

EDITORIAL COMMENTS

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Cereal Foods and Nutrition in Ancient Egypt

Food is an important topic for archaeologists because it reflects social, economic, and belief systems, but its most fundamental role in human life is as sustenance. The foods used by different cultures had a critical bearing on the health and nutrition of their populations. Archaeological research into food has concentrated mainly on two areas. One is the resources, or raw ingredients, that made up ancient diets, and the methods by which these resources were obtained.^{1,2} The other is the medical and nutritional experiences of ancient individuals that biological anthropologists have reconstructed by looking at the formation, structure, and chemistry of teeth and bones.^{3,4} When enough data are available, from burial grounds for example, the health of whole populations can be assessed.

It has been difficult, however, to investigate the links between raw resources and the skeletal and dental patterns caused by food consumption. The often elaborate processing procedures involved in the consumption of prepared foods intervene. The contributions of specific prepared foodstuffs to ancient nutrition and health are particularly elusive, because the archaeological evidence may be insufficient or may be difficult to recover, analyze, or interpret.

The archaeological record consists of the material remains of the past. It is never complete. This is especially true for food preparation, since it is highly complex and frequently involves many stages that cause substantial physical and chemical transformations.⁵ Perhaps one of the greatest difficulties is that the primary evidence, the food itself, is rarely preserved. Food is made to be eaten, and is processed to be more easily digested by humans. Whatever is not actually consumed is highly susceptible to decay.⁶ Nevertheless, some actual ancient prepared food does survive. Such material is now more carefully targeted and recovered by archaeologists, while methods of analysis are constantly being developed for ancient foods and other perishable organic materials.^{7,8}

The special circumstances of preservation in Egypt offer an excellent opportunity to investigate specific prepared foods and their effects on ancient Egyptian nutrition and health. The extremely arid climate often preserves organic material very well, and civilization flourished in the Nile valley for millennia, producing large quantities of archaeological material. These include fairly abundant food items.

In ancient Egypt, the main crops were emmer and barley, a type of wheat that is now rare. They were converted into bread and beer. This is well known from documentary records.⁹ Both bread and beer were staples, and therefore important for ancient Egyptian nutrition. The first step in establishing their dietary contribution is to find out how they were made, since mixtures of ingredients and the methods by which they were processed have a direct effect on nutritional value. Milling and cooking methods, for example, may affect digestibility, dietary fiber, and essential nutrients.¹⁰⁻¹²

Until recently, the rich archaeological record was hardly studied; scholars focused their attention on artistic depictions, such as reliefs, paintings, and models that decorated ancient tombs. The portrayal of baking and brewing appears to be straightforward. Modern interpretations about the processes,

however, are contradictory and often vague.¹³ More information is needed if the production of ancient Egyptian bread and beer is to be properly understood.

The direct evidence of the foodstuffs themselves is the best place to start. Whole and easily identifiable bread loaves survive in some numbers, and are found in most major Egyptological museum collections throughout the world. Beer remains are also preserved, although they are often not recognized as such. Water and volatile compounds have evaporated, but the dried solids are still attached to the pottery vessels that once held fresh beer. Analysis of loaves and beer remains has shown the ingredients that were used, how they were prepared, and what the final product was like.^{14,15}

Microscopy has proved to be a remarkably effective tool. At low magnifications, broken cereal grains can be detected and identified by their morphological characteristics. On many grain fragments, the bran has been removed, indicating that the ancient Egyptians did not always eat 100% wholemeal bread. The degree of husk incorporated into the bread and the beer can also be qualitatively assessed, to determine if there was a high fiber and absence of silica intake. The level of husk varies greatly, but the bran and husk in some loaves, together with low quantities of chaff in beer, establishes that ancient Egyptian cereal-processing technology was adequate to remove a considerable quantity of fiber. The texture of ancient bread is also diverse, from finely ground to full of whole-cooked grains.

Aridity has preserved not only the macrostructure but also the microstructure of these remains. Tissues of cereals and other plants used to make bread and beer, starch granules, yeast cells, and possible lactic acid bacteria are all recognizable using scanning electron microscopy. While plant tissues help to identify the ingredients that were used, and the presence of yeast indicates whether fermentation had occurred, it is the structure of the starch granules that provides the most important information about ancient processing techniques.

Raw starch granules from wheat and barley occur in two forms: large, lens-shaped granules about 15–40 μm in diameter, and small spherical granules about 1–10 μm across.¹⁶ Cereal chemists have established that such granules change their form according to the processes to which they have been exposed.¹⁷ For example, malt for brewing is made from sprouted barley. Starch granules in sprouted grain are pitted on the surface and show extensive internal channeling, due to enzymatic degradation.¹⁸ When cereal products are cooked in water, the starch granules swell and distort, and may merge if sufficient moisture is present.¹⁹

Ancient Egyptian cereal foods contain starch granules of closely analogous appearance. The large numbers of morphologically unchanged starch granules indicate that aging is not the reason for altered shape. Starch granules in most beer residues and some bread loaves are pitted and channeled, showing that the ancient Egyptians used malt for brewing, as well as for some bread loaves. The pattern of distorted and merged

starch in the residues indicates that beer was made by mixing uncooked malt, which provided active starch-degrading enzymes, with well-cooked grain or malt, whose starch would have been highly susceptible to enzymatic breakdown. The combination of these differently treated cereal fractions would have been an efficient method of producing simple sugars for yeast fermentation, without the need for close temperature and time controls. This ancient method is very similar to those used for many present-day traditional African fermented beverages.^{20,21}

With a better understanding of processing methods, we can begin to examine the nutritional effects of ancient foods. One area of particular interest to me is the role of fermented foods in past diets. Fermentation is a critical food-processing method for recent and modern traditional diets, because it can boost levels of important nutrients such as essential amino acids, decrease harmful compounds, improve storage qualities, and alleviate monotonous diets by creating a range of tastes and textures.^{22,23} Just as in recent and modern nonindustrialized agricultural systems, ancient peoples had to contend with the threat of famine and inadequate food supplies. Even in the fertile, naturally well-irrigated Nile valley, these problems could be acute. The ability of fermentation to augment the diet substantially must therefore have played a critical role in ancient nutrition, though very little is currently known about it.

The similarity between ancient Egyptian and modern traditional African brewing offers one potential route for analysis of the nutritional significance of ancient foods. Traditional African fermented foods are beginning to receive serious scholarly attention, and their diversity, ingenuity, and importance are becoming apparent.²⁴ Modern parallels will provide useful information with which to assess ancient Egyptian foods. Another approach is the replication of ancient foods, using authentic modern ingredients and techniques as similar as possible to those used in ancient times. These modern replicates could then be used for detailed nutritional studies. The effects of processing and fermentation methods on fermented cereal foods may affect such nutritional aspects as essential amino acids, vitamin content, mineral availability, digestibility levels, fiber content, and quantities of anti-nutritional components such as phytate and tannin. Analyzing the nutrition of ancient foods directly is extremely difficult due to the great alteration of biomolecules over time.²⁵

Nutritional investigations of ancient foods and diet will never approach the precision and detail of modern studies. One of the main contributions of archaeology, however, is to provide long-term perspectives of general trends and patterns. If the nutritional significance of ancient Egyptian foods can be assessed, aided by exceptional preservation and close modern-day parallels, such work may have wider significance. New insights may be gained for ancient populations in areas where organic preservation is much poorer. The excellent survival of desiccated remains in any arid region offers the opportunity to investigate ancient nutritional problems and how they were overcome. It may be that such studies will resurrect useful nutritional practices for the present day.

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