Egyptian Brewing: The Production of Beer Based on Archaeological Evidence

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Production of beer in ancient Egypt was an important daily activity. Beer was an essential part of the nutrition of the ancient Egyptian as well as important in religious life. Beer production dates back to at least the 35th century BC. The standard model for the production of beer in ancient Egypt is based on the interpretation of artistic depictions in tombs and the modern practice of making bouza, a beer produced by Nubian and Coptic populations in modern Egypt. Another model has been put forth by Delwen Samuel that uses high powered microscopy to analyze beer residues. Based on starch morphology, Samuel argues that the standard method of brewing needs to be rethought. Using this model for beer production, I attempted to reproduce beer of ancient Egypt.
Beer is simply defined as, “a beverage made from fermented cereals” (Samuel 2001:171). Fermentation is microbial change in an organic substrate (Platt 1964:69; Platt and Webb 1946:132-133; Samuel 2001:171; Stahl 1989:172) which can be done through the metabolic activity of yeasts or bacteria on sugars, converting them to alcohol. Many cereal crops that are rich in starch can be used to produce alcohol. Modern western beers are generally made from barley or wheat, but often have additions of rice and maize (Mares 1988:61). Beer is also made from millet (Barth 19667:154; Karp 1980:89; Netting 1964:376), sorghum (Platt 1964:72), maize or quinoa (La Barre 1938:225) and a variety of other crops.

It is necessary to define some terms for the study of beer. Malt is grain that has been germinated or sprouted. Mash is malted or milled grain that has been mixed with hot water to form wort. Wort is the fermentable liquid that, after fermentation, becomes beer (Samuel 2001:171).

When Braidwood (1953:516) asked the question, “Did man once live by beer alone?” most agreed that the first use of grain agriculture was probably for the production of gruel. Cooking, or even just soaking the hard kernels of cereals in water makes them more palatable for humans. It was suggested (Braidwood: 525-526) that the first beer could have been a thin gruel left uncovered and inadvertently fermented with wild yeasts. The results of fermentation could have been pleasant, but as anyone who has left juice in the refrigerator for too long knows, the results of accidental fermentation are not always pleasant. When the happy accident of gruel-turned-beer was enjoyed, the practice of leaving thin gruel out could have caught on. How this proposed “first beer” turned into
large scale production that was essential to the Pharaohs of Egypt is beyond the scope of this presentation, and further investigation is needed on the evolution of beer in ancient Egypt.

The image of beer as a fermented thin porridge is a clear sign that the earliest beers were different from what is commonly thought of as beer today. Also in stark contrast to today, this early beer was considered a staple (Arnold 1911:65; Breasted 1907:60,131-132; Drenkhahn 1975:871; Erman 1894:196; Lutz 1922:76; White1963:107). Inscriptions in tombs in ancient Egypt as well as in administrative records show that beer and bread were seen together as everyday food, consumed by everyone, with beer being described as the “national drink” (Darby et al. 1977:532). A scene of vendors selling beer in a marketplace was found at the New Kingdom (1550-1170 BC) city of Ahketaten (James 1985:252).

The fermentation of grains can actually enhance the nutritional value by adding fatty acids, amino acids (Samuel 1999:171), sugars and vitamins (Platt 1964; Stahl 1989; Steinkraus 1979). As well as making for a nutritious part of the diet, beer could be a source of reliable potable liquid (Samuel 1996:3). Water from wells or rivers could have harmful bacteria in it and the alcohol content of the beer, as well as it’s cooking, could make beer the safer option. The alcoholic quality of beer would have been enjoyed, just as it is today. The effect of alcohol would have been a way to relax and socialize. Beer was also used for medicinal purposes (Strouhal et al. 1992:18-25), as either a part of a mixture to help make the medicine taste better, or as the medicine itself. Medical papyri list 17 types of beer (Strouhal:128).
Beer was left as an offering to gods and was left with the dead in tombs as food for the afterlife. In the tomb of Meket-Re, there was a scale-model of a brewery and bakery built (Kemp 1989:120-124; Winlock 1955:Model G). The tomb of Ti has the inscriptions of beer-, bread- and pottery making, seen in figure one (Épron et al. 1939:plates 66, 67; Geller 1992:Figure 11).

![Figure 1. From Geller 1992:130,212. Scene from Tomb of Ti of baking and brewing. Process is shown in sequence from bottom left to top right, from measurement of grain to filling and sealing jars of sieved beer.](image)

The process of making beer is often implied through the interpretations of these models and inscriptions, as well as wall paintings in temple workshops at Thebes (Lauffray 1979:Figure 16) and statuettes (Davies 1902:Figure 20). Along with the
artistic record, the modern practice of brewing by Coptic and Nubian populations in Egypt of a beer called *bouza* (Lucas and Harris 1962:11-15; Morcos et al. 1973:1153-1156) is often used to help interpret the ancient Egyptian practice. Delwen Samuel (2000:537-539) asserts that there can be problems with interpretations of artistic scenes of brewing, as well as implying modern beer onto beer of ancient Egypt and that both need to be set aside. Samuel has instead used high-powered microscopy on residues of beer from ancient Egypt to produce a model (Samuel 2000:figure 22.2) for the production of beer based on the known morphology of starches.

**METHODOLOGY**

It was necessary for this project to do a literature review of beer in Egypt. Research was done first on the standard view of brewing beer. Along with research into the accepted model for ancient brewing, I reviewed the process of making *bouza*, which is very similar. Next was an in-depth look at the evidence for the proposed model of brewing in ancient Egypt by Delwen Samuel. For the purpose of this project, an attempt to recreate the beer based on Samuel’s model for brewing was made.

*Standard Model for Brewing in Ancient Egypt*
As stated above, the accepted model for brewing in ancient Egypt is often based on artistic interpretations and *bouza*. Ancient Egyptian beer has been generally described as richly yeasted dough that is lightly baked in loaves and then crumbled through sieves into vats with water where flavorings made have been added. Fermentation is then completed and the liquid was decanted into jars and moved to be stored or consumed (Hornsey 2003:65-67; Samuel 2000:Figure 22.1). This description is very basic. Variations on this fundamental plan are common, differing in ingredients, flavorings and processing.

Brewer and Teeter (1999:105) state that bakeries and breweries are often seen together because both required the use of barley dough. The dough for brewing was baked and then crumbled into a vat and mixed with water and, sometimes, date juice. This mixture was said to ferment quickly, and the liquid was strained after into a pot that was sealed with a clay stopper, where it could be stored or consumed.

Corran (1975) claims both barley and wheat were likely used and that both were probably malted (germinated). The author describes a method of malting, for private houses and small breweries, as wetting whole ears of the grain and then burying them in earth until germination began, then they were dug up and the kernels were separated. For large-scale breweries, no process for malting was given. The malted grain wasn’t allowed to dry, but was crushed in mortars and formed into malt cakes. Unmalted grain was also used in much the same fashion; wetted (but not sprouted), crushed and formed into cakes. All malt cakes were said to be baked to a dark brown, leaving the inside uncooked. In a clay vessel, broken beer cakes were soaked in water and were left to
stand for a day. The mixture was then stirred and pounded with pestles. The thick porridge-type mixture was then strained into a fermenting vessel while kneaded and had water added. A young beer would ferment in two to four days, and could be consumed then. However, a matured beer is also described. After the initial fermentation, the young beer would be transferred to another vessel for the purpose of removing sediment. In this vessel, a secondary fermentation took place, increasing the alcoholic strength of the beer. The sugar source for the second fermentation is not mentioned.

Strouhal et al. (1992:127-129) also describe the bakery-brewery connection, but the authors point to wheat as the main cereal for beer production. The wheat was soaked for a day in a vat of water, rolled out to dry, wetted again, then crushed, placed in a large vat and trampled by someone with their feet. No mention of malt is made, although may have happened during the step of soaking the wheat. After the trampling, yeast was added and the mixture was left to ferment. When fermentation was well advanced, the mixture was strained through a cloth or sieve and the liquid was set aside to “mature.”

Stale bread is said to have been used in place of grain. The bread would be crumbled into a vat with water and boiled, then left to ferment. The fermented liquid, of either the grain or stale bread, could be seasoned with spices, dates, mandrake, safflower or other additives, but would be strained first.

James Geller (1992:124-131) proposes that wheat was used primarily because barley doesn’t split starches well. But, the author does claim that wheat could be used in combination with barley or sugar. He also suggests that at Hierakonpolis (site HK-24A, the Vat Site) date juice, or dates, were added to increase sugar content for fermentation.
The method of *bouza* making plays heavily into his interpretation of the artistic and document record of beer;

Steps in the bouza-making process are readily identifiable in numerous Egyptian tomb reliefs and models… It is safe to assume that bouza available in Egypt today is fundamentally the same beverage as the unembellished versions of the staple beer of antiquity (Geller:131).

*Making Bouza*

The making of *bouza* (Lucas and Harris 1962: 11-15; Morcos et al. 1973:1157) is done by first cleaning and separating wheat from other material. Wheat is the preferred cereal, but barley, millet, sorghum or maize could be used. Three-quarters of a batch of cereal is then ground, kneaded with water, shaped it into loaves, and the loaves are lightly baked, the resulting dough remaining raw in the middle. Some accounts mention the addition of yeast (Lucas and Harris). The remaining quarter of the batch of cereal is soaked in water. While some (Morcos et al.) say that this is as close as it comes to malting, Lucas says that this grain was sprouted in water to make malt. At this point the loaves are broken up and added to water, along with the quarter of the grain not put into loaves, and the mixture is left to ferment. A small amount of an old batch of *bouza* can be added to the water to help start the fermentation process, this is known as seeding. The mixture is then left to ferment for at least a day. The resulting mixture can be strained through a sieve and consumed or stored.

In the 1920s, Lucas (1962) took 16 samples of *bouza* from around Cairo for examination. The samples all had the look of thin gruel, as well as the same texture.
Each of the samples were described to be yeasty and in active fermentation. Alcoholic content ranged from 6.2 to 8.1 percent. The lower alcohol content beers would be younger beers while older beers are left to ferment longer, meaning more alcohol. Along with more alcohol content, protein content also increases as fermentation continues. First day bouza from Cairo in the 1970s, was measured to have 3.8 percent alcohol and 11.9 percent protein content. On the third day of fermentation, alcohol content had risen to 4.5 percent while protein content had risen to 13.1 percent. Interestingly, if the final beer is not sieved, the nutritional benefits increase from the sieved version (Morcos et al. 1973:1154-1157). The alcohol content of the bouza described by Lucas is comparable to modern western beers. The lower alcohol content bouza is more practical for everyday, staple use.

*Using Starch Morphology to Determine the Ancient Egyptian Brewing Process*

Samuel’s focus was put mainly into residues on pottery that were left behind by beer. Two sites were used: the Workmen’s village at Amarna and Deir el-Medina (Figure 2), where the workers who built and decorated the tombs in the Valley of the Kings and Valley of the Queens in Luxor were housed (Samuel 1996:4). Funerary offerings of beer in the tombs from Deir el-Medina and residue from pot sherds made up the bulk of the sources of beer evidence.
The first to use microscopy on residue of beer from ancient Egypt was Grüss (1929). Grüss found starch granules, yeast cells and bacteria. Samuel had the benefit of scanning electron microscopy (SEM) which has a much higher power of magnification. The SEM was used to follow the morphology of the starch granules to determine what processes they had gone through. Using known morphology of modern starch, Samuel was able to develop a model of beer production from ancient Egypt.

SEM shows enzymatic attack on starch granules that is characteristic of enzymatic attack (Figure 3). Heavy pitting is clearly seen on the starch granules found in residue of beer. The enzymatic attack suggests the process of sprouting the grain. The germination of grains produces amylase enzymes which break down starches into simple sugars like glucose (Samuel 1996:6-8; 2006:206). Evidence
for malting in texts comes from the word pronounced “beshaw” which is translated as “malt” (Nims 1958:56-65).

In figure four there is a clear distinction found in beer residue between individual starch granules to a gelatinized mass of starch. When starches are heated, they will change in a predictable way (Samuel 1996:7,8; 2006:206). Starches will deform, bend and eventually will merge and become a large mass of starch when cooked in lots of water. When not cooked in enough water, starches will not merge. The individual starch granules that are among the gelatinized mass is the basis for Samuel’s idea that beer was made in separate batches, one being cooked thoroughly and another added after the cooking was complete.

Figure 4. From Samuel 2000. Individual starch granules embedded in a gelatinized mass of starch. Scale 10µm
The mixing of the cooked and uncooked grain would help to produce more sugars. The starches that were well heated would be more susceptible to enzyme attack. Therefore, more starches would get broken down into simple sugars. This is necessary for yeast fermentation. The yeasts will metabolize the sugars into alcohol and carbon dioxide. Figure five shows yeast found desiccated while in bloom in beer residue on a pottery sherd at an Amarna Workmen’s Village dump.

Results

SEM shows that you can follow the starch morphology from residues of beer from ancient Egypt. Using the starch morphology, Samuel built a model (figure 6) for brewing beer. This is a two part process, one part boiled in water and one not. There is no mention of bread in this method. It is obvious from the example of bouza that beer can, and is, made from bread, but that this is not necessarily the case with ancient Egyptian beer.
At Hierakonpolis, dates were found near a proposed brewery, but the date of the dates could not be determined to be contemporaneous with confidence (Geller 1992:131; Maksoud et al. 1994:219-224). One of the initial reasons for dates being associated with beer is the word *bnr* (pronounced “benner”) which is frequently used with the word for beer. *Bnr* is sometimes translated as date, but could also mean “sweet thing” (Faulkner 1986).

The four possible grain treatments for making beer according to Samuel (1996:10) are: Unheated and unmalted; malted and dried gently; heated, moist and unmalted; and heated, moist and malted. Different combinations of these treatments will produce different flavors of beers. There are texts which have names for many different beers including sweet beer, dark beer, garnished beer, beer of the protector, beer of truth and beer of eternity (Hornsey 2003:37).
Experimentation

The first step to reproduction was to acquire the grain for brewing. An internet search provided both emmer wheat and two-row barley. I acquired five pounds of hulled emmer wheat and barley, the grains used during New Kingdom Egypt (Samuel 1997:5; 2000: 539,540; 2001:171). Beer brewing was attempting a total of four times.

For the first attempt, I spilt a batch of four cups of emmer wheat in two, two cups each. One half of the batch was sprouted by putting on a small baking sheet and adding water to barely cover the grain. The grain was left to sprout for a full day, at which time a small rootlet was out of one end. Malting produces amylase enzymes that break down starches into sugars. While still wet, I crushed the malt with a mortar and pestle and added it to a half a gallon of cool water. With the other half of the batch, I left it unmalted, but soaked it in water for an hour to soften before grinding it in a mortar and pestle. The resulting coarsely ground grain was added to a half gallon of hot water and was cooked in a large pot, covered, for about an hour. The malted, cool water batch and the unmalted, cooked batch were then mixed and left to steep for half an hour and then sieved. The roughly three-quarters of a gallon of liquid remaining was funneled into a one gallon glass jug with one packet of brewer’s yeast, and topped the jug with a rubber top and airlock. This was left to ferment in a dark corner of my kitchen with a towel covering it, restricting the light that could reach it.
In the experiment, some modern brewer’s tools were used. These were used to give the beer the best chance to succeed. Although the Egyptian brewers used vat ovens, it was more practical to use the electric stove in my apartment. The airlock device and rubber stopper were employed to try to prevent airborne bacteria from entering the brew while the yeast was taking to the wort.

The wort was watched closely. As yeast metabolizes the sugar in the liquid, it produces alcohol and carbon dioxide. The airlock device on top of the jug doesn’t allow air to get into the jug, but does allow air to escape. As the yeast created carbon dioxide it went out of the airlock. This was a clear signal that the fermentation was going well.

The following attempts went in a similar fashion, with only minor differences separating the subsequent efforts. The second experiment was made with barley, with all other steps remaining the same. The third try was done with wheat, but the entire batch of grain was first malted. Half of the malt was placed in an oven at 300 degrees to be baked until slightly browned, then put in cool water to wait to be joined with the other halt of the malt which was boiled. The fourth attempt was made with a mixture of emmer wheat and barley. Both wheat and barley were malted and browned in an oven, but only the wheat was boiled, while the barley was left in cool water.

In each case, it was a successful attempt to brew beer. The beer ranged in color from pale yellow to a yellowish-orange; the color getting darker with the roasted malt. In all cases the liquid was cloudy. Each beer had a very light, refreshing liquid. The taste was OK.
CONCLUSIONS

Delwen Samuel’s model for producing beer was produced using remains of beer from ancient Egypt by following the starch morphology. Other models for the ancient Egyptian brewing process are more reliant on interpreting inscriptions, paintings and models from tombs along with the modern practice of bouza. The model based on starch morphology can be assumed to have been a beer produced for at least a period of time in the area of Amarna Workmen’s Village. Other models may have been made, the large number of different beers shows that there was a great variety, but they can only be implied. Only Samuel’s model is based on physical evidence found at an archaeological site, from vessels that had beer residue.

The method proposed by Corran (1975) had some ideas that were very interesting. The idea that grain for brewing, both malted and unmalted would be formed into cakes fits well with the view that loaves were used and with Samuel’s use of both malted and unmalted grain.

There is likely to be much debate on the methods used to produce beer. In the future, the use of SEM can look into the residues left by beer to examine in great detail the ingredients that were used to produce a food that was such an important part of the ancient Egyptian life.
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