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Reconstruction of Bread Samples Excavated in Százhalombatta-Földvár, Hungary

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Introduction

Bread has been the staff of life in Europe since wheat and barley were domesticated. Identifying wheat and barley grains have become common events in archaeobotanical studies from Neolithic sites up until the present. But finding bread or beer are much more difficult (Samuel 2002). While beer is almost impossible to identify archaeologically, it turns out occasionally bread has been uncovered and identified. In the summer of 2014 at the Bronze Age site of Százhalombatta-Földvár, Hungary, the excavation team, directed by Dr. Magdolna Vicze, uncovered some fragments of what was surmised to be fragments of charred bread (Figure 1). Professor Christine Hastorf from the University of California, Berkeley, recently accompanied colleagues in Százhalombatta-Földvár, Hungary to assist in the excavation of an Early to Middle Bronze Age site. During the excavation, she found charred samples of what appears to be small chunks of bread in a ceramic bowl within a house that collapsed during to a Bronze Age conflagration (Figures 2 and 3). Christine Hastorf then looked at these and other fragments under a microscope in the museum laboratory and concluded that these were fragments of bread, but in what state? A plan was developed to complete a series of experiments to learn what different phases of bread making looked like burnt in different conditions. The plan was, by using these experimental results we could better interpret the bread fragments found at Százhalombatta-Földvár to interpret the burning conditions. Was the bread already baked when the fire of this house occurred or was the bread rising? During the autumn 2014 Brittany Colter-Graham and Juanito Acdan worked on this project with Christine Hastorf of experimental dough and bread production and burning. This report presents the results of this work, with conclusions of the bread found at the site Százhalombatta-Földvár.

The experiment we conducted aimed to reconstruct a range of bread so that we could see what was most like the archaeological bread samples that Professor Hastorf excavated. We performed three trials, each with the same bread recipe, but different charring temperatures and charring times. We differentiated between oxidized bread/dough conditions (left to react with the air within the furnace) and reduced bread/dough conditions (wrapped in foil and placed in a container of sand so that it has little to no interaction with the air within the furnace). See photos labeled A-E in the photographs section for pictures of the site and bread fragments at the excavation site.



Figure 1. Százhalombatta-Földvár, located on the west side of the Danube River



Figure 2. Charred bread in situ.



Figure 3: Bread collected during excavation

Background

For a long time, food remains, particularly bread samples had been ignored in archaeological excavations of ancient human settlements. But over time, archaeologists have realized that some of the unknown items uncovered during excavation might be bread, based on more detailed study of studying modern bread samples and microscopic analysis. From this angle of investigating food in the past, one can gain a better insight into the dietary habits of past civilizations. This allows us to form conclusions about the place of bread in Bronze Age society. From the results of this analysis, it seems that bread was produced in every house at this site. But were they made for “offerings”, or just for daily meals? Archaeological evidence of bread making at the Amarna Egyptian workmen’s bakeries reveals that working classes ate different types of bread than did the royalty (Samuel 1989, 1993, 1994). Through detailed archaeological analysis of the bread forms, ovens, and plant remains, Delwin Samuel uncovered how the wheat was processed and made into specific shapes, reflecting the materially defined boundary between the workers and the royalty

(Samuel 1996b). But in this dense Bronze age site on the shores of the Danube River, from this level of deposit, it seems that most houses had bread prepared, so that when their houses burned, they abandoned bread of different recipes in them.

To study these breads we created an experiment of simple, Bronze age bread recipes to bake that was then charred in a series of conditions, to learn which was most like the archaeological bread uncovered at the site.

Methods

Since Hastorf observed two recipes in the Bronze Age bread from Százhalombatta-Földvár in 2014, one with whole grains and one without, we chose to investigate these two recipes in our experiments, one with whole wheat grains and one without. Thus we created these two recipes in our experiments.

1) Baking Bread: Recipes/Materials

❖ Wheat bread studied by Juanito Acdan and Wheat bread with whole grains studied by Brittany Coulter-Graham



Both included:

- ½ packet of dry yeast (approximately ½ tablespoong)
- 1 ½ cups lukewarm water
- ½ tablespoon salt
- 2 ½ cups of unbleached, all-purpose flour, plus more for dusting.
- The second recipe included a small handful of wheat grains.

❖ Materials used for Baking

- Electric/Gas Oven
- Wooden board for kneading
- Mixing Bowl
- Kitchen towel
- Cooking/Baking Tray
- Wooden Spoon
- Measuring Cups
- Broiler pan (or some container to hold hot water)
- Oven Mitts
- Parchment paper

Baking Procedure completed by both recipes: *

1. In a large bowl mix in the ½ package dry yeast and salt into 1 ½ cups lukewarm water. Leave for 5 minutes until frothing. Stir in flour (and whole grains) with wooden spoon, mixing until there are no dry patches. Dough will be quite loose.
2. Place dough on a floured wood board, adding flour as needed, begin kneading. Knead until dough is smooth and satiny. Knead for about 5-8 minutes. Place back in bowl to rise.
3. Cover lightly with a kitchen towel, but don't seal the bowl airtight. Let the dough rise at room temperature for 2 hours or until doubled in size. Insert two fingers into middle of dough ½ inch and if the indentations remain, the dough is ready.
4. Second rise: repeat step 3, but knead for a shorter amount of time. Upon completion, place dough on a floured parchment paper and cover lightly with a kitchen towel. Let it rise for 40 minutes until almost doubled (shorter rise time).
5. Toward the end of the second rise, about 10 minutes before baking, turn oven on to 450 degrees Fahrenheit and place both the broiler pan (lower rack) and baking tray (middle rack) in the oven.
6. After the dough has rested and is ready to bake, take off cloth, dust the dough lightly with flour. Slash the top with serrated knife three times. Also add slashes along the circumference of the dough 1 centimeter apart, 1 centimeter deep, like what was seen in the Bronze Age bread.
7. Slide the dough (with the parchment paper) on top of the hot baking sheet in the oven. Pour about 1 cup of hot water into the lower pan and shut the oven quickly to trap the steam.

8. Bake the bread until well browned, about 24-28 minutes. Cool the bread completely before breaking it open.

*Largely adapted from: <http://www.melskitchencafe.com/rustic-crusty-bread-a-simple-how-to/>~Baking was done at a place of each experimenter's choosing, which was kept constant throughout the duration of the 2014 semester.

See photos labeled Appendix C-E to see what dough and bread samples looked like before charring.

2) Charring Procedure

Baking/dough making was done in advance before each charring session. There were eight samples charred during each charring session because of the two bread recipes and distinction between oxidizing/reducing states.

To be clear, at each charring session, we charred:

- 1 oxidized wheat bread sample,
- 1 oxidized wheat bread with grain sample,
- 1 oxidized wheat dough sample,
- 1 oxidized wheat dough with grain sample,
- 1 reduced wheat bread sample,
- 1 reduced wheat bread with grain sample,
- 1 reduced wheat dough sample,
- 1 reduced wheat dough with grains sample.

We had three different charring sessions in which the furnace was set at different temperatures and samples were left in the furnace for different amounts of time. This was in part to see if we could learn about the charring conditions of the archaeological bread that was encountered, in what conditions did these houses burn. To be more specific we completed three burning modes:

- Trial 1: 320 degrees Celsius for 3 hours, medium
- Trial 2: 230 degrees Celsius for 5 hours, low and slow
- Trial 3: 500 degrees Celsius for 1 hour, hot and short
During this trial, the furnace started at 350 degrees Celsius and was then adjusted to 500 degrees Celsius after the samples were put into the furnace (took 30 minutes to reach 500 degrees C)

**Device used to char the samples was the Furnace Thermolyne/Eurotherm 2416.

See photo labeled I in photographs section for furnace setup.

Experimental Results

In this section, we record and discuss the results of each trial, accompanied by pictures to give a visual representation of the sample results. We decided that we needed to see what low, medium and high temperatures might produce, to try to reproduce the possible conflagration of the houses that burnt down in the Bronze Age settlement. We therefore tried low and slow, medium temperature with a medium time and a very hot and short temperature regime. We first began with the medium setting (#trial 1) then did the low temperature with long time (#trial 2) and finally the short and very hot condition (#trial 3).

Trial 1: 320 degrees Celsius for 3 hours - medium temperature and time



Figure 1: Overview of charring results from trial 1.

Observations for Trial 1:

- Samples of oxidizing bread reduced to ash.
- Samples of oxidizing dough retained their shape while seeming to “puff” up a little, perhaps because they baked before becoming charred.
- Reduced bread samples retained their shapes and burned “nicely”; texture appears rough and coal-like, very similar to the archaeologically excavated bread; probably the best reconstruction for this trial.
- Reduced dough samples melted into the foil that they were contained in; once cut, the texture of the samples were similar to the reduced bread samples; while the texture of the inside of the reduced. Dough samples were good, the outside “melted” texture makes it unlike the archaeological samples
- For more pictures of this trial, view photos labeled J-L in the photographs section

Trial 2: 230 degrees Celsius for 5 hours -- lowest temperature, low and slow burning



Figure 2: Overview of charring results from trial 2.

Observations for Trial 2:

- Oxidizing samples held their shape much better than the reducing samples.
- Oxidizing bread samples, in particular have texture very similar to the archeological samples; the decorative slash pattern on the sides held up well; best reconstruction for this trial.
- Once again, the oxidizing dough appears to have baked before becoming burned.
- Reducing bread samples have nice texture inside, but the side slash decoration pattern seems to have “faded” away.
- Reducing dough samples have the same nice texture as the reducing bread samples, but on the outside have melted into the foil, acquiring the shape of the foil it was wrapped in.
- For more pictures of samples from this trial, see pictures labeled M-Q in the photographs section.

Trial 3: 500 degrees Celsius for 1 hour -- hottest experiment: hot temperature



Figure 3: Overview of charring results from trial 3.

Observations for Trial 3:

- Both oxidizing bread and dough samples turned into ash, so much so that it was impossible to distinguish between the two.
- Reducing bread samples held their shapes and displayed nice curvature; slash decoration patterns remained visible; best reconstructions for this trial.
- Reducing dough samples did not “melt” into the foil they were wrapped in like the other trials; texture inside is very porous with visible holes where pockets of air left a small hollow space.
- For more pictures of samples from this trial, see photos labeled R-T in the photographs section below.

• **Comparison to other Archaeological Bread Samples**

In order to better understand possible reconstruction scenarios for the bread samples found at Százhalombatta-Földvár, Hungary, we also did additional research to see what others have discovered of bread evidence in the field and compared their findings what we have found:

- In Bjorko, Sweden, Ann-Marie Hansson and colleagues have discovered an abundance of bread samples that were possibly leavened (having a porous texture), definitely baked, preserved by charring, and made between the years AD 400-900. Microscopic evidence supports that many of the samples had a round shape before being broken into chunks. Some of the samples had oats within. These breads found were offerings in graves. See picture labeled R in photograph appendix section for a view of one of these samples.
- In an article by Delwin Samuel (1989), she talks about various desiccated loaves she has found and studied in Egypt, which were likely baked during the Pharonic Period (2000-1200 BC). Microscopic evidence supports that the loaves were likely leavened and very moist as dough. See picture labeled S in the photograph appendix section for a view of a sample that Samuel talks about.
- Keller (1866) published an article in which he talks about excavated bread samples made of wheat grains and others made of barley in the Swiss lake dwellings. Most likely 3000+ years old, these samples were baked on hearthstones and then later charred by mistake. The samples made of wheat were possibly part of a “cake” as they had flat sides and concave bottoms. It is unspecified if they were leavened.
- Unleavened chunks of bread found in Ur, Iraq have been dated back to the Ubaid Period (2500-500 B.C.). The samples were made of finely ground flour, baked, and later charred.
- A variation of bread samples that included very tiny fragments, bread rolls, and flat breads was discovered in Northern Italy and made from flour. They were baked during the Greco-Roman Period; some were preserved, some were charred. Leavening was done with variation. They were found in cremation burials.
- Samples dubbed the “Glastonbury Buns” were discovered in Glastonbury, England and likely from the Iron Age (1500+ years old). The buns were cake-like and not really like bread; thought to be made from poorly grinded wheat and honey. These samples were probably not baked, and it was unspecified whether they were leavened or how they were preserved.

The samples found by Professor Hastorf in Hungary are believed to be leavened and baked (round shape suggests the dough rose before/during baking), and decorated with a slash pattern around the side on a flat baking stone. They were found within a container in a collapsed house. While the current published research on archaeological bread samples vary, the information supports the idea that the bread was baked and probably leavened before it was charred in the conflagration that occurred in these Bronze Age houses..

Conclusion

The reducing bread at 320 degree Celsius, oxidizing bread at 230 degrees Celsius, and reducing bread at 500 degrees Celsius are the best possible candidates to match with the archaeological bread sample. Given this, it is likely the bread had been baked before the conflagration that preserved it in these Bronze Age houses. Dough samples melted, rose, or displayed holes in the center, making them unlikely to be representative of the archaeological samples. Most other preserved breads in archaeological research for the surrounding areas list the samples as most likely baked, indicating that the Hungarian sample is less likely to be dough but most likely bread ready to be eaten. Because two out of the three best reconstructions are reducing, and many of the oxidizing samples reduced to ash, it is also likely that the Hungarian samples were not exposed to oxygen in the air while they were charred as the houses burnt. Thus, it is probable that the house collapsed before it was overcome by the conflagration. However, the

oxidizing bread at 230 degrees Celsius had the best compact, rough texture most like the texture of the Hungarian bread samples. Thus it cannot definitively be concluded if the bread was oxidized or reduced when it was charred.

Experiment Bread Photograph appendix:



A- Closer look at the texture of archaeological bread B- Slash decoration pattern on archaeological bread sample



C- Wheat bread/dough with grains before charring



D- Wheat bread/dough before charring E- Samples (oxidizing on slabs, reducing in containers)



F- Furnace Setup



G- Oxidizing dough texture (trial 1) H- Reducing bread texture (trial 1)



I Reducing dough texture (trial 1)



J- Slash pattern-oxidizing bread (trial2) K- Oxidizing bread texture (trial2)



L Oxidizing dough texture (trial2)



M- Reducing bread texture (trial3) N- Reducing dough texture (trial3)



O - Slash pattern visible on reduced bread (trial 3)



P- Reducing bread texture (trial 3)

Q- Reducing dough texture (trial 3)



R- Archeological Bread Samples found in Sweden (Hansson) S- Desiccated bread sample found in Egypt (Samuel)

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