BREAD, THE STAPLE FOOD:

HOLDING ANCIENT MESOPOTAMIAN SOCIETY TOGETHER

ANCIENT LIVES (ANE 103)

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ABSTRACT:

The Ancient Mesopotamians, much like modern people, ate bread. Beyond that simple fact however, the scientific community is in the dark about a lot of the details. We have endeavored to answer some of the most basic questions surrounding the manufacture and consumption of bread in the ancient world. In particular, we focused on how mixing barley and wheat flour could improve the quality of baked breads and what that difference in quality could mean for society. We baked nine different breads. Each bread had a different mixture of flours and sourdoughs. We discovered that adding even a small amount of wheat flour drastically improved the flavor, texture, and even appearance of the resulting bread. Due to the greater abundance of barley and the relative scarcity of wheat in Ancient Mesopotamia, the wheat bread would have been more expensive. This led us to conclude that wheat breads would have been reserved for the rich and could have served as some sort of social signaling. We also discovered that barley breads did not rise very much due to their low gluten content. This led to a visibly flatter bread that could also could have served as a social signal. In Ancient Mesopotamia, bread might have been more than

just a staple of their diet. It could have held their rigid social structure together by making class divisions visible and tangible in the heart of the home: the dinner table.

INTRODUCTION:

The ease of agriculture in Mesopotamia is part of the reason it became a hearth of early civilization. The first wheat, oats, barley, and lentils evolved from wild plants that grew in the area that is now Iraq. Mesopotamian cereal crop production consisted of primarily barley and emmer wheat. Mesopotamia cereal production was comprised of 80% barley and 20% wheat typically, although this fluctuated with ambient conditions- in times of famine, for example, wheat production fell. The importance of barley in the life of common Mesopotamians cannot be overstated--in some periods, barley was used as currency, with workers being paid in barley rations. Such barley was commonly processed and baked into breads or porridges. Barley was also used in the production of beer, which had both ritual and caloric significance in Mesopotamian society. Barley was a basic element of the Mesopotamia economy and the primary source of calories for the common man. Here, we study the relationship between barley and bread- in particular, testing and analyzing all the assumptions and theories build up by the archeologist about the importance of grains and the bread making process in Mesopotamia.

Bread can be roughly grouped into two types, leavened and unleavened. Unleavened bread was a form of bread which was not fermented during the dough-making process, while leavened bread was fermented. There is ample evidence to suggest that Mesopotamians produced both types of bread- the tandoor ovens of Mesopotamia are best suited for making flatbreads, while over 50 bread “molds” were discovered at the palace in Mari, such molds being necessary to shape leavened bread as it rises. The breads were meticulously classified and listed in terms of size, shape, texture, thinness of the flour, component, and so forth. Bread, apart from

being eaten plainly was also included in porridge and soups, comprising a staple of Mesopotamian diet. Bread was often present in the form of rations for workers who helped build massive structures, palaces, and temples. This is the type of bread we are study--the bread of working people, rather than the types of bread that would likely be eaten by nobility.

All leavened bread in Mesopotamia was sourdough, as the ancient Mesopotamians did not understand the significance of yeast in fermentation (or know of its existence). Thus, all fermentation was accomplished through sourdough cultures, like chickpeas or barley sourdough, instead of through adding purified yeast. To make sourdough, a mix of flour and water is left to ferment and fed periodically with more flour. This process leads to the growth of bacteria and wild yeast, which break down the starches within the grain to produce lactic acid and carbon dioxide. The lactic acid gives the bread its characteristic sour taste, while the carbon dioxide causes the bread to rise and form leavened loaves.

Bread, however, can only rise if it contains gluten, which is found in certain grains. When the bread is kneaded and hydrated, various proteins come together to form gluten, which forms a springy network within the bread. When the bread is left to rise, the yeast emits pockets of CO2 that are captured by the gluten network. This creates the familiar airy pockets and palatable texture in risen bread.

Risen bread is not merely a modern subjective preference. The process of allowing yeast to digest the proteins and carbohydrates of the dough actually improves the nutritional content of the food. Because bread was a staple food, this augmented nutritional content was incredibly important for the health of individuals. Therefore, it is reasonable to classify the desirability of bread by its ability to rise.

Archaeologists have theorized that most Mesopotamians ate 100% barley bread (Goulder 2010). However, attempts to reproduce 100% barley bread have resulted in hard, barely edible

loaves. Barley lacks the requisite proteins to form gluten, and thus dough prepared from barley does not rise properly. This prevents the formation of leavened barley loaves. Recognizing this, modern bakers do not make 100% barley loaves. This casts doubt on the claim that Mesopotamians baked leavened 100% barley bread.

We hypothesize that previous attempts to reproduce Mesopotamian bread have been unsatisfying because they have not been carried out in consultation with food scientists. Studying food in history is by its nature an interdisciplinary endeavor. In this experiment, we examine Mesopotamian bread through the lens of food science. We will test different ratios of barley to wheat in sourdoughs. We will also examine some suggestions proposed by archaeologists to mitigate the problem of barley bread not rising. These suggestions include roasting the grains (to increase available sugar content or to easily remove the bran) and using chickpeas (which contain bacteria similar to yeast) as a sourdough starter.

This endeavor is based in the philosophy that the human body has not changed over the last few thousand years; as such, we should value our experience in eating the food that we believe they did. The Mesopotamians were creative in the kitchen and would not have eaten unpleasant, hard bread if they had any choice. Earlier analysis has often gotten caught up in nutritional and economic analysis and ignored the bread's taste and texture. To quote food scientist Karen Methany:

"We need to recognize that food is not just a source of nutrition or the result of chemistry, but also a complex sensory experience, and one that was potentially a source of pleasure. Food is not just good to think, then….it is also good to eat."

By creating different types of bread and assaying the eating experience ourselves, we yield insight into how the ancient Mesopotamians cooked to optimize eating experience.

MATERIALS AND METHODS:

Sourdough Starters:

1. Mix flour and non-chlorinated water in a bowl. We prepared four mixtures, corresponding to the following compositions of flour:
    i. *Group 1*: 2 cups water + 2 cups barley flour
    ii. *Group 2*: 2 cups water + 1 and ⅓ cups barley flour + ⅔ wheat flour
    iii. *Group 3:* 2 cups water + 1 and ½ cups barley flour + ½ wheat flour
    iv. *Group 4:* 2 cups water + 1 cup barley flour + 1 cup wheat flour
2. Cover the jar with cheesecloth or any other porous material. This keeps out various pests but allows for air to circulate.
3. Store the mixture in a warm place (70° to 80°F/21° to 27°C is ideal, but work with what you have) with good air circulation. Our cultures were visited daily and re-stirred. This is because agitation increases yeast activity, thus stimulating the fermentation process. After some number of days tiny bubbles at the surface of the mixtures should be observed. This is carbon dioxide gas and indicates the presence of active yeast.

Microbiology Analysis:

1. Prepare a number of Eppendorf tubes equal to the number of sourdough cultures.
2. Add 900 ul of PBS (phosphate buffered saline) to each tube.
3. Add 100 ul brine of each sourdough culture to separate Eppendorf tubes. (the PBS needs to be added first, to avoid possibilities of contamination)
4. Add 200ul to each agar plate
5. Spread the mixtures with a cell-spreader.
6. Label everything and incubate plate upside down to avoid condensation.
7. Analyze the microbiological cultures through the microscope

All doughs were made by mixing 100 ml of water, 4 gr of salt, 60 gr of sourdough starter and 200 gr of flour. The flour and sourdough compositions are given in the following table.

Flour Composition	**Sourdough Type**
100% wheat flour	100% wheat sourdough
100% wheat flour	100% chickpea sourdough
100% barley flour	100% barley sourdough
100% roasted barley flour	100% barley sourdough
100% barley flour	100% chickpea sourdough
100% barley flour	Yeast (sourdough not used)
60% barley flour/40% wheat flour	60% barley/40% wheat sourdough
75% barley flour/25% wheat flour	60% barley/40% wheat sourdough
50% barley flour/50% wheat flour	50% barley/50% wheat sourdough

Table 1. The flour and sourdough compositions used for the experiment.

1. Knead the dough for around 10 minutes to attempt to form a gluten network.

2. Shape the doughs by hand into slabs 5cm thick. Place doughs in a locked plastic bag and seal tightly, ensuring there is no extra air trapped in the bag.
3. Lay the bags flat on a horizontal surface. Ensure ambient temperature is 30ºC.
4. Measure the height of the dough (We did this by laying index cards flat upon the highest point of the dough, and then recording the height of the index cards with a ruler).
5. Take measurements of the dough height after 5 min, 10 min, 20 min and 30 minutes. Record measurements.
6. Wrap the dough in plastic wrap and refrigerate for 48h at 2-3ºC.
7. Shape each dough into a loaf
8. Let it ferment for a 2nd time for 15 minutes at 30ºC
9. Bake it in the oven at 450ºF for 25 minutes
10. Let it cool for 10 minutes
11. Cut each bread loaf in half, freezing one half for measuring elasticity next week and the other half for tasting. Evaluate the bread quality, structure and mouthfeel for each loaf.

RESULTS:

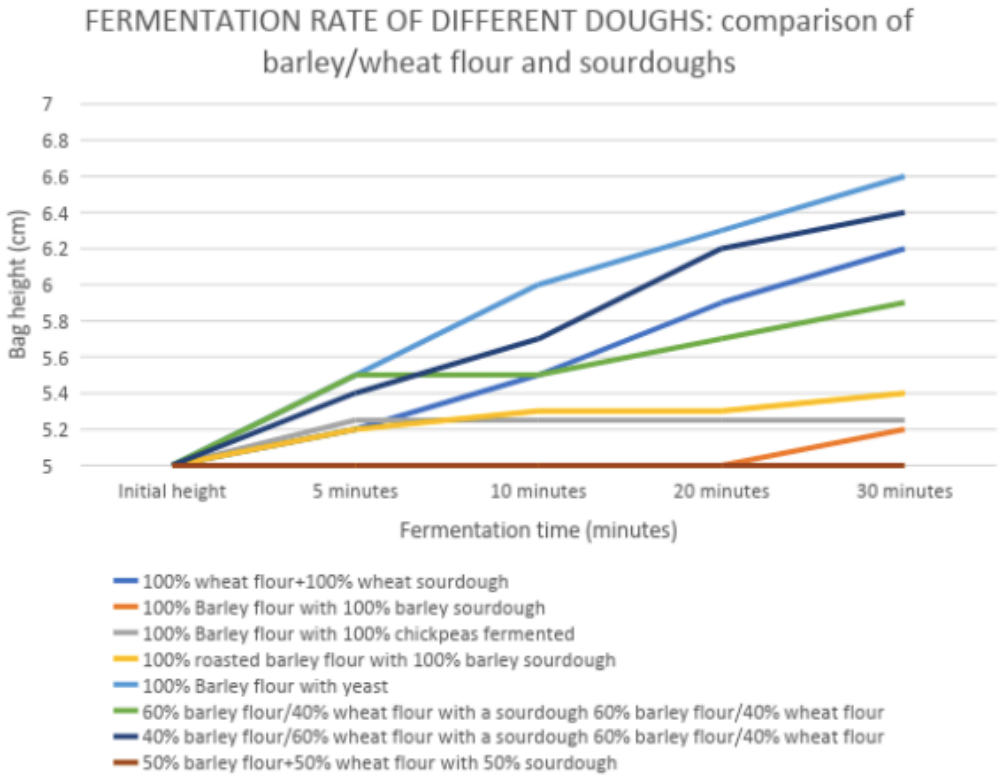

Figure 1. Fermentation rate of different doughs: comparison of barley/wheat flour and sourdoughs.[1]

As shown in this graph, the fermentation rates were best in the 100% barley flour with added yeast bread, the 40% barley 60% wheat flour with matching sourdough bread, the 100% wheat flour and sourdough bread, and the 60% barley 40% wheat with 60% wheat and 40% barley sourdough. This makes a lot of sense, as the more wheat-heavy breads were consistently of higher quality. It also follows that the bread with added yeast would ferment faster than our homemade sourdoughs because they're manufactured to do so quickly.

Control:

- 100% wheat flour+100% wheat sourdough
- This bread was one of the most palatable and had the most elasticity. Predictably, as our control, this was one of our most successful breads

Chickpea Sourdough

- 100% Barley flour with 100% chickpeas sourdough
- 100% Wheat flour+100% chickpeas sourdough
- 100% Barley flour with baker's yeast

The chickpea sourdough breads fermented more quickly than the barley breads, but not as quickly as the baker's yeast or the wheat-focused sourdoughs. The chickpeas did not add enough additional protein to have a significant nutritional effect, and they did not have much of an effect on palatability. The difference in quality between these two chickpea breads is based on

[1] N.B. Wild yeasts were present on all of the flours used. The 'barley flour with yeast' bread had additional baker's yeast added.

the flour-type. Though the breads were very similar in palatability, the bread with baker's yeast fermented quickest.

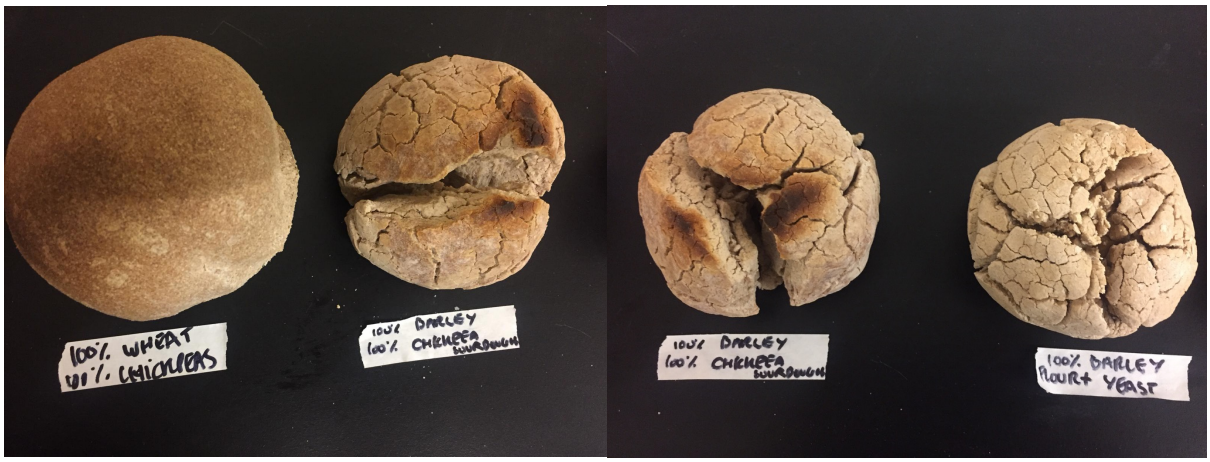

Figure 2. The control and chickpea sourdough group.

Roasted vs Non-Roasted Barley Flour

- 100% Barley flour with 100% barley sourdough
- 100% Roasted barley flour with 100% barley sourdough

The roasting caused the roasted-barley bread to take on a darker color, but all other criteria stayed largely similar. Elasticity, crust, taste, and overall quality did not differ significantly.

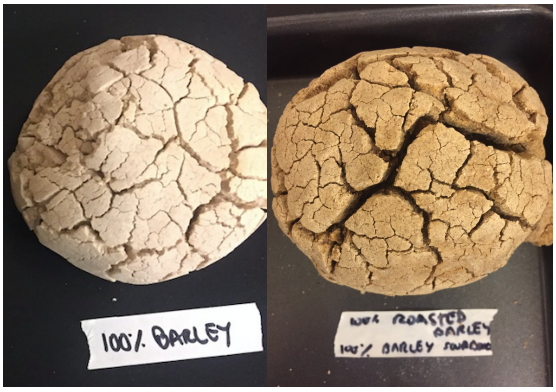

Figure 3. Roasted vs. non-roasted barley flour group.

Mixing Barley and Wheat

- 75% Barley flour/25% wheat flour with a sourdough 60% barley flour/40% wheat flour
- 60% Barley flour/40% wheat flour with a sourdough 60% barley flour/40% wheat flour
- 50% Barley flour/50% wheat flour with 50% sourdough

Though the barley flour and sourdoughs were undoubtedly the least successful breads in that their crusts, elasticity, fermentation, taste, texture, palatability, and overall quality were far lesser, adding a small amount of wheat greatly improved all these criteria. Though the 75% barley flour/25% wheat flour with 60% barley/40% wheat sourdough and the 60% barley flour/40% wheat flour with 60% barley/40% wheat sourdough had weaker gluten networks than the fully wheat bread, they had much nicer crusts and textures, and could actually be treated as bread, whereas the more barley-focused breads (like the 100% barley flour, 100% barley sourdough bread) were too brittle and dry to be considered palatable.

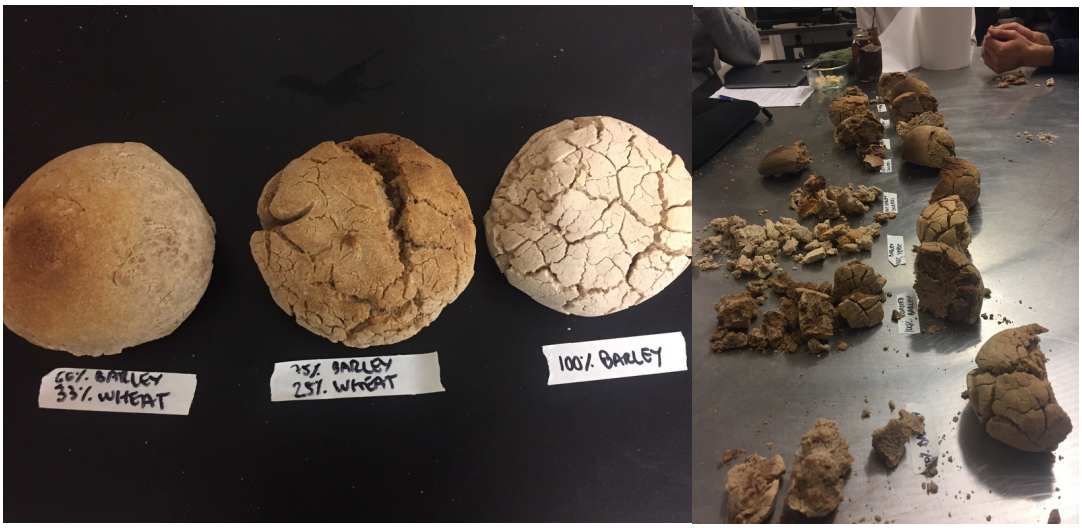

Figure 4. The mixed barley and wheat group.

CONCLUSION:

The 100% barley bread was not unpalatable, but one interesting observation is the fact that vast portions of the barley bread were inedible due to the hardness of their crusts. For the loaves we baked (initially 5cm in diameter), volumetrically about half of the bread was so hard as to have been inedible, while the innermost half had a distinct sourdough flavor, albeit lacking in texture from a modern standpoint. From the flavor standpoint, it's very plausible that over time prepared Mesopotamian sourdough cultures could produce good tasting barley bread- this is indeed an evolutionary process, and which over time would lead to bread compatible with Mesopotamian tastes. On the other hand, the inefficiency of baking such small loaves (over half inedible) means that it is perhaps possible for a focus on larger loaves of bread, which would not experience so much loss from the exterior hardening perspective. We know that ancient Mesopotamians had a sense of texture as there are scripts that would show Mesopotamian preference to finely ground grains (Bottéro1995), so it shows that these people did have a sense of taste and a preference for certain taste, textures, and smells over others.

Because the Mesopotamians grew less wheat than they grew barley (Rosemary 1981), it makes sense that wheat would be more expensive than barley. The increase of bread quality by just adding a little wheat flour is so great that the demand for wheat had to be quite high. This means that there would have to be several different "grades" of bread. The percentage of wheat in your bread could have been a status symbol. Those who could afford the nicer loaves of bread would be able to display that wealth and privilege. The stark differences between the breads would make an effective social signal.

To create a pleasing tactile and sensory experience, some sort of access to the more expensive wheat crop was certainly necessary. These observations suggest that perhaps Mesopotamian social structure was stratified along these lines, with the wealthier individuals enjoying more pleasant food experiences. This is different from the social stratification present in

the 21st century developed world, where almost everyone has access to food that at least tastes enjoyable.

Through the Yale Babylonian culinary tablets, it is shown that bread was clearly a source of nutrition that the ancient Mesopotamians could not live without. This is emphasized through the fact that they had over 300 types of bread depicted in their ancient cuisine (Bottéro1995). This fact remained true for all walks of life--from the richest of the rich to the poorest of the poor. For this reason, it becomes clear that the distinction between classes came not from the kind of diet, but rather from the quality of it.

Given the great discrepancy between the amount of wheat produced versus the amount of barley in ancient Mesopotamia (Bottéro1995), it can be assumed that a much larger group of people consumed barley, rather than wheat. As detailed above, the higher the percentage of wheat in the bread, the easier the formation of a gluten network which in turn would allow the bread to rise better and maintain its shape. This produces a more enjoyable, and higher quality type of bread. The more wheat, the better the bread; the less wheat grown, the rarer the commodity. A rare, nutritionally beneficial, and quality crop is bound to cost a pretty shekel--and in this manner wheat becomes a grain of the elite. This lends towards the idea that barley--and by default bread with a high percentage of barley--was a grain left more to the commoner class.

Furthermore, grains contributed to the stratification of ancient Mesopotamia due to its early use as a form of payment for the mandatory labor required by the state (Rosemary 1981). The dominating theory is that beveled rim bowls were used as a measuring device in which to dole out rations of grain for the people that would help build massive architectural structures like irrigation canals and palaces (Millard 1988).

We were only able to hypothesize on breads relation to other aspects of Mesopotamian life because we studied the bread--and subsequent recipes--through more than one lens. This

means we did not carry out our analysis of Mesopotamia bread through one field of study--such as history or archeology or food science--but rather by combining a variety fields and using their unique points of view to create a nuanced understanding of Mesopotamian bread.

Without a combined approach to our study, our process and ensuing discoveries would have been drastically different. Our experiment and analysis heavily relied upon actually experimenting with food to further understand the recipes. These recreations allowed for a realistic understanding of the Babylonian tablets that took into account the baking process as well as the sources themselves. Only by taking this approach could the contrast in quality between types of bread become clear, allowing for further analysis into Mesopotamia social status.

CLOSING REMARKS:

In conducting our experiments, we set out to further validate the use of barley as a staple crop in the creation of leavened bread. Developing a better understanding for Mesopotamian bread production led to revelations about the practicality of large-scale production of one bread product vs. another, and provided us with experience that hopes to justify the amount of granular detail we attempted to achieve; distinguishing between the barley and wheat concentrations, the differences in product as a result of having different gluten networks, differences in nutritional content, etc. Further, we attempt to gain insight into the socio-economic implications of having access to certain elite bread products and attempted to characterize preferable qualities. This project emphasizes the importance of interdisciplinary study, as we have repeatedly seen that some of the most compelling research questions have been posed by those taking a fresh research approach to long-debated subjects.

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