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In this issue you will find an insert from Assured UK Malt.

Cold mashing process – a technology possibly used in ancient times in the Orient

ANCIENT ORIENTAL BREWING CRAFT | Not only was the first beer brewed in ancient times in the Orient, it was also one of the main foodstuffs in the region. Excavations in Tall Bazi in Northern Syria have led to new insights into malt and beer making in ancient times. The following contribution contains a summary of these findings, based on an article "Interdisciplinary Investigations into Ancient Oriental Beer Brewing in the Tall Bazi/Northern Syrian settlement about 3200 years ago". (1)

ANCIENT ORIENTAL BREWING CRAFT is well-known from written sources but has been practically not confirmed up to now by archaeological evidence. This makes new findings regarding malt and beer making from the Tall Bazi site in Northern Syria all the more interesting. The site is located 60 km south of the border with Turkey, on the Eastern shore of the Tishrin reservoir dammed since 1999. Excavations were concentrated until 1999 on the western lower city that has been excavated over a wide area and is meantime largely submerged. It is an extension of a settlement with an urban character established in the 13th century B.C. About 50 houses served for residential purposes and for production of objects of all kinds (2).

Details of find

Unknown circumstances led to the city being abruptly abandoned. This gave rise to a find horizon where most objects of daily living are preserved. Organic artefacts are largely decomposed due to weathering, a remarkable feature is that ceramic vessels are present in houses in a standardised form and location. Vessels of volumes up to 200 l with a wide opening are especially striking (Fig. 1). In all instances, they were sunk in the floor at the best ventilated location in the house. In addition, vessels with a tapping in the base were found in practically all houses (Fig. 1), with about half the volume of the large vessels (90 – 110 l).

In contrast to other storage vessels, no bulk goods of any description were found in both types of vessels. This raises the question as to whether they might have contained liquids. Drinking water can be eliminated due to the unavoidable microbial growth in water when left standing in this climate. Other liquids such as oil, honey or wine are also out of the question because the vessels are too large for storage of such valuable liquids for a single household.

In order to identify the liquid, broken fragments of the vessels referred to as well as others that, based on archaeological indications, might have been connected with beer or wine were subjected to spot tests (3). In some instances, residues of tartarte were found, in good agreement with archaeological indications. Especially the above-mentioned vessels were found to contain residues of oxalate, while vessels with the base tapping have been used for at least two purposes. It emerged in the course of investigations that the large vessel could be referred to as a "beer vessel". Oxalate crystals are formed when grain is mixed with an excess of water. 7.6 mg/l of oxalate was formed after a 24 hour steep of 200 g of barley in 0.5 l water (1). As oxalate can arise from other plants, for example rhubarb (290 – 640 mg of oxalic acid/l (4)), an oxalate find does not necessarily provide evidence for beer. However, the probability is high. As no tartrate was found in the beer vessels, wine or better still grape juice can be eliminated as a starting medium for fermentation (yeast cells on the surface of the grapes).

Some yeast cells were also found in isolated cases. Yeasts are, however, ubiquitous in the vicinity and thus only an indication for fermentation though not compelling proof. A further indication is provided by sporadic starch grains found on the fragments. Important utensils such as stirring spoons or reed mats as working tools were not found (organic!). These utensils can, however, be assumed to have been used in the culture.

Other objects found in Tall Bazi allow conclusions to be drawn about inadequate separation between solid and liquid components in the liquid: numerous bronze filter points were found which were pressed onto the ends of suction pipes in order to drink liquid from a communal vessel, such as is usual up until the present day in various African societies (Fig. 2).

Fig. 1 Large 200 l volume "beer vessel" and a so-called base-tapped vessel having 90 – 110 l volume

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The first conclusion that can be drawn is that the large vessels possibly had a role in the brewing process. This is indicated by the fact that the beer vessel is fixed in the floor. This presupposes that what it contained was not hygienically vulnerable because the vessel could not be cleaned. On the other hand, contact with the floor ensured that there was a cooling effect, something that was of particular interest in summer. As the vessel was only half sunk in the earth and the remainder was exposed to the influence of the ambient temperature, a temperature difference arose during fermentation (only 2.7% of the total energy is chemically bound in the anaerobic phase, the remainder is heat energy (6)), leading to a circulation within the vessel. However, in order to achieve a greater degree of certitude, it was necessary to brew a "Bazi beer" on location, taking account of conditions in antiquity.

Climatic and botanic situation

Tall Bazi is on the edge of a rain-fed farming zone. It can be assumed that the climate in 1200 B.C. was similar to that of the present day (7). The Euphrates region was then covered with sparse alluvial forest, and the few trees were used more in construction than as firewood. Twigs and animal dung were used in the latter case. A paleobotanic analysis of grain showed up mainly multi-rowed barley, and rarely naked wheat and emmer. Some barley grains showed clear signs of germination.

Technological situation

It has to be assumed that the male and female beer brewers of Tall Bazi had a more than adequate technological range of experience. These people were very well trained in handicrafts and were in a position to make a product in a reproducible manner which was seen to be valuable enough to find mention in very many written documents (8).

There are other aspects associated with beer production that will be dealt with below. One asset is that it is possible to have water in storage and keep it suitable for drinking as a result of the low pH value, as the occurrence of pathogenic germs is prevented (9). Furthermore, beer is a nutritious beverage with many physiological benefits.

As no progress has been made heretofore in deciphering cuneiform writing, such as which grain was used in which state for malt and beer making, it has to be made clear right from the beginning that, from a technological standpoint, malt was and is a fixed feature of beer preparation. Otherwise, the nutritive and alcoholic yield is much too low because the required amylolytic enzymes that are capable of converting native cereal starch to a sugar which can be utilised by yeast are not present. Extensive pre-tests showed that high alcohol yield is possible only with malt. Most fermentations based on unmalted grain had no appreciable alcohol yields. Boiled unmalted barley grist was the only one having a small yield, comparable to half the alcoholic content when using malt grist (1).

Consequently, amylolytic enzymes are present in sufficient measure only when the grain has germinated and thus malted. An important aspect which also speaks in favour of the use of malt is the adequate presence of amino acids in the malt wort for supporting yeast growth, allowing multiple yeast cycles without any problem. Conscious use of yeast is the most conceivably sensible variant. It is hard to imagine that a male or female beer brewer would not have recognised the utility value of a "live" fermenting foam cover of a top-fermenting fermentation.

Fig. 2 Tirike men drinking beer through straws (5)

This in no way indicates that only malt was used. It was certainly also the case that unmalted starch sources were used (10). Forms of pre-gelatinised starch such as bulgur (boiled, unmilled grains) or bread are conceivable.

Experimentally determined findings relating to technology of antiquity

On the basis of the archaeological, climatic and botanical conditions described, brewing tests were directed towards producing a drinkable beer without artificial heat input. This extreme technology has to be regarded as basic technology of the "western city" brewers of 3200 years ago. This basic technology can be extended in every direction (heating, flavouring etc.). Cold mashing involves having an enzyme potential present and that the starch has to go through pre-gelatinisation. Malt can provide both of these conditions to a sufficient extent. Malt bread cannot be considered as pre-gelatinised starch due to the site conditions (no baking moulds) and the extremely liquid dough that arose in the tests.

Malting

It was found that the base-tapped vessels were extremely suitable as steeping and germination vessels. Germination was carried out, on the one hand, in vessels and, on the other hand, on mats. The working area, constructed as originally from terracotta tiles, assured a constant pile temperature of about 24°C during germination. The pile

MALT CHARACTERISTICS OF BARLEY (2004 HARVEST) MALTED 9/2004 AND 4/2005 IN TALL BAZI

compared to a pilot malting carried out in the Faculty of Technology of Brewing I, in accordance with MEBAK [11]

	Extract	Saccharification	Final attenuation	FAN	α-amylase
Unit	%, anhydrous	min	%	mg/100 g malt dry matter	ASBC anhydrous
Bazi malt (standard)	72,2	<15	74,2	79	9
Bazi malt (9/04)	71,2	keine	62,8	59	6
Bazi malt (4/05)	69,5	15–20	70,8	88	20

Table 1

Fig. 3 Spreading out green malt on the terracotta roof for kilning

Fig. 4 Milling the Bazi malt in a saddle mill

was turned over twice a day, and germination was completed after four days vegetation time. Kilning took place on a terracotta-roofed hut (Fig. 3). Here, an important factor emerged. 60 °C was reached in the summer months without any problem whereas only 45 °C was measured in April. This could be an indication of seasonal malting, supported by the fact that the barley varieties still used today require a long dormancy (germination power 09/2004: 50% and 04/2005: 82%; both from the 04/2004 crop).

After approximately one year dormancy, it was possible to malt the barley into a better malt (Table 1).

Milling

The dry grain was milled in a saddle mill without any problem. Mortars were also found in Bazi but the saddle mill was preferred in a practical comparison of both milling systems (Fig. 4).

Mashing, wort preparation and fermentation process

Mashing-in was carried out at 34 °C, with vigorous stirring for 15 min, using a grist/water mixing ratio of 1:8.3. A mixture of *Saccaromyces* and *Schizosaccharomyces* yeasts as well as *Lactobacillus* species were added to the mash subsequently, and the mix was allowed to stand for 36 h at about 24 °C.

A mixture of alcoholic and lactic acid fermentation is the most conceivable probability, as shown by pre-tests. With a view to a low alcoholic content, the resulting beers were mashed in very dilute form because these beers were drunk by all sections of the population (also by children).

The beers had the anticipated low alcoholic content (1.6 vol %). They were highly fermented (final attenuation 87.0%), standard in terms of iodine (0.118 in the photometric iodine sample) and, with a pH of 3.90, provided a certain degree of safety against microbial contamination. The beers were stable in Germany for over two months. The very diversified taster panel assembled on location certified the beers as having a pleasant lively character with enjoyable consumption potential.

Summary

Based on a multiplicity of archaeological and paleobotanical circumstantial evidence, we succeeded in coming up with a conceivable process for ancient oriental malt and beer production for the period around 1200 B.C, using experimental test series on location. This is a cold mashing process in large beer vessels with malt or malt elements which had been previously steeped and germinated in base-tapped vessels. Germination could also be continued and completed on a mat. The mashing process was followed by a heterogeneous fermentation which most probably resulted from intentional propagation.

Many questions are still open in relation to Bronze Age malt and beer production. With this interdisciplinary approach (archaeology, brewing technology), new impetus should be given to solving this historical puzzle.

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