soybean is an excellent source of protein and of fat, and we had also mentioned earlier that the soybeans that we're working with also do contain fiber. This filtering process will allow all the soluble products in the soybean—the sugars, the protein, and the fat—to go through, along with the water, and what we'll retain when we filter is we will retain the fiber. (pause) This fiber, in fact, is nutritionally very, very good, but it does convey some thickness to the beverage, and often, when people are consuming soy beverage or soy milk, they may well choose to consume it as an alternative to cows' milk, and therefore, they might be more partial to a beverage that is not as thick. So right now, we are filtering the soy, and we are removing the fiber. (pause)

DePue: And it looks like the next step would almost look like an old-fashioned pressure cooker here. And this is nothing more than the press, then, that we're looking at?

Weingartner: What we have here is one form of a press.

DePue: But still the end product we're getting is not consumable, is that right?

Weingartner: The product we're getting now is soy milk base that has had the fiber removed. Before we're going to consume it, we would want to pasteurize it or process it further. When we say "pasteurize it"—if we were at home, and we had soy milk, we would put it in a pot, bring it to a near-boil, and then we would let it simmer for about twenty minutes on the stove at near-boil. After that twenty minutes, our research has found that we have a product that is pasteurized, that is free from pathogenic organisms. And we can then either drink it, or else we can put it in the refrigerator and leave it there and store it.

This is an example of one filter press, but the thing that is... We're going to wait for Scott to open that because I'm very good at burning my hands. (laughter, pause) We have a spoon?

DePue: And essentially what we're looking at is the remaining fiber? (pause)

Weingartner: Now, we have not yet squeezed out all of the water, but this is the remaining fiber. And when we squeeze out all the water, it will have the appearance of being almost dry. It will be about 75-85 percent fiber and about 25 percent protein. This product actually has a name; it is called okara, and it is the fiber part of soy milk—the part that we extract.

DePue: What are the applications for that product?

Weingartner: The applications that we use it most for is an application as an ingredient in food products. We use it as a product that is mixed often with wheat to make pasta products like spaghetti. We also use it as ingredients used in bake products. In addition to supplying fiber and protein, it actually changes the functional properties of some of the foods and improves the texture.

We're going to walk over to look at another machine. We're just going to do a quick walk right over here. (pause)

DePue: Karl, what do we got here?

Weingartner: This piece of equipment that we have here is called a roller extractor. Its function is similar to that of what we just did when we filtered out the okara from the soy milk. You can see that this has a lot of rollers, and it's large. This would be used in an operation if we were commercially extracting fiber from soymilk. It is a continuous operation. You can pump soy milk in, and this will physically remove the fiber, and it will also squeeze out the water from the fiber so that we will end up with an okara that is almost a paste—very dry.

DePue: Thank you. Next step.

(pause in recording)

DePue: We are in the INTSOY test kitchen here, and Karl, I know you're about ready to make yogurt, I believe. Is that correct?

Weingartner: That is correct. We have made our soy milk base, and what we have recently said is from that base, we can make many soy products: soy milk, which we talked about, or soy ice cream, or soy yogurt. We refer to these products as soy dairy analogs because they're not dairy, but they're dairy-like. In the case of yogurt, we're going to go through an example of what we could do. We have in our pot here, we have soy milk. We're going to add some sugar to it. I'm not going to through the weighing, but we're going to add some sugar and mix it in. Then what we're going to do is we're going to heat the soy milk up. We have previously heated it; that's why our steam is coming out. And the heating is actually very important because what we're going to do, what we're trying to do is with the aid of microbiology, we're going to take this sugar that we've added in here, and we're going to change that sugar to lactic acid, and that's going to give us the characteristic flavor, sort of the pucker flavor we get when we have a real nice yogurt and we say, "Oh boy." So we've heated this up, and it turns out actually—I'll have to check the temperature. (pause)

DePue: What temperature were you looking for?

Weingartner: Cut.

(pause in recording)

DePue: Well, I just asked you a question, put you on the spot, but around thirty-two is what we think it might be, so go ahead and take us from there.

Weingartner: Now our soy milk is a little hot—our soy milk right now is near boiling—it's near thirty-eight—and we're going to let it cool for a few minutes until we get down to around thirty-two degrees Centigrade.

DePue: And how long would the boiling process normally take?

Weingartner: We're not boiling; it's just to heat it.

DePue: How long would that process take?

Weingartner: It's okaying to take, depending on the stove, it's going to take you just a couple minutes.

(pause in recording)

DePue: Karl, we're getting closer to that magic point?

Weingartner: We are. We have heated our soy milk up—our soy milk base. We have added our sugar to it, which is going to be what we food scientists call our 'substrate.' We're now going to add some starter yogurt—this is yogurt that is already there—and we're doing that to add this because we're going to use the bacteria, the live bacteria that are in here, and that's going to be what's going to take off. These bacteria are going to use the sugar that we've mixed in here for a fermentation process. So we have our soy milk, we have our sugar—our carbohydrate source—and we have our microorganisms. And our next step is we're going to move over—we're going to walk a little bit in the kitchen. I don't know whether you want to turn that off or not.

DePue: I think we can follow you.

Weingartner: Okay. (pause) So what we have now is we have all of our ingredients: our soy milk, our sugars, and our culture starter. And now we're going to incubate this. So we're going to move over and put it in our oven. (pause) And we're going to allow our mixture to ferment, incubate, until the sugar is changed to lactic acid. While we do that, the soy milk will gel in a manner very similar to cows' milk, and we'll end up with a final product very similar—cut. In about six hours under incubation, we will end up with a soy yogurt product very similar to this. This example that I'm holding in my hand is, in fact, yogurt made from cows' milk, but it's to give us an idea. It will be gel like this, it will have lactic acid in it, and it will also have a little bit of sweetness.

If we wanted to, we could add flavors to it. We could add cherry preserves, blueberry preserves, and we would end up with a yogurt that is what we food technologists refer to as sundae-style yogurt, where we have the preserves on the bottom and the yogurt on top.

DePue: If we did not add any flavors, would there be a distinctive difference in the taste between dairy yogurt and soy yogurt?

Weingartner: That is a very good question. The product that we get has a definite yogurt-like taste—that is, it has a sensation of both being sweet and tangy at the same time, which is what we think of when we think of yogurt. The tastes are different because, remember, with the cows' milk product, we will have a milk taste here. The soy milk yogurt is actually blander than the cows' milk yogurt. I like to think that the cows' milk yogurt has more flavor to it, and the soy milk yogurt is actually a blander product.

DePue: But I would assume that means it can accept other flavorings very easily.

Weingartner: Yes. If soy is processed properly, the way we have done previous to this, where we have blanched it and then filtered it, we end up with a product that has very little flavor, either good or bad. Some people refer to it as slightly nutty—like peanutty—and some people just say it's very bland, and that flavors can be added to it very easily. Thank you.

DePue: What's the next step that we're going to see, then, Karl?

Weingartner: Thank you.

DePue: Okay.

(pause in recording)

DePue: Karl, I believe what we're going to look at next is how to make tofu. Is that correct?

Weingartner: Yes. Tofu, as we're aware of, has been around the world, people have been using it for hundreds if not thousands of years. It is a relatively new product to us here in the Midwest. Although the process to make tofu is similar to the process that we've seen before, it's slightly different, and we're going to go through a prototype of making tofu right now. The first thing that we do when we make tofu is that we take our soybeans, and unlike the other process, we soak them in cold water.

DePue: And that's what we've got here. The beans have already been soaked, then?

Weingartner: What we have here is the beans have been soaked, and they have been drained. The soybeans now have absorbed a lot of water. One pound of soybeans have now grown until now they weigh two pounds, and that additional pound is the water that's been absorbed. We need to do this process this way because for the work we're doing—the process we're doing—it's very, very important that the protein that is in the soybean be very soluble. And for that to happen,

we need to be very careful about the quantity of heat that we use in the process, whereas the other process that we looked at earlier, heat was less of a consideration.

DePue: Is the tofu going to include both of the main components—well, actually three, I guess—the oil, the protein, and the fiber?

Weingartner: Yes, it is. We're going to transform the soybean into soy milk in a manner similar but not identical to what we did before. We are going to remove the fiber, and then we're going to go ahead and coagulate the soy milk and produce our tofu. (pause)

DePue: What's the device he's putting this in?

Weingartner: We're going to add our soybeans to this grinding machine that we have. (rattling noise) One of the things that we do a lot in soy is we try to acquire equipment that other companies have manufactured, and we try to test it out here. This particular piece of equipment comes from Canada. It's made by a company called ProSoya. We're going to add our soybeans to this. Inside of this machine is a grinder, and we're going to add our soybeans, and then we're going to add our water.

DePue: I notice this device you have next it has got Russian writing on it, so you do have an international flavor here.

Weingartner: Yes, we do. We do. We're going to be adding the water now.

DePue: Is this plain old cold tap water?

Weingartner: This is plain old tap—potable water. Nothing fancy. (pouring sounds)

DePue: And again, if we were going to go down the road to ADM, they might be doing the same kind of thing, but on a massive scale.

Weingartner: That is so true. I keep saying this, but it's true. The processes for most of these food products that we're making, the processes are very similar; it's just the type of equipment that one uses that's different. We've closed this up. (pause, machine noise)

DePue: And that's the grinding we hear now?

Weingartner: Right now we're grinding the soybeans and the water, and what we're making is soy milk.

(pause in recording)

DePue: Karl, I know you just turned the grinder off. We still hear some sound; what's the sound now?

Weingartner: What we're using, this machine has a steam generator over here, and what we're doing is we are adding steam to our soy milk—our soybeans and our water—and we're using the steam to cook the soy milk.

DePue: So what we've got now is essentially a steam cooker.

Weingartner: What we have now is essentially a steam cooker. And this will take us perhaps ten or fifteen minutes until we finish cooking our soy milk.

DePue: So this is a good time for us to move on to the next stage while this continues to work, right?

Weingartner: Yes.

DePue: Okay, excellent.

(pause in recording)

DePue: We are now at a completely different stage. I understand this is how we're going to extract the oil. So start us off.

Weingartner: We have been working with wet processing—that is, processing soybeans with water. What we're going to see now are two examples of dry processing. We had said earlier that one of the things that is very characteristic of soybean processing in North America is the quantities—the scale of operations where they work at thousands of pounds per hour—several tons per hour. We're going to look at a technology that does processing of soybeans, but at a much lower capacity. What we have here is a dry extruder. The soybeans are cracked into eighths. These are our soybeans. And then they are passed through this dry extruder. In here, in this barrel, there's a series of steam locks and screws, and through the barrel turning, we create friction, and the soybeans are heated. When the soybeans go in here, they're at room temperature. If we're talking Centigrade, about twenty-five degrees Centigrade—seventy-five Fahrenheit. And when they come out of here, just through friction, we're going to have soybeans that are cooked after thirty seconds, and they're going to come out of a temperature of about 200-270 degrees Fahrenheit. The soybeans are going to be so hot that they're going to be near-molten once the process gets going.

If we were to collect those soybeans, those extruded soybeans afterward, we would have a product that would be suitable as a cooked product. It could be used as an ingredient in animal feed, or it could be used as an ingredient in food products. The product that we would have, when it comes out of this extruder, is referred to as either soybean meal or full-fat soy flour. So that is one process we're going to see in the next few minutes. Instead of just collecting the soybeans, because we're trying to show as much technology as possible, we're going to then take our hot soybeans and take them from this conveyor and feed them into our next process.

And this piece of equipment over here is a mechanical screw press. It is used to mechanically extract or squeeze oil from oilseed products. It could be soybeans, but it could just as easily well be peanuts. So we're going to physically squeeze the soybeans until we have oil that comes out, and we will have a chance to take a look at that. The operation, since we are using commercial equipment, will be loud; it will be noisy.

DePue: So during that time, we're probably not going to have much of a conversation, right?

Weingartner: That's right. What we're going to see is we're going to see soybeans going into extruder; hot, cooked soybeans coming out; and then we're going to see then transported up to our screw press; and then we're going to see that screw press transfer that soy meal into oil—raw, edible oil—and a product that we call soybean meal or soy flour.

DePue: And there's going to be one slight alteration that we have asked you to do, and that's so we can actually see what's being extruded in here, correct, and that's to take the safety plate off for just a minute or two, and we can watch that and actually see what's happening. Is that correct, Karl?

Weingartner: That's correct. We normally put a wire cage over here to ensure that no one gets their fingers caught, and for the purpose of this demonstration, we have removed the cage so that we can better demonstrate what we're doing.

DePue: Okay. Are we otherwise ready to begin?

Weingartner: We are ready. Cut. (machine noise)

(end of audio file one; audio file two begins)

DePue: Karl, you weren't lying to us when you talked about how noisy that was. We have the end product here. Tell us, first of all, the dry product that you're standing behind.

Weingartner: We have produced two products. We started out putting our soybeans—we cooked them, we heated them, and then we put them through our mechanical screw press. We extracted our oil over here, and after we removed our oil, what is remaining is a product that we refer to as either soybean meal or lowfat soy flour. When we started out, our soybeans contained about 18 percent oil. As we can see here, we've extracted a lot of the oil. In this soy flour, we have a product that contains perhaps, instead of 18 percent, 6-8 percent oil. By removing that oil, we have concentrated the remaining constituents. When we started, we had perhaps 38-40 percent protein. Now, because we've removed the oil, the quantity of protein in here in terms of percent, has increased. Now we have a product that's about 44 percent protein. If we use this later and mix this with other products, we can increase the protein content of foods by adding just a little bit of this. Normally we could have a bread that might contain 10 percent protein, and if we add a small quantity of this soy flour and mix it with the wheat flour, we can very easily raise the protein content of that bread up to 15 percent. And we're talking about actually increasing the protein content by 50 percent.

DePue: I would imagine this is also excellent livestock feed, if it was to be adopted to that use.

Weingartner: Yes, it would be excellent livestock feed. And we never forget what we have here is two commercial products. We have the soy flour, which could be used as an ingredient in poultry feed, or we could use it as an ingredient in human food, and we have this oil, which is referred to as crude edible oil.

DePue: I wonder if we could walk very quickly over here and see what you started with. And my question over there is if you included the hull in this process, or was the hull already removed?

Weingartner: Are we on?

DePue: Yeah.

Weingartner: Can we turn off for a second?

DePue: Okay.

(pause in recording)

Weingartner: What was our question again?

DePue: The question was if that has had the hull removed.

Weingartner: This has not had the hull removed. This was our whole soybeans, which we have cracked with this machine over here. And we put the soybeans through here. And we started out with whole soybeans, and when we got finished, we have soybeans that are cracked in about one eighths. And it contains the hulls as well.

DePue: Let's go ahead and take a look at the soy oil. (pause)

Weingartner: Soybean oil is a vegetable oil, but it is extremely healthy. And most vegetable oils are healthy, but soybean oils... When we extract from here, we have a product called crude soybean oil, and it's actually a mixture. It's a mixture of oil and things that are actually soluble in oil. If we take a look here, we can see. On the top, we have our oil. And this is the oil after it's got a chance to settle overnight. What we see at the bottom is going to be some sludge. We also have in there products that we refer to as gums. And we can remove those gums so that we have a soybean oil that is degummed and clearer. The gums contain some very, very important nutrients,

including vitamin E, which is very good for us in small quantities and serves as a component in our food to act as an antinutrient, a scavenger of oxygen.

To degum soybean oil, we'll take our crude soybean oil, we'll mix in a small quantity of water—about 2 percent water. That is, for every 100 pounds of soybean oil, we're at about two pounds of water. We will warm it to about 150 degrees Fahrenheit—that's seventy-five degrees Centigrade—we'll stir it, and then after about ten minutes or so after we stop stirring it, the gums that are in the soybean will leave the soybean oil and move to the water, and we'll have two layers or two phases.

After we separate the gums out, we end up with a product here which we refer to as—or not "we"—the industry refers to as crude degummed oil. This can either be used the way it is, or else we can further process it. The next processing step, if we wanted to go further, is referred to with a general term called refining.

DePue: Can you talk very briefly—I know we've got to get to the next step—but very briefly about the nature of the fats that would be in that oil.

Weingartner: The soybean oil, which is a vegetable, contains oils and fats that are unsaturated. They are considered very healthy in terms of promoting good cardiovascular health—good heart. It also contains a group of compounds referred to as essential fatty acids, 'essential' meaning that these are components that our body actually can't make and we have to ingest. And soybean oil is not the only way to get essential fatty acids, but it is one of them. Another product that contains a lot of essential fatty acids is fish oil. But here in the Midwest, we probably consume less of that than there is available in other parts of the United States.

DePue: So having gone through all these processes—and as we're talking, maybe we can move over to see the end product of the yogurt—but having walked through all these processes, it sounds like soybeans is almost a miracle food.

Weingartner: It is, it is. There's a lot that can be done with it, in terms of the technology and in terms of the nutrition.

DePue: And I think the last thing we're going to see, then, is the end product of the tofu—I'm sorry, I said yogurt, but tofu is what we've got.

Weingartner: Yes, tofu.

(pause in recording)

Weingartner: We finished cooking our soy milk with our steam. Soy milk is coming out under pressure. And again, as with our other process, we're going to collect it, and then we're going to filter it to remove our fiber.

DePue: And of course, everybody knows tofu as that—it's already gelled, and it's in the square shapes, and it's—

Weingartner: That's right. (pause) Now what we have here is not yet tofu; it is soy milk. It is soy milk that has been processed in a way slightly different than the soy milk we made earlier in this demonstration. (pause)

DePue: I would think the same process, though. We're just filtering out the fiber, now?

Weingartner: Yes. (machine noise) So now we're filtering out the fiber, we're collecting our hot soy milk, and then in a very short period of time, we will add our coagulant.

DePue: And from there, how long does it take to set?

Weingartner: In general, after we add our coagulant, it will take from twenty to thirty minutes to form curds. The curds that we form are actually very similar to the curds that we see when we make cottage cheese. And when we say "curds," we're talking about curds of protein and fat.

DePue: Is that a stage when you're cooling the curds down?

Weingartner: Yes, temperature is important in several aspects of tofu manufacture. Right now, our soy milk that we've made is near-boiling—it's just about boiling—and we're going to cool it down quite a bit. It's about 190 degrees Fahrenheit right now, and we're going to cool it down to about 160-170 degrees Fahrenheit, which is still quite warm but cool enough so that we can get our chemical reaction to happen very nicely.

DePue: Okay, lets's go ahead and take a break here, quickly.

(pause in recording)

Weingartner: We have cut the camera for a few minutes. We have allowed our soy milk to cool down to 160 degrees Fahrenheit. We then added our coagulant, a calcium salt. We mixed it up, and we allowed our curds to form. When we say curds, what happens is the protein in the soybean forms a gel, and it looks very, very similar to curds that we would see when we make cottage cheese. We give them about twenty to thirty minutes to form, and then after that, we spoon them out. And it's very very similar—and if people have had experience making cheese at home, they'll understand what we do. We will then take those curds, put them in what we call a forming box that is lined with cloth, we will fill it up—we filled it up—and then we will close it up, and then we add some pressure to gently squeeze out the water. After about thirty minutes of pressing, the excess water has been removed, and the curds gel together so that they form a product that is called tofu, but if we were going to give it a name, we would probably call it soy cheese. And I'm going to ask Scott to give us a hand here to open this up, because in case it gets broken, I can— (metal clangs)

DePue: And there's one thing I know about tofu: it really has no flavor to speak of.

Weingartner: That is correct. If made properly, it should be very bland. Okay, let's get a close-up of that. This tofu was made from our whole soybeans. It contains all the protein of the soybeans except for what is lost during the processing, and it contains the fat of the soybeans. It also contains a lot of water, sort of, in a way, like I said—not like cheese, but like cottage cheese, and also sort of like Jell-O. The reason I say that is, for every one pound of soybeans that you start with, those dry soybeans, you should be able to make two and a half pounds of tofu. Now, this is not magic, because processors always lose some soybeans along the way, but we're acquiring a whole lot of water to go along with those soybeans.

If made properly, it should have a very light color, either a white or buff color. The buff color is an indication of the fat that we have in there, because we do have 18 percent fat, and fat is normally yellow; the rest of it is white. We're going to slice it now. The next step that we would do is we would store this in water, because if we didn't store this in water, the water that's in the tofu would leave, and it would start to desiccate and get dry.

DePue: Now I know that the tofu I see in the store is often a purer white than this, and it doesn't have the speckles in it.

Weingartner: Well, the speckles are just from our forming. And depending on what forming device we use, we'll have speckles or not. Over here, we can see a wooden forming box, and that wooden one,

in fact, does not have the speckles. The wooden one is a traditional box. We use the metal boxes because in terms of health and safety, they conform to our current requirements to use our equipment that is stainless steel, and then we can thoroughly clean and disinfect before we use.

DePue: Well, you've shown us an awful lot here in the very short time we've been here. I'm amazed by the versatility of this plant. And the other thing that comes through very strongly is how incredibly nutritious it is and how beneficial it is to the consumer. Any comments that you'd like to make in closing, then, in that regard?

Weingartner: Yes. I just want to mention again that our group's interest is promoting soybean processing and nutrition, and the thing that we think is neat and interesting about the work that we do is that the size of the processes we use for both home use and commercial are much smaller than what is normally done in North America. And we hope that by using the information that is gained from our processes, we can spread the processing and utilization of soybeans throughout the world.

DePue: From what you've shown us here, Karl, you have both a fascinating job and a fun job, too. I'm sure you enjoy it.

Weingartner: It's a lot of fun.

DePue: Thank you very much, Karl; it was great.

Weingartner: Thank you.

(end of interview)