Real Medieval Science Project, or the Art of Doing Science

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Honestly, it's not my fault. I had no intent to start a project like this. I was simply looking online for interesting medieval Welsh pottery shapes to hand over to a friend who keeps me in pipkins and other medieval cookware.

In doing so I came across the images of a pair of pots, one inside the other, from a museum on the Anglo-Welsh border. The article that accompanied the image opined that the two pots shown, found in that way, were used to perform fireless cooking as in this recipe…and here, it quoted a recipe from "Two Anglo-Norman Cookery Books", by Constance Hieatt. "Oh, neat!" says I, to myself. "Chemical cooking." And I went on my way searching out new and exciting pipkins.

Unfortunately for my peace of mind, I've had a lot of chemistry over the years, and that memory of the recipe kept bubbling up. I went back to that website, hunted up the source, and found to my delight that I did actually own a copy of Hieatt's text! And yes, what was there matched what was on the website—no omission or addition to the text changed the meaning of the actual recipe. So I started thinking….I knew the reaction of Calcium oxide and water was exothermic, but was it exothermic ENOUGH to actually cook food?

So I poked around online again, this time trying to see if anyone had actually tried this recipe. I asked some of the most knowledgeable medieval cooks I know, if they had heard of anyone trying this. the Florilegium was an enormous help here….while there were no references to anyone trying it, it DID provide two more accounts of "recipes" for people cooking with lime and water. The first was an account of a Persian man called al-Razi, who was known to cook eggs without a fire, in a pot, and the second was a small assortment of German 15th century recipes that called for cooking chicken between two tin plates, and using quicklime and wine to heat the whole apparatus.

Now I had 3 different accounts, across FIVE centuries of cooking, with three different cultures. And the word came down from the lofty towers of my Laurel, Duchess Juana Isabella, saying unto me "Hey, you HAVE to do this. Make it so!" Therefore, I started with materials research.

Our subjects, the medieval population of Western Europe, would be quite familiar with limestone and its various products. Limestone itself would be an easily quarried stone used in building. If roasted at a high temperature, calcium carbonate cooks off into calcium oxide and carbon dioxide. Calcium oxide (also known as unslaked lime) is white, soft, usable to amend acidic soils and firming up loose soils. In our period, it was used also for making mortar, plaster, and even in the case of Henry III, it was used as a weapon to blind an invading French fleet. Adding water to make the aforementioned plaster and mortar results in slaked lime, which is much less reactive…and this slaked lime gives off heat as it converts.

Another confession: I am a science nerd. Once I found the numbers online for the conversion of calcium oxide to calcium hydroxide, I had to know. It turns out that a liter of water will fully react with

3.1 kilograms of calcium oxide, and produce3.54 megajoules of energy (this is 3355 BTUs). Is this enough to actually cook food (not just heat it)? Yes, in theory. But as a medieval cook, theory isn't something you can eat. I had to try it. There was just one thing standing in my way.

Where does one find unslaked lime? Everything I've read indicates is a very commonly used chemical, so where is it? My attempts to call industrial chemical suppliers locally went unanswered. Building and construction stores only carried slaked lime (well, one store did have a product that was 2.5% unslaked lime according to the label). I considered making it myself from calcium carbonate, in our glass kiln, but that was vetoed by my wife. eBay and Amazon DID have the pure product, as lab-grade chemicals, but for those, you'd be paying lab-grade prices, too. Finally, I tried to email a US-based international dealer in this product. The link for their West-coast distributor just….bounced. One final try…I emailed their Vice President for Special Projects. This qualified, right?

He thought so. Oh, it took a little convincing. Who I was took a bit. I had to explain what I was going to do, and why, and that I did understand the MSDS he sent me, and that while Calcium Oxide isn't toxic, per se, neither was this actually meant to come in contact with food…I'm sure you can imagine how it went. The amount I needed was also a bit of a problem. I was hoping for five or ten pounds. Their main unit of sale was twenty five TONS. So he called his most local distributor to me (two hours away), and had him "pull a sample"…twenty pounds, in two different sizes of gravel. Really, it was a great experience. Especially since the following week, we were going to go to the West Kingdom's 50th year Beltane celebration, which meant 10 days where I could hang out with medieval cooks and just TRY things, under near-medieval conditions.

I brought all the gear to make this happen. I brought vessels as closely matched as to what was described in the texts as I could. I brought the quicklime, of course. I had safety gear: apron, goggles, long thick rubber gloves. I had measuring gear—a scale, volumetric measures, and probe thermometers. There was food to cook. I was ready. Well, almost. Sadly, the scale broke literally as I packed it, so I had to do some estimation. But I was ready to Bring the Science!

My first trial was just mixing quicklime and water to see what sort of temperatures I would get as well as the final resulting consistency of the fully slaked lime. It generated enough heat that I did not want to hold the metal container with unprotected hands until it had cooled somewhat. The resulting plaster looked to be a very useful product in finishing my medieval stove project (but that's a different obsessive project…). My highest recorded temperature was 183 degrees F, which is pretty respectable for a steel bowl of white rocks and water.

I decided to skip the second trial—following the techniques of al-Razi to cook eggs without a fire. As far as I could tell, it was mostly a "trick" done to impress audiences. Further, as we were camping on a primitive site, we did not have easy access to the large amounts of water it would take to wash the slaked lime off the outside of the eggs. This could wait for a future attempt.

The third trial was one I had been waiting to do since the beginning of the project. This was the one that used the double pot. The recipe from Hieatt and Jones Two Anglo-Norman Culinary Collections is as follows:

To cook meat without fire....
Take a small earthenware pot with earthenware lid of the right size. Then take another pot, also earthenware, also with a suitable lid that fits well. This should be five fingers deeper than the first, and three fingers bigger round. Then take pork and chicken, cut them into nice pieces, get good spices and put them in, and some salt. Take the little pot with the meat in and put it inside the big pot. Set it upright, cover it with the lid and seal with damp, sticky soil, so nothing can come out. Then take lime that has not been slaked [quicklime], put it in the big pot full of water, but take care that no water gets into the small pot. Leave it alone for as long as it takes to go five to seven leagues. Then open your pots, and you will find your meat well and truly cooked.

I had one stoneware jar with a lid from my potter friend that looked to be about three cups in volume. I decided to alter the recipe a little because a pot full of nothing but meat would be rather boring—I seasoned some pork, cut into one inch cubes, with salt, savory, cinnamon, clove ginger, cubebs, and thyme, and added wine and lentils. The size of the small pot dictated the size of the larger pot as above. I quickly ran into some issues. First of all, my larger pot was an unglazed terracotta flower pot, meaning I had to improvise a lid for the larger pot. Secondly, as lime slakes, it expands. While nothing broke, I did have trouble with keeping the outer lid in place. Third, it's a messy process, with mushy slaked lime getting everywhere. Fourth, due to the way the lid sealed on the smaller pot, I was unable to run a probe thermometer into the smaller pot to monitor the internal food temperature .

I was able to monitor the temperature of the smaller pot just at the outside. The high temperature reached was 213 degrees F, which cooled over the space of two hours to 87 degrees F. At this point, I made the decision to open it up, even though the listed cook time is 5-7 hours (given average walking speed, a person can walk about 1 league an hour).

The results? The food inside was cooked, but not cooked WELL—the lentils were still somewhat hard, and the meat was not cooked to a tender state. The temperatures recorded showed a rapid drop from the high of 213 down to 140 in only a half hour or so. I believe this was due in part of several issues unrelated to the cooking method. First, we were doing this outdoors, in an unenclosed area. The daily temperature at that point was in the 50's, with a fairly constant cool and damp breeze blowing (approximately 5MPH). Convection processes would cool the apparatus much more rapidly than otherwise. Secondly, the unglazed terracotta pot did not retain the heated liquid that well. We could see bands on the outer surface where heat and liquid on the inside were pushed to the outer edge of the outer pot. This would carry heat as well. I did not precisely follow the instructions of the recipe which called for filling the outer pot with water and adding the lime--I reversed this to keep from having bits of lime blasted out of the pot (think Pop-rocks), which may have resulted in incomplete conversion

of the lime. Lastly, the whole apparatus was on an iron shelf we had access to, raising it up for easy measurements and monitoring. Iron is a great heat sink, and so after the fact I have to wonder how much heat was lost that way.

I definitely look forward to trying this again under better circumstances.