BEEF BLASTERS

By Wes Ishmael

Contributing Editor – Beef Magazine™ January 2000

You know it's going to be a tough day when your boss summons you to meet with the office brass and in come three agents from the FBI and three from Alcohol, Tobacco and Firearms (ATF). They immediately flash their badges and begin a no-nonsense interrogation about why you're trying to acquire explosives, and why none of your bosses know anything about it.

Never mind that you're a research scientist at USDA's 7,000-acre Agricultural Research Service (ARS) facility in Beltsville, MD, smack between Washington, DC, and Baltimore.

Developing the Hydrodyne, a pressure process that tenderizes meat and destroys pathogens, is genuine cloak-and-dagger stuff.

Morse Solomon, research leader of the ARS meat science research laboratory, tried to explain to the agents that the explosives were for an experiment he was conducting at the request of the Secretary of Agriculture's office. They had requested his help designing an experiment to prove their Hydrodyne theory – that shock waves unleashed by an explosive set off in water would tenderize a piece of meat submerged in the same water.

"Who exactly called you from the Secretary's office?" asked the agents.

"I wrote it down, but I don't remember off the top of my head," said Solomon.

"Did you even verify that it was the Secretary's office?" wondered the agents.

"I didn't really see a reason to," replied Solomon.

"And who are you designing the experiment for? Who is trying to deliver explosives to you?" demanded the agents.

"Some guy named John Long."

"What's his background and how do we get hold of him?"

"I don't have any idea ...," said Solomon.

In hindsight it's easy to understand how it was that Solomon left this interrogation as much of a suspected terrorist as John Long. Keep in mind, this ARS complex houses all kinds of pesky bacteria, parasites and the like. Plus, to meet Solomon is to believe his creative thoughts must come at the same frenetic pace as his conversation. It's easy to imagine him chasing down the bottom line without worrying about where a cache of explosives was coming from.

"Things weren't going well," remembers Solomon. "Plus, John is a very persistent guy, so he was still trying to get me the explosives."

Solomon wasn't familiar with the requirements for buying explosives. So when a supplier enlisted by Long contacted Solomon, his naivete was all too obvious. The suspicious supplier turned him in to the FBI.

The government agents told Solomon they would monitor his activities as they tried to get a lead on this John Long fellow. They told him he could accept phone calls from Long but no packages. Solomon dodged Long's calls for two weeks. By this time, he was pondering his career prospects and his freedom.

What seemed like a lifetime later, Solomon was again called to the office of his boss's boss. This time there was just one FBI agent and one ATF agent.

"Let's try this again," said the agents. "Do you know who John Long is?"

"I still don't have any idea," said Solomon.

"Well, we do," said the agents, finally smiling. Turns out, Long is a retired CIA weapons designer with Pentagon clearance; he used to design nuclear weapons. He and his partner tracked Solomon down via a former Assistant Secretary of Agriculture. They and their Hydrodyne idea were for real.

Launching A New Idea

Since meeting Long in 1992, Solomon has heard several versions of how Long first conceived of tenderizing meat with explosives back in the '60s. Suffice it to say, by the time Solomon entered the picture, Long had his Hydrodyne process and a prototype already patented.

The device today is a 7,000-lb. steel tank that holds 282 gals. of water and 400–600 lbs. of meat. The meat is bagged and submerged in the tank. An explosive is suspended over the top of the meat, then detonated.

But Solomon was far from knowing all of this when he traveled to an off-site location in Virginia, armed with meat, to witness his first Hydrodyne "shot" at tenderization. He was still skeptical.

When Solomon arrived and saw these would-be pioneers taking rubber trash cans out of their car, he said, "No, no, that's alright. I've already got the meat in a cooler, we don't need those."

"No, you don't understand," they said, "This is our Hydrodyne unit. There is no reason to build the one you saw the picture of until we know that this works."

Solomon's heart could have slipped beneath an ant's belly with room to spare. He believed the machine already existed, that his experiment and expertise were only to determine how well the process worked.

They buried the trash cans, detonated the explosives and raced back to the lab to see the results. "It didn't work," says Solomon. "There wasn't any change in the meat at all."

Long made a quick phone call to a physicist friend. Bemusedly, that friend informed him there was no way the process would work without steel in the container for shock-wave reverberation.

They tried again, with steel in the bottom of the trash cans. The results were incredible. Basically, Solomon says you can take tough steaks, as measured by Warner-Bratzler shear force and, under the right conditions, hydrodynamic pressure technology can make them eat as tender as filet.

"The meat is softer than normal when you take it out, but it firms back up in the cooler," says Solomon. In taste panel work conducted by ARS researcher Brad Berry, consumers detect the change in tenderness but no differences in flavor or juiciness. Solomon adds, "In some studies with salted meat (kosher processing), we've found this process also helps preserve the cherry red color."

In round numbers, Solomon explains they've seen everything from a 20% to 60% increase in tenderness. Part of that has to do with how tender the meat is to begin with. The process will not over-tenderize meat, so it will not add anything to meat that is already tender.

What's more, Solomon points out, "With this process, not only does it reduce shear force values, but it flattens out the tenderness variation across the steak, making it consistently more tender."

For the record, Solomon says, the shock waves work because meat, beef in this case, is 75% water.

"The shock waves travel through anything that is an acoustic match with the water (the water in the beef). The things that are not an acoustic match (muscle tissue and intramuscular fat) are torn. That's why the cuts have to be boneless or semi-boneless. The shock waves shatter the bone and over-tenderize the tissue next to it," he says.

Armed with successful results, Long and his business partners formed a company and constructed a $1.6 million prototype. He's now working apart from ARS to perfect the process. At the same time, Solomon and his research team continue to do their own experiments with a scaled down version of the prototype and those trusty trash cans.

The Rest Is History, Almost

With more steel in the actual Hydrodyne unit, researchers believed its performance had to outpace the trash cans. So far, it hasn't. Researchers reduced shear force 37–57% in the original metal prototype, but effectiveness lessened as structural changes were made to accommodate the force of the explosions. The last time Solomon tested the modified unit, tenderness gains had dropped to 12–24%. All the while, the venerable trash can is increasing tenderness 33–67%.

The jury is still out, but explosives experts from the army and navy think the differential may have to do with the fact that the sides of the trash can actually explode out, while an implosion occurs in the self-contained unit. The theory is that the explosion conjures up a shock wave three times more powerful than the implosion.

As private industry and ARS wrestle with the differences, Solomon and his crew uncovered something even more startling. With an added tweak, the process destroys pathogens.

"Food safety is a bigger issue than tenderness, and we're getting a 40–60%* reduction in bacteria load with hydrodynamic pressure technology," says Solomon. That, plus increased tenderness for an estimated 8–10¢/lb.

Understandably, Solomon says meat processors are excited about the prospects, especially considering how well Hydrodynamic pressure stacks up when compared to other postmortem technologies that require aging. But, Solomon says they're not thrilled with a batch system unless the batch could be at least 10 times larger than the 600 lbs. of meat held by the current prototype.

With that in mind, Solomon and his team of research scientists envision an inline system that would preserve the added effectiveness of the trash can explosion. He believes commercial application may be only two years away.

If it does become reality, chalk it up as a good day for the U.S. beef industry, and a long haul for one scientist who dodged the long arm of the law to make it possible.

* Meat samples were examined immediately after HDP treatment. Shelf-life bacterial populations in the samples showed a 3-log reduction (for example, they decreased from 300,000 colony-forming units to 300). *Agricultural Research/December 2000*

Answer the following questions with your team:

1. What's the science behind this story?
2. Do you consider Dr. Morse Solomon a scientist or an engineer? Explain.
3. What do you think are the characteristics of a scientist?
4. What's the twist of science in relation to how research is conducted at the beginning of a study compared to the end results?
5. Do you know of any other examples in science or recent history where discoveries were made unexpectedly? Explain.
6. How do scientists get their ideas?
7. What's the interrelationship of the different sciences in reference to this experiment?
8. How does a scientist prove a hypothesis to be correct? How and by what means is it proven correct?
9. What happens after a scientist proves a hypothesis to be correct? How does that hypothesis become a reality and get put to use?
10. How do Dr. Solomon's experiments relate to you?