



DIANE LYONS
A. CATHERINE D'ANDREA

Griddles, Ovens, and Agricultural Origins: An Ethnoarchaeological Study of Bread Baking in Highland Ethiopia

ABSTRACT An ethnoarchaeological study of highland Ethiopian griddle technology is compared to bread-baking technologies in Africa and the Near East. There is a functional relationship between the use of ovens and griddles and the presence or absence of gluten in bread ingredients. Ovens are most appropriate for cereals containing gluten and may be implicated in the selection of higher quality gluten in domesticated wheats. We conclude, based on evidence for griddle use and the performance characteristics of African cereals, that indigenous species were exploited in highland Ethiopia before Near Eastern cereals were introduced. Griddle-cooking practices that bias the preservation of Near Eastern cereals over African ones may explain the absence of African cereals in the early archaeobotanical record. [Keywords: Ethiopia, ethnoarchaeology, archaeobotany, ovens, griddles]

BREAD IS AN ANCIENT STAPLE for peoples of Africa, Europe, the Near East, the Indian subcontinent, parts of China, and indigenous populations of Australia and the Americas. As a staple, bread plays a fundamental role in social relations and in the religious celebrations of many peoples. Bread types define ethnic cuisines (e.g., pita, baguette, Wonderbread™) and demarcate social class. Traditionally, elites of Egypt, Arabia, Yemen, and Europe ate leavened white wheaten loaves while the poor consumed dark, coarse, and unleavened bread (Jacob 1945; Pomeranz and Shellenberger 1971; Sheppard and Newton 1957; Tanahill 1973). More recently, Westernization has promoted the consumption of white wheaten bread globally. Social relations, local crop production, health, and cultural integrity are compromised where changes to bread ingredients and baking technologies have occurred (Counihan 1999; Isaacs 1987; National Research Council 1996; Olmstead 1997; Varisco 1997; Weismantel 1988).

Clearly, changes to bread production and consumption are important to anthropologists interested generally in the interrelationships between technology, diet, cuisine and social dynamics. The history of this important food can be studied indirectly through baking technology. We define bread either as a pancake, a flatbread, or a loaf, which is made from cereals, roots, tubers, nuts, seeds, or legumes and can be baked, fried, or steamed. Most food-heating technologies are not studied in the detail necessary

for archaeological analysis (Brumfiel 1992; Stahl 1989). This is partly because women, who cross-culturally dominate food processing and preparation, are perceived by Westerners as nontechnical. Therefore, their technologies tend to be poorly documented (Dobres 1995; McGaw 1996; Wright 1991). This is unfortunate as specific plant foods are linked with specific heating and processing technologies. These technologies present an indirect means of tracking dietary change (DeBoer 1975; Lerche 1975; Reid and Young 2000).

A fundamental question addressed here is technical choice: Why use griddles rather than ovens to make bread? To answer this, we conducted an ethnoarchaeological study of griddles in the village of Adi Ainawalid, located 20 kilometers northwest of Mekelle in Tigray province in highland Ethiopia (Figure 1). We compare these griddles to baking technologies in Africa and the Near East and conclude that technical choice is constrained by social factors involved in producing bread and by the physical properties of the starchy foods available. These observations have universal implications for understanding technical choice in bread baking and add to our documentation of women's technologies.

The study further addresses the question of agricultural origins in highland Ethiopia. Ethiopia and Eritrea served for millennia as crossroads for cultural contacts and dispersal of crops between Africa and Southwest Asia (Brandt

Loco Cookers, EX1022

AMERICAN ANTHROPOLOGIST 105(3):515–530. COPYRIGHT © 2003, AMERICAN ANTHROPOLOGICAL ASSOCIATION IPR2024-00642

Loco Crazy Good Cookers, Inc. v. North Atlantic Imports, LLC

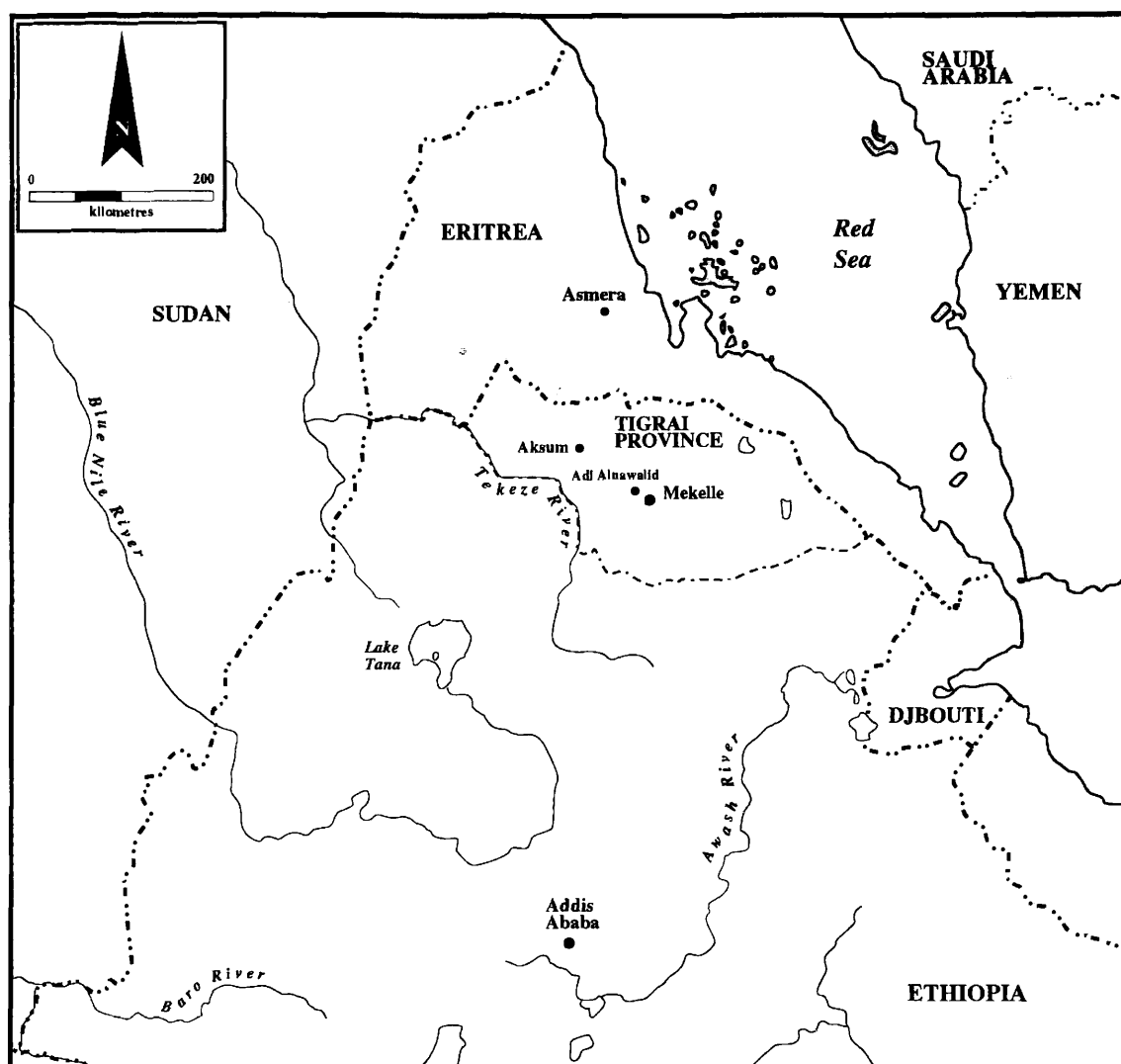


FIGURE 1. Study area.

1984; Butler et al. 1999; D'Andrea et al. 1999; Fattovich 1975, 1977; Munro-Hay 1993; Phillipson 1993). While highland Ethiopia was a source for plant domesticates, it is uncertain as to which came first to the region: indigenous crops or Near Eastern ones. The earliest archaeobotanical evidence for domesticated plants in Ethiopia dates to the mid-first millennium B.C.E. and includes introduced Near Eastern cereals such as emmer (*Triticum dicoccum*), bread wheat (*T. aestivum*) or durum wheat (*T. durum*), barley (*Hordeum vulgare*), lentils (*Lens culinaris*), and also an indigenous African cereal, tef (*Eragrostis tef*) (Bard et al. 1997; Boardman 1999; Boardman and Phillipson 2000: 469–470; Dombrowski 1971). However, the small quantity of archaeobotanical data recovered to date makes it premature to conclude that Near Eastern crops were introduced before indigenous ones were domesticated. Other indigenous African cereals, particularly finger millet (*Eleusine coracana*) and sorghum (*Sorghum bicolor*), have not been found in East African contexts earlier than the first millennium C.E. (Ambrose 1984; Boardman and Phillipson 2000; Rowley-Conwy 1997). Food-processing technologies that do not expose some cereals to charring are suspected as one cause for their absence in the archaeobotanical

record (Young and Thompson 1999). In this situation, linking specific food-heating technologies with specific plant foods would provide an indirect means for tracking these plants where botanical remains are absent. Richard Wilding (1989:308) suggested that the history of the griddle in Ethiopia indirectly reflects the use of tef to produce *taita* (*injera* in Amharic) bread. We argue more broadly that griddles are linked to the use of indigenous African species and serve as indirect archaeological indicators of these plants.

GENDER, DIET, AND TECHNICAL CHOICE IN BREAD BAKING

We concur with the view that technology is a functional and a social product (Dobres and Hoffman 1999; Lechtman 1977; Lemonnier 1986; Pfaffenberger 2001; van der Leeuw 1993). Byran Pfaffenberger's (1992:497) concepts of technique and sociotechnical system are useful in explaining the technical choice of ovens or griddles in bread baking.

Technique includes the material resources, tools, skill, operational sequences, knowledge, and modes of work coordination used to produce material objects. These are

analyzed from a functional perspective. In particular, the Tigrayan diet is dominated by products of tef, barley, wheat, sorghum, and finger millet. These cereals each have different performance characteristics, defined as the set of interaction-specific capabilities that a material possesses (Skibo and Schiffer 2001:143). Performance characteristics affect the technical choice between griddles and ovens for bread baking. Griddles are plates that are heated from below producing direct dry heat. Steam heat can be produced with moist batters baked under a lid (Parker et al. 1989). Ovens are preheated, enclosed compartments that bake with dry radiant heat and sometimes employ trays, platters, or moulds. As we discuss below, Near Eastern cereals that contain gluten, particularly wheats, are closely linked to the geographic distribution of ovens. Griddles are appropriate for the wider range of nongluten producing foods used in bread making worldwide.

A sociotechnical system refers to linkages between technical activities, material products, and social coordination of labor (Pfaffenberger 1992). Griddle baking is a technical activity coordinated within the sociotechnical system of cereal production, constituting the most important social and economic activity of rural Tigrayan households. Bread, the fundamental element of every meal, is ultimately the product of the reciprocal exchange of labor, technical skills, and knowledge between husband and wife. Men plough, crop, and harvest cereals that women then store and process (D'Andrea and Mitiku 2002; D'Andrea et al. 1999). Gendered divisions of labor for many tasks are not absolute, but ploughing is performed exclusively by men whereas cooking is done exclusively by women. Participation in specific technical acts also contributes to defining gender roles and identities (Childs 1999; Dobres 1999). Food processing is so strongly associated with Tigrayan women that men are considered effeminate if they enter a kitchen (Bauer 1977:90; Tewolde 1993:232).

Cereal production and processing, and the technologies of bread baking, are closely linked activities of rural life. Interlinked techniques can resist alternatives if they work well together (Pfaffenberger 1992). For example, Tigrayan women organize a series of activities to make bread, including grain processing, stove and kitchen construction, fuel acquisition, basket making, and preparing sauces and condiments that accompany the bread. These activities coordinate with Tigrayan cuisine. Cuisine is comprised of cultural rules and tools to construct meals, prepare recipes, and to present and consume dishes in social and ritual contexts (Crown 2000; Farb and Armelagos 1980). Diet and cuisine are conservative cultural elements, and new foods can be regarded as inedible or inappropriate in socially structured meals (Douglas 1975; Lévi-Strauss 1969; Simoons 1994). Change in cooking technology can be inhibited by affects on taste, texture, format, nutritive value, and food's shelf life (Arnold 1985:139; Dirar 1983:184; Dorsky 1986:56). Women use their role in producing and serving foods to negotiate their political

and social interests, a strategy that has been called "gastropolitics" (Appadurai 1981; Arnott 1975; Brumfiel 1991; Counihan and Kaplan 1998; Gero 1992; Hastorf 1991; Hastorf and Johannessen 1993; Maclagan 1994). It follows that new foods are more likely to be accepted if they can be prepared with existing technology, substitute for customary ingredients, and either hold or enhance the food product's value in traditional social contexts (Crown 2000; Farb and Armelagos 1980; Leach 1999; Weismantal 1988).

GRIDDLE TECHNOLOGY IN ADI AINAWALID

Material Components of Griddle Stoves

We collected data from 55 Adi Ainawalid households between 1996–99. Griddle stoves are built inside kitchen structures that are separate from main buildings (D'Andrea et al. 1999) (Figure 2). Stoves have two components: fireboxes and griddles. Fireboxes are built on untreated earth floors against inner kitchen walls using upright stone slabs. Stoves have openings in the front to feed fuel and oxygen and on top to heat griddles or pots. The stone slabs are covered with thick coatings of clay, sometimes mixed with straw. A clay finishing slip is applied to the exterior surface at least once a year. Stoves usually succumb to heat-stress within three to ten years.

Stoves have up to three adjacent yet separate fireboxes that heat respectively a ceramic griddle (*mogogo*)¹ bonded with clay to the stove top, a metal griddle (*mecklohachen*), and a boiling pot. We observed five different stove types in Adi Ainawalid that are made with different combinations of *mogogo*, *mecklohachen*, and boiling-pot fireboxes (Figure 2). Other researchers working in the Ethiopian highlands (but not in Tigray) describe griddles as being heated over three-stone hearths (Dombrowski 1971; Messing 1957b; Simoons 1960:167; Walker 1933:30). It is possible that stoves for heating griddles are unique to the northern highlands. In addition to these elements, stoves employ *mugdi*, removable dome-shaped lids fabricated from dung and clay that retain heat and conserve fuel; variants in the highlands include lids made with reeds, wattle and daub, and clay (Dombrowski 1971:115; Messing 1957b:133; Parkyns 1966:197; Shack 1974:20).

Mogogo are made with a one-to-two or one-to-three ratio of black claylike soil to sand. The prepared mixture is pressed into a circular shape using a mould or is formed by hand on a clean sandy surface. Griddles average fifty-eight centimeters in diameter, are two-to-three centimeters thick, and have beveled rims that rise approximately one centimeter above the flat cooking surface.

The *mogogo*'s rough, noncooking surface is fired for about fifteen minutes by leaning two griddles together in an inverted V-shape setting the fire between them. The smooth cooking surface is blackened with a boiled mixture of kerosene, lamp soot, and cooking oil or butter and then is burnished to a high gloss. The surface is seasoned with various oils and is rubbed with an oily cloth both



Mecklohachen

Boiling Pot

Mogogo

Five oven types observed in Adi Ainawalid are made from combinations of the three fireboxes shown above. These five types are:

Type 1: *mogogo*

Type 2: *mogogo* and *boiling pot*

Type 3: *mogogo* and *mecklohachen*

Type 4: *mogogo*, *boiling pot*, and *mecklohachen* (as illustrated in the photograph)

Type 5: *mecklohachen*

FIGURE 2. Five stove types.

prior to and during bread baking to prevent sticking. *Mogogo* are easily identified in archaeological contexts by their oily black burnished surface and a scorched bottom (Dombrowski 1971:115). Low firing, the addition of large quantities of grit temper, rough base finish, and griddle shape is consistent with techniques that enhance thermal shock resistance (Schiffer and Skibo 1987; Skibo and Schiffer 1995, 2001).

Mecklohachen are purchased from blacksmiths in the Mekelle market. They are thin, slightly concave rimless plates with smaller diameters than *mogogo* (*mecklohachen* diameters average at forty-nine centimeters). *Mecklohachen* are heated on fireboxes or portable stoves. The average use-life for *mogogo* is two years and seven for *mecklohachen*.

Because the region is largely deforested, firewood collecting takes hours, while dung is available within or near

domestic areas. Therefore, dung is the primary fuel and is generally associated with deforestation, the keeping of domestic animals, and bread making (Anderson and Ertug-Yaras 1998:99; Kramer 1982:47–48; McQuitty 1984:265; Miller and Smart 1984).

Griddle Baking and Associated Cooking Practices

We define three bread types for the purposes of this study. Pancake is a flexible, thin, slightly leavened bread made from fermented batter. Flatbread is either an unleavened or slightly leavened bread, less than three centimeters thick, made with dough or batter. A loaf is leavened or thick bread and is made from batter shaped in moulds or from wheat or rye flour dough. Batter is fluid and less viscous than dough and is poured onto griddles or into moulds. Dough is malleable and is hand formed prior to baking.

All Adi Ainawalid bread types are produced on griddles. *Taita*, a pancake bread, is the most definitive bread of highland Ethiopian cuisine. Tigrayan meals consist of layers of *taita*, served on communal trays or baskets with vegetable or meat sauce (and sometimes both) ladled on top. Pieces of *taita* are torn off and used to pick up sauce. When available, tef flour is preferred for its flavor, texture, and tef *taita*'s long shelf life (Asiedu 1989:195; Gebrekidan and GebreHiwot 1982). However, barley is more commonly used as a substitute in the highlands and sorghum in the lowlands (Simoons 1960:167). At Adi Ainawalid, *taita* is made of tef or of barley flour alone, tef mixed with sorghum, barley, or more rarely finger millet, and with varying proportions of barley and durum wheat flour. *Taita* is baked on the mogogo in two to four minutes without turning the bread over (Figure 3).

Only *taita* is prepared from fermented batter, and several varieties can be produced using different fermentation times (Stewart and Getachew 1962). Color affects its symbolic value. White-grained tef symbolizes wealth and is preferred, but red-grained tef is cheaper and more commonly used. Elsewhere in Ethiopia and in Yemen, researchers have reported preference for white tef over wheat flour, and white-grained varieties of sorghum and wheat over red for



FIGURE 3. Baking *taita* on a mogogo.

their superior bread- and beer-making qualities (Bornstein-Johanssen 1975; Parkyns 1966:198; Shack 1974:20; Simoons 1960:105). Hamid Dirar (1993:58–59) attributes such distinctions to Westernizing influences, but differential performance characteristics should not be ruled out.

Three additional bread types were observed. *Kicha* (or *kitsa*) and *embasha* are wheaten flatbreads. *Embasha* is slightly leavened with beer and is eaten in the fields. *Kicha* and *embasha* are baked on a mogogo for about ten minutes and are turned over once in order to cook both sides of the bread. *Habishti* is a leavened wheat loaf particular to southern Tigray that is baked for harvest and Holy Days. *Habishti* is baked on mogogo or mecklohachen on a bed of *Acacia saligna* leaves to prevent sticking and to add flavor. The mugdi is sealed to the griddle with fresh dung, and the bread is baked for 30 to 40 minutes. Other distinct bread types include *hanza*, *tasfa*, *tadiq*, and *daboo* (Harris 1844:173; Parkyns 1966:201; Walker 1933:112). Although these were not observed in our study, they indicate the existence of a greater range of bread types for use in specific social and ritual contexts.

Mecklohachen are used to roast grass pea (*Lathyrus sativus*) before it is ground into flour (Butler et al. 1999), to prepare barley *kicha* or finger millet for brewing beer, and to create *kollo*, a nutritious food made by roasting and popping whole grains of wheat, barley, chickpea (*Cicer arietinum*), and sorghum (D'Andrea and Mitiku 2002). In making *kollo*, grains are added to a hot, unoiled metal griddle and are whisked around the surface (Figure 4), often scattering grains on the floor. As such, *kollo* preparation may be an important source for carbonized grains in the archaeological record. Significantly, tef and finger millet are never roasted as *kollo* (Simoons 1960:107), because the performance characteristics of these cereals makes them inappropriate for roasting. This poses a potential bias that favors preservation of Near Eastern crops over African indigenous cereals—with the exception of sorghum as the only African cereal that is made into *kollo*. Aside from *kollo* production, opportunities for grain charring in the kitchen are few (Butler et al. 1999; D'Andrea et al.



FIGURE 4. *Kollo* roasting.

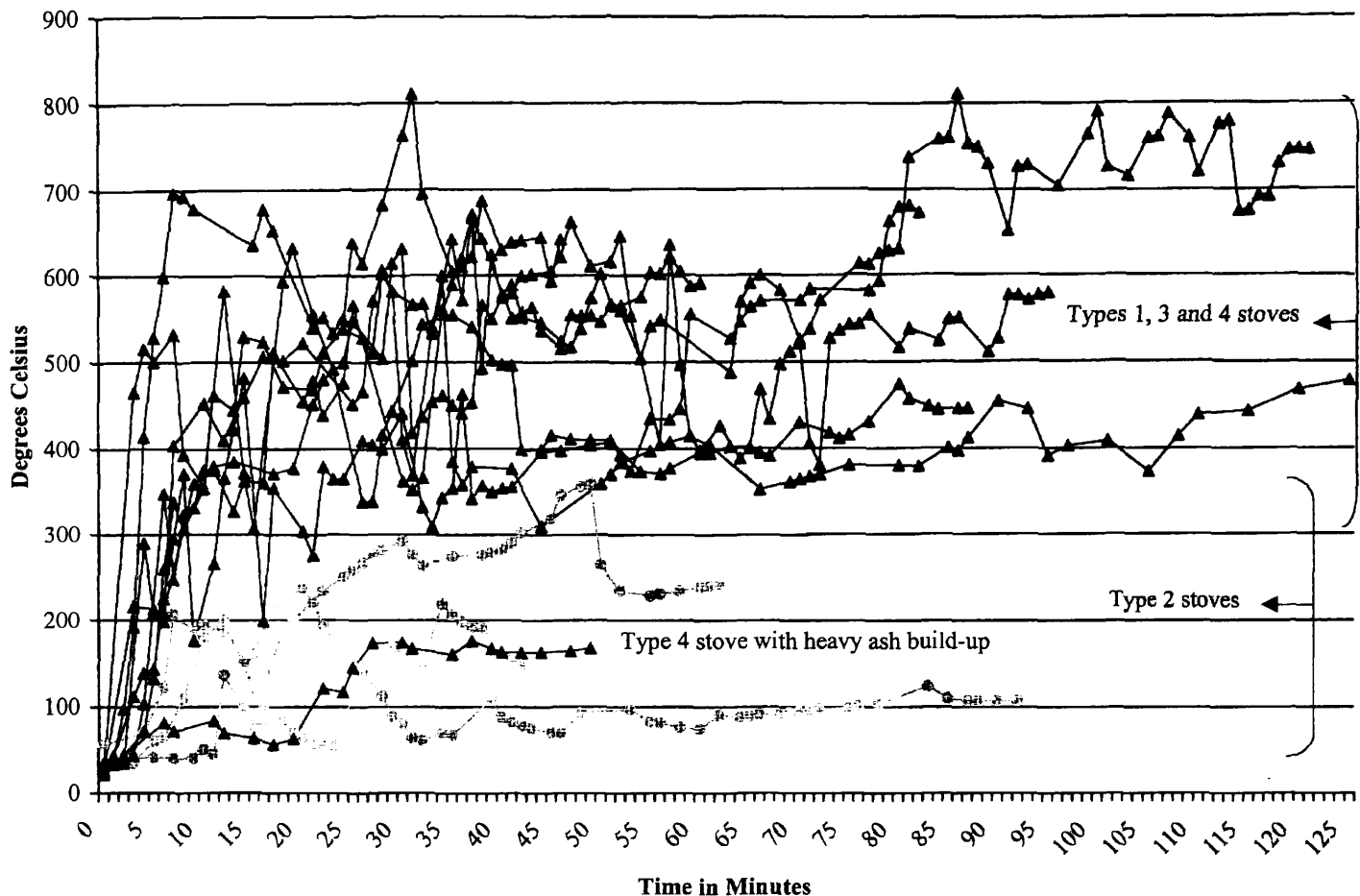


FIGURE 5. Temperatures at fuel source during taita/kicha baking in types 1, 2, 3, and 4 stoves.

1999; D'Andrea and Mitiku 2002). Granaries are located inside *hidmos* (Tigrayan flat-roofed, stone-walled houses), and grinding tables are constructed in *hidmos*, courtyards, and kitchens. Grains are cleaned in the courtyard and the *hidmos*, away from potential charring. Other opportunities for charring occur in *hidmos* when kollo is made on portable braziers. These practices may be ancient, as portable stoves are found throughout the Aksumite sequence (Wilding 1989). Nevertheless, sweepings from the compound are thrown into the kitchen stove and seeds could be collected, charred, and incorporated into stove ash in this manner.

We conducted 14 heating experiments: 11 of taita or kicha baking and three of kollo roasting with fires primarily fuelled by cattle dung. Figure 5 presents temperatures obtained with a thermoprobe at the base of the fuel source during taita and kicha baking. Figure 6 summarizes periodic readings at the base of the griddle and in the ash. Temperatures at the fuel source sometimes exceeded 800 degrees Celsius, comparable to previous stove experiments (McQuitty 1984; Nicholson 1989; Samuel 1989). A temperature of about 400 degrees Celsius (a range of 300–600 degrees Celsius) must be maintained at the base of the mogogo for taita baking. Lower temperatures can cause the bread to stick to the griddle and, subsequently, tear during removal.

Figure 7 illustrates three kollo-roasting heating regimes: two studies used a mecklohachen and one used a mogogo. Temperatures fluctuated more on mecklohachen, but informants were less concerned with maintaining the same steady high temperature necessary for baking bread. Mogogo can become as hot or hotter than metal griddles but can retain heat more effectively and maintain more constant temperatures.

Ash forms a highly effective insulator. An abandoned stove was examined and less than one centimeter of compacted charring was found on the floor of the mogogo firebox and even less on that of the mecklohachen. Temperatures recorded in the ash ranged from 68–213 degrees Celsius, which are high enough to char but not to incinerate grain (Nesbitt 1997). A stove's effectiveness can be compromised by heavy ash buildup. The lowest temperature series was recorded for a type 4 stove with heavy ash accumulation as shown in Figure 5. Ash is usually removed after each firing. However, because frequent burning and ash removal create a deep depression in the floor, ash is sometimes kept to maintain firebox volume. In such conditions, grains in the ash are repeatedly fired and this affects seed charring. Heating efficiency is also influenced by stove type. In Figure 5, type 2 stoves produced low temperatures at the fuel source while maintaining adequate heat to bake taita. Most likely, type 2 stoves lost heat

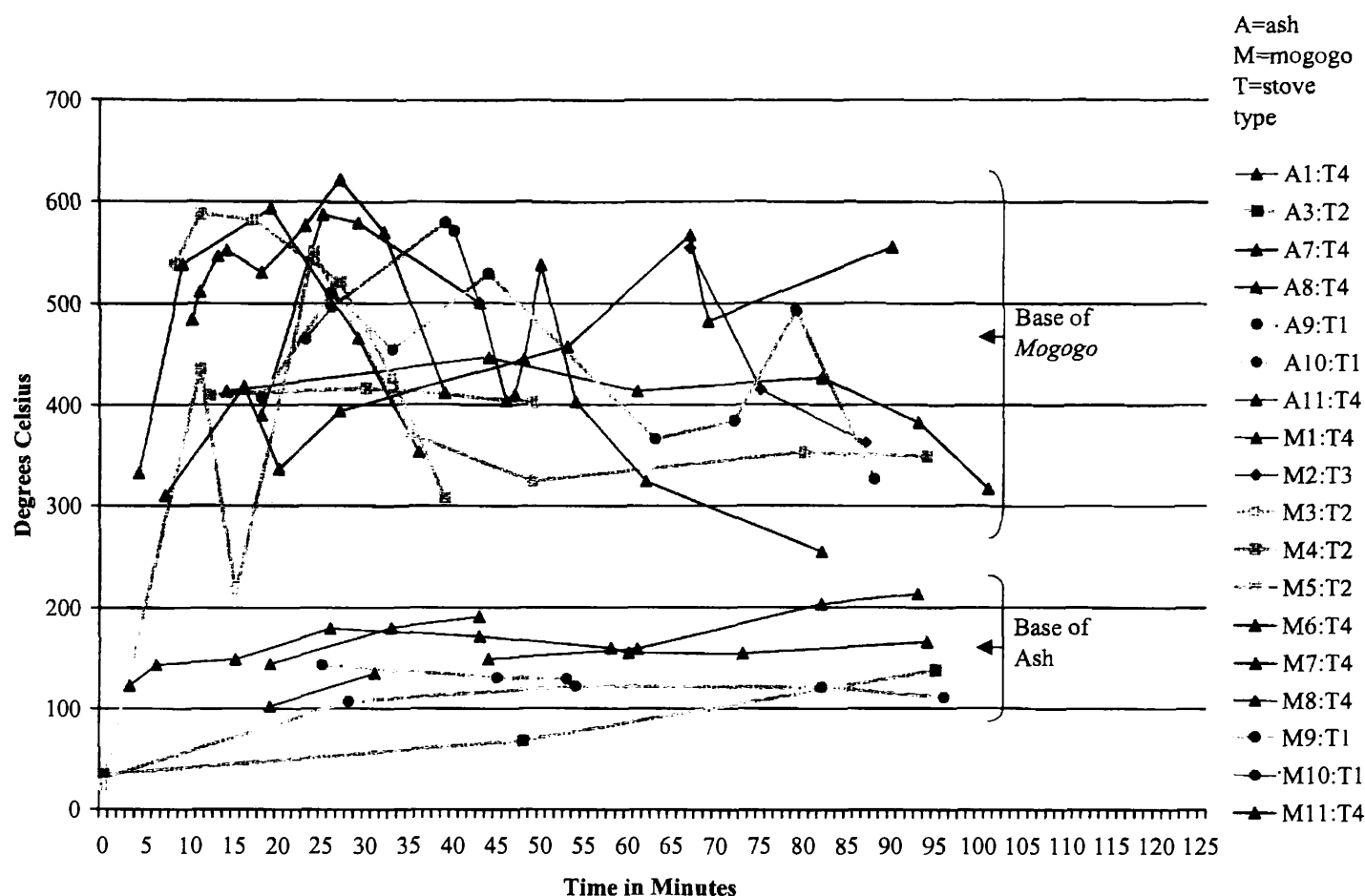


FIGURE 6. Temperatures at mogogo base and in the ash during taita/kicha baking in types 1, 2, 3, and 4 stoves.

through the adjacent boiling pot firebox that has more openings relative to surface area than do other fireboxes. This could prevent grains from charring in the ash.

OVEN AND GRIDDLE DISTRIBUTION IN THE NEAR EAST AND AFRICA

While cereals have diffused across Ethiopia and the Near East, baking technologies have not. A brief survey of Near Eastern and African baking technologies demonstrates a close relationship between the geographic distribution of ovens and Near Eastern cereals, with the exception of highland Ethiopia. Other baking techniques including griddles, slabs, sand or earth ovens, and dough simply baked in hearth ash are geographically widespread.

Near Eastern Bread-Baking Technologies

Ovens are an ancient method of heat treatment in Near Eastern domestic contexts (Gourdin and Kingery 1975). Domed ovens are found in Turkey and Iraq c. 7000 B.C.E., but there is no evidence that these populations ate bread (Balter 1998:1443; Braidwood 1983:158; Martin and Russell 2000). Others have suggested that early bread-baking methods in the region included preheated ceramic trays or moulds (Chazan and Lehner 1990; but see also Pollock 1999:95; Voigt 1983:159). The *tannur* is the most commonly

reported domestic bread oven in the Near East. Tannur are found in Southwest Asia, Turkey, Afghanistan, India, and Pakistan (Pomeranz and Shellenberger 1971:59–70; Tannahill 1973; Wulff 1966). These ovens first appeared in domestic and monumental buildings in Mesopotamian cities by 3100 B.C.E., and later in Bronze Age Jordan (1550 B.C.E.) and New Kingdom Egypt (1550–1070 B.C.E.) (McQuitty 1984:261; Ochsenschlager 1974; Samuel 2000:566; Van de Mierop 1997:156).

Tannur are cylinders or cones of mud plaster or brick, lined with clay. They are either freestanding or, more frequently, set into benches or floors (Kramer 1982:99; Ochsenschlager 1974; Pomeranz and Shellenberger 1971:67; Samuel 1989, 2000; Serjeant and Lewcock 1983:543). Oven sizes vary but all have an opening near the top to insert bread and a smaller opening at the base for draft, fueling, and ash removal. Fuels include animal dung; mixtures of dung, reeds, and wood; or chopped straw (Kramer 1982:47; Ochsenschlager 1974; Samuel 1989; Sweet 1960; Weinstein 1973:274). Moistened and flattened rounds of dough are pressed onto preheated inner walls to which they adhere and bake in a few minutes. Tannur ovens are used to produce flatbread made with wheat or barley throughout Southwest Asia, sorghum in southern Arabia, and sorghum and

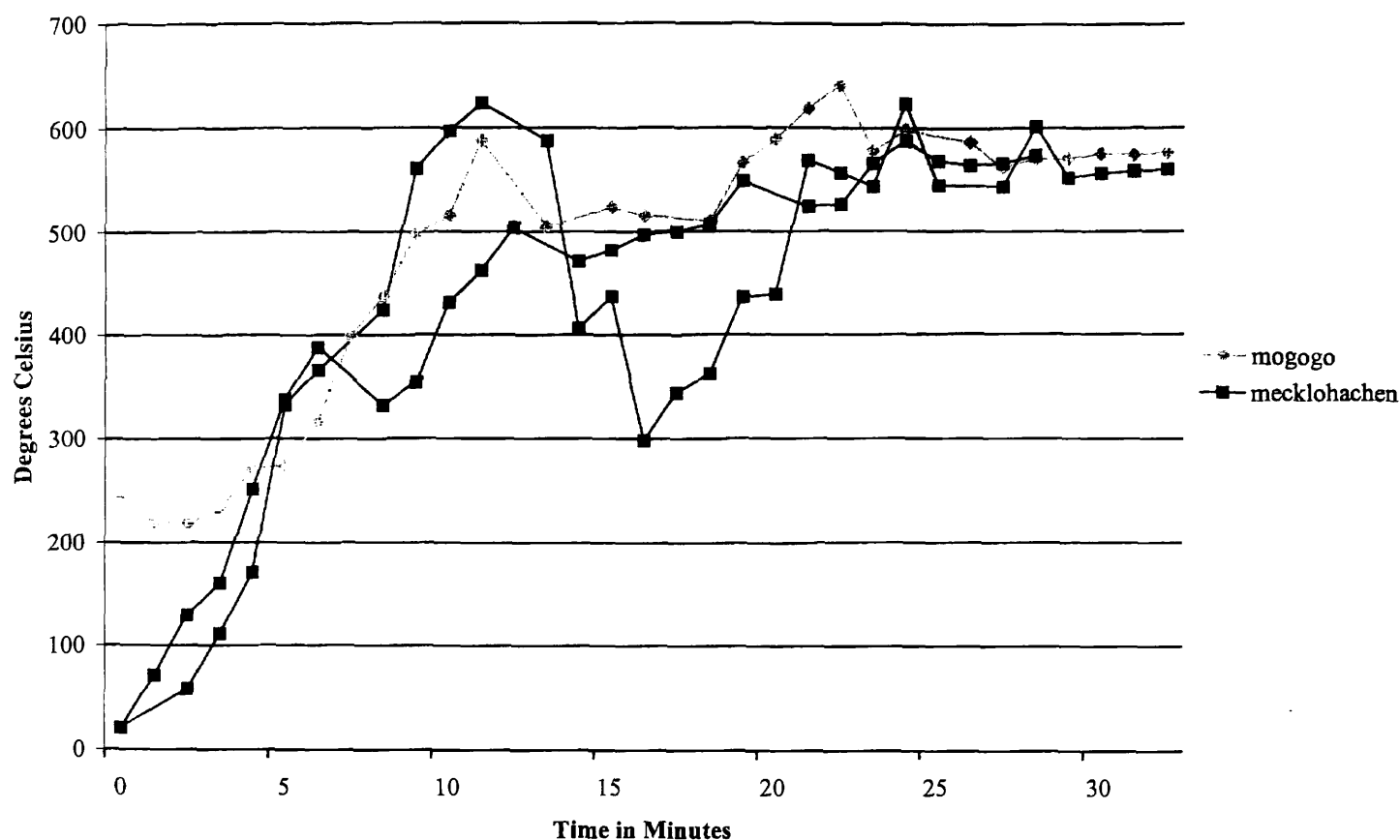


FIGURE 7. Temperatures at fuel source during kollo roasting on mecklohachen and mogogo.

bulrush millet (*Pennisetum typhoides*) in Yemen (Bornstein-Johanssen 1975).

Other baking methods have been reported for the region. Edward Ochsenchlager's (1974) ethnoarchaeological study in Iraq describes rice-flour (*Oryza sativa* L.) flat-bread baked on a *tabag*. *Tabag* are discs of sun-baked mud that occur archaeologically by 2500 B.C.E. The slab is preheated over the fire, rice batter is poured onto the surface, and hot dung coals are placed on top of the batter to bake it through. When traveling, Bedouin bake bread on the preheated surface of a thin concave iron disc (*sadi*) (Ochsenchlager 1974:167). In Yemen, ceramic or metal griddles (*sulla*) with basket or clay lids are heated on top of tannurs and are used to make sorghum pancake (*lahuh*), which is served at Ramadan. *Lahuh* is made with a fermented batter that produces a bread similar in texture and appearance to Ethiopian *taita* and is mentioned in historic texts dating to the tenth century C.E. (Bornstein-Johanssen 1975; Serjeant and Lewcock 1983; Varisco 1997:69).

African Bread-Baking Technologies

Prior to the New Kingdom, barley bread was probably baked as hand-formed loaves in hearth ash, on griddles, in moulds, and on ceramic dishes (Chazan and Lehner 1990:29; Larsen 1936; Samuel 1989, 2000). In the New Kingdom, emmer wheat replaced barley as the predominant crop and the tannur-like oven became the only baking method

evident in domestic and temple buildings of this period (Samuel 1989, 1999:131, 2000:569). In Africa, tannur use has been reported in Egypt, North Africa, eastern Sudan, and Zanzibar (Balfet 1975; Bruneton 1975; Pomeranz and Shellenberger 1971:58).

In sub-Saharan Africa, wheat bread may have been economically important only in highland Ethiopia. The Aksumite Kingdom (300 B.C.E.–C.E. 800–900) left inscriptions stating that bread, translated as *wheaten loaves* (an indiscriminate term), was rationed to state workers and prisoners (Kobishchanov 1979; Phillipson 1993:355). No commercial Aksumite bread-baking facilities are known, and only one possible oven has been reported from an elite residence near Aksum (Anfray 1972). Records indicate that huge quantities of bread were taxed from rural households to feed noble visitors, armies, and relocating dissident populations during Aksumite and later times (Kobishchanov 1979). But how was this bread baked?

Ceramic griddles are as old as the evidence for tef, barley, and emmer in highland Ethiopia. Joanne Dombrowski (1971:123,130) recovered ceramic griddle fragments from the lowest levels of both Lalibela and Natchabiet caves near Lake Tana, dating to 520 B.C.E. $\pm$ 80 and 80 B.C.E. $\pm$ 80, respectively. Dome-shaped clay griddle lids appear later in the early second millennium C.E. (Dombrowski 1971: tables 6 and 7). At Aksum, griddle fragments are uncommon until the later Aksumite period (Phillips 2000: 391; Wilding 1989). One of the earliest ceramic griddles

from Aksum has a 19-centimeter diameter and dates from the second to fifth centuries C.E. (Wilding 1989). Numerous griddle fragments are found after the sixth to seventh centuries C.E. with diameters of 30–40 centimeters. Wilding (1989:308) claims that these resemble modern griddles, but they are significantly smaller than those reported here or by Simon Messing (1957a).

Tigrayan fermented griddle bread must be considered as part of a wider African bread tradition. In southwestern and central Ethiopia, a sour-tasting pancake and flatbread are prepared from the fermented pseudostem of *ensete* (*Ensete ventricosum*) (Bezuneh and Feleke 1966; Hamer 1987:18; Kaplan et al. 1971:162; Smeds 1955:24). *Kissra*, a Sudanese pancake bread, is a staple made with fermented sorghum or finger millet batter, which is heated on ceramic griddles called *doka* with three stone hearths (Dirar 1993:173). *Kissra* is baked uncovered and is slightly thinner than *taita* (Dagher 1991:10–11). Dirar (1993) argues for the separate development of *kissra* and *taita* but notes striking similarities in their preparation, baking, storage, and mode of consumption, possibly pointing to a common age or origin. Ceramic *doka* bear a marked similarity to Ethiopian griddles in size and shape (Dirar 1993:171) and occur after the Meroitic period circa C.E. 600 (Adams 1986; Shinnie and Shinnie 1978:107). Some ancient Nubian *doka* are decorated with rim incisions (Adams 1986:104) similar to those found in griddles from Lalibela (Dombroski 1971:115). Ceramic *doka* were replaced with rectangular metal pans (*sadj*) by the 19th century (Dirar 1993:171). Rare granite *doka* are also reported for Sudan (Dirar 1993:173).

Nomadic peoples in the Sahara, northern Sudan, and Egypt use the *sadj* or preheated stone slabs to bake wheat and sorghum bread (Adams 1977:586; Hobbs 1989:50; Nicolaisen 1963:237). Tuareg also bake millet bread in preheated depressions in the sand or earth, covering the batter with sand, hot coals, or a fire to bake the batter through (Gast and Adrian 1965:32–33; Nicolaisen 1963). Nomadic Ethiopian pastoralists and Bedouin in Sudan and Egypt also use sand or earth ovens, some of which have floors of heated pebbles or pottery shards for baking sorghum or millet bread (Dirar 1993; Dufton 1970:220; Hobbs 1989).

Pancake bread may have been consumed in West Africa in ancient times (MacLean and Insoll 1999). Susan Keech McIntosh (1995:159–160) suggests that pearl millet (*Pennisetum glaucum*) and sorghum were made into bread in the early phases of Jenne-Jeno (400 B.C.E.–C.E. 500), perhaps using sand or earth ovens similar to those of the Tuareg. Medieval Arabic travelers observed bread made with unspecified tubers and millets in the eastern Sahara, Jenne, and Gao. Their accounts come from different regions and centuries and provide a range of observations from bread being consumed as luxury items to its availability as cheap traveler's fare (Lewicki 1974:46–47, 80).

PERFORMANCE CHARACTERISTICS OF BREAD INGREDIENTS

So why use griddles rather than ovens? We suggest that technical choice is strongly correlated with the performance characteristics of bread ingredients. The presence or absence of gluten, starch, or pentosans in cereals, legumes, roots, and plants affects the capacity of their flours to absorb water, to form dough or batter, and to expand.

Gluten is exclusively found in Near Eastern cereals. Glutenins and gliadins are storage proteins found in the starchy endosperm of cereals belonging to the Triticeae tribe of grasses. They are found primarily in wheat and to a lesser extent in rye (*Secale cereale*), barley, and oats (*Aveneae* tribe). Storage proteins in wheat are unique in that they are "technologically active" (Belderok 2000:30). When wheat flour is mixed with water and kneaded, glutenins and gliadins become hydrated and form gluten, the only elastic protein derived from plants (Shewry et al. 1995:1186). When dough ferments from bacteria present in flour or when a leavening agent is added, carbon dioxide gas is produced. Gluten traps gas in its elastic framework and the dough expands (Coulter 1984:95–97). When dough is heated, gluten loses its elasticity and becomes firm.

Domesticated wheats are classified into three ploidy levels: diploids (A-genome), tetraploids (AB- or AG-genome), and hexaploids (ABD-genome). Gluten's elastic quality for making raised bread is largely determined by the quantity of high molecular-weight glutenin subunits (HMW-GS) (Anderson and Greene 1989; Barnes 1989:381; Flavell et al. 1989; Shewry et al. 1989; Yamashita et al. 1957). The number of HMW-GS in wheats increases from diploids to tetraploids to hexaploids (see Belderok 2000:5; MacRitchie 1999). Gluten in all wheats absorbs water and forms a cohesive mass, but hexaploids have greater elastic capacities than those with lower HMW-GS ratios.

Seed hardness also contributes to dough formation (Giroux and Morris 1998) and is not correlated to gluten quality. The harder the seed, the greater the starch damage that will occur in milling. Starch damage increases water absorption making dough swell (Belderok 2000:32–33). Therefore, hard hexaploid wheats, such as bread wheat, have gluten and experience significant starch damage, so their flours absorb *more* water, resulting in airy, raised loaves. Soft hexaploid varieties such as spelt (*T. spelta*) absorb less water and produce heavier bread (Abdel-Aal et al. 1999; LeClerc et al. 1918). Tetraploid wheats, such as emmer and durum, contain weakly developed gluten that does not leaven well; however, these hard wheats have high water absorption properties that are important in making Near Eastern flatbreads (Williams et al. 1988).

Rye and an ancestor of wheat known as goatgrass (*Aegilops*) are part of the secondary gene pool of wheat. Both are more closely related to wheat than barley and oats (Clayton and Renvoize 1982, 1989:147; Harlan 1992:109; Terrell and Peterson 1993:23). Gluten in rye flour

does not form a continuous elastic network. Its components are held together by pentosans which absorb water and form a sticky, jellylike substance that traps gas which causes the dough to expand (Prihoda et al. 1993:24). Next to wheat, rye flour produces the most extensible doughs. Barley and oats have gluten but their chemical composition makes them unsuitable for leavening (Tannahill 1973:67).

Indigenous African cereals such as tef, finger millet, pearl millet, and sorghum contain no gluten. It appears that starch and pentosans absorb water in flours made from these grains. Fermentation of these flours makes a batter that has low viscosity and enough elasticity to make very thin griddle bread (Dirar 1993:205). The microorganism *Leuconostoc mesenteroides* and other lactic acid bacteria produce gas during fermentation (Dirar 1993:95; Gashe 1985; Goody 1982:125; National Research Council 1996; Rooney et al. 1986). Slightly leavened or "puffy" bread is produced when part of the batter is boiled until the starches gelatinize and trap gas (National Research Council 1996), which is part of the last fermentation stage in the making of kissra, taita, and lahu (Dirar 1993:204; Gashe 1985; Serjeant and Lewcock 1983; Stewart and Getachew 1962). High moisture levels in these batters and the use of a lid when baking further steam-leaven the bread and contribute to rapid starch gelatinization that traps gas bubbles producing the "eyes" that are part of taita's aesthetic appeal (Parker et al. 1989).

Starch and pentosans in some varieties of sorghums and millets absorb water and produce highly concentrated and sticky gels that form a viscous dough (Badi et al. 1976; Prihoda et al. 1993:24). Fermentation aids the process by softening the protein matrix where starch is stored (Dirar 1993:95), and sorghum varieties that produce softer-textured kernels are preferred for fermented bread (Rooney et al. 1986:339, table 3). Sorghum and millet flour doughs are firm and can be baked in tannur, but they are neither elastic nor extensible (Food and Agricultural Organization 1995).

DISCUSSION

Only certain Near Eastern cereals (wheats, rye, barley) have gluten that makes a dough that is both viscous and elastic. It is reasonable to infer that these performance characteristics were intentionally selected in their domestication. Domesticated rye, einkorn (*T. monococcum*), emmer, and barley appear in the Near Eastern archaeological record during the ninth millennium B.C.E. Although free-threshing wheats (including tetraploids and hexaploids) are distinguishable in the archaeological record early in the seventh millennium B.C.E. (Garrad 1999:82; Hillman 2000), hexaploid cultivars such as bread wheat are believed to have developed in the fifth to sixth millennium B.C.E. (Zohary and Hopf 2000:54). Gluten produces dough that can be hand formed and baked on walls, floors, or trays inside ovens. Bread wheat and rye flours are unique

in their ability to make leavened loaves (Belderek 2000:30). Leavening is best realized in ovens, as loaves are thicker, requiring sustained high heat and longer baking times than flatbread.

It is likely that ovens, as a heating technology in Near Eastern domestic contexts, encouraged the use of local cereals in making bread. Tannur use was ubiquitous by the fourth millennium B.C.E. and ethnographically was intended for flatbread baking from diploid and tetraploid wheats, barley, millet, and sorghum flours that make dough but have inferior leavening capabilities. To our knowledge, bread ovens are only found where Near Eastern cereals (especially wheat) are used in making bread.

Griddles bake bread made from starchy ingredients with no gluten that are often made into batter. Griddles have a global distribution for baking bread from starchy foods in Africa, the Americas, and Australia. All sub-Saharan bread made with indigenous African cereals, wild grass grains, or tubers is reportedly baked on griddles, in hot sand ovens, or on preheated slabs. In the Americas, maize (*Zea mays*) tortillas are baked on griddles (Cushing 1974; Linton 1924). In South America, manioc (*Manihot esculenta*) is made into "cakes" on ceramic griddles (DeBoer 1975; Roosevelt 1995). Similar griddle bread made of sweet potato (*Ipomoea batatas*), manioc, and fermented plants is reported for the West Indies and northeastern South America (Tannahill 1973:244–245). In the eastern United States, maize and nut flours were made into bread by boiling or baking on hot stones and on ceramic griddles (Swanton 1979:354–367). California native groups baked acorn flour bread on heated flat stones or in stone-lined earth ovens (LaPena 1978:339). Aboriginal Australians make damper from flours of wild millets, grasses, and other plants using sand ovens (Isaacs 1987). In northwestern Europe griddles were used to bake bread from rye, spelt wheat, barley, and oats where people could not afford oven bread. Furthermore, the moist climate required that cereals were parched prior to storage, a practice that destroys gluten's elastic properties (Barnes 1989:388; Leach 1999; Lerche 1975:334).

As Wilding (1989) proposed, the history of ceramic griddles in Ethiopia may indirectly reflect that of tef. Most archaeological study in the highlands has been of elite and urban contexts (Bard et al. 1997; Fattovich et al. 2000; Phillipson 2000). Additional excavation of rural settings is required to define the age and distribution of griddles in the highlands. Sampling error is likely responsible for the apparent time gap between the appearance of griddles near Lake Tana and those near Aksum. Although archaeobotanical evidence is expected to provide a more definite answer, the fact that griddles are used to roast grains of wheat, barley, and sorghum, but not tef or finger millet, should alert archaeologists to a potential source of bias in the archaeological record.

Gluten is not the sole determinant in technical choice. Wheat and barley flours are baked on griddles, while breads made from sorghum and millet flours are

baked in tannur. It is curious that tannur are not found in highland Ethiopia, in view of the long presence of wheat and barley and the degree of contact that existed between Ethiopia and South Arabia (Bard et al. 1997; Fattovich 1988, 1990). The adoption of the tannur and the widespread use of emmer as an ingredient are apparently linked in New Kingdom Egypt (Samuel 2000). However, although emmer is present in Ethiopia by the mid-first millennium B.C.E. (Bard et al. 1997; Boardman 1999), the tannur is absent. Few food-related technologies diffused from South Arabia into Ethiopia in the first millennium B.C.E. as both Pre-Aksumite and Aksumite pottery are predominantly African in tradition (Fattovich 1990). This supports the interpretation that cuisine was largely unaltered during this period, even if new foods were adopted.

Whereas Ethiopians appear to have adapted Near Eastern cereals to an African baking technology, in Yemen African cereals (sorghum and pearl millet) were baked in tannur. We tentatively suggest that the Ethiopian and Yemeni cases support an interpretation that nonindigenous cereals were adopted after local grains and baking technologies were well established. This is consistent with anthropological evidence that new foods are more readily accepted if they can substitute for ingredients in an existing cuisine (Crown 2000). Rural Ethiopian and Near Eastern cuisines consist of bread (or porridge) and beer. Wheat and barley can substitute for tef and finger millet to make these products.

Other social factors may have prevented the tannur from diffusing to highland Ethiopia. Diet and cuisine change, but in a sociotechnical system that involves the entire production of food from field to kitchen, where food production is intertwined with associated skills, technologies, and reciprocal social relations, this process is complex. Rural domestic baking is the domain of women today in Ethiopia, Sudan, Yemen, and Southwest Asia. The antiquity of gendered divisions of labor in Tigray cannot be determined with the limited archaeological evidence. Nevertheless, cross-cultural studies (see Crown 2000) strongly support the assumption that in the past women also processed and prepared grains in Tigrayan farming households. Ethnographically, it is evident that African women do almost all domestic cooking (Goody 1982:101).

If women in the past processed foods and baked bread in contexts similar to those reported here, they may have resisted the tannur. Women's roles in bread production are implicated in the construction and maintenance of ethnic cuisine, gender identities, and gastropolitics. Aside from the food itself, objects used to process and serve bread are manifestations of a woman's skill and her contribution to the household. Both food products and decorative serving containers are prominently displayed at meals and on other social occasions. In the absence of mechanical flour mills, rural women perform an astonishing 20-hour workday (Tewolde 1993). If such time constraints occurred in the past, it seems reasonable to speculate that women resisted adopting new skills and techniques unless

they offered some significant advantage. Tannur and griddles use the same fuel and have the same baking times. There is no evident advantage in using one technique over the other, and these techniques are not interchangeable. They are components of different sociotechnical systems and produce different cuisines that take time to master.

Some changes in technology occurred. Griddle diameter size and the frequency of their appearance increase from the Aksumite period to modern times (Phillips 2000; Wilding 1989). Producing larger bread may relate to women's attempts to reduce cooking time and possibly feed larger families as expanding state economies demanded more tribute in the form of labor (cf. Brumfiel 1992). Deforestation also increased around Aksum beginning in late Aksumite times (Butzer 1981; DiBlasi 1997), so fuel consumption may have stimulated modifications to griddle size and perhaps the development of lids. Consumption and symbolic importance of bread may have increased after the mid-first millennium C.E. as Christianity and Islam expanded into highland Ethiopia and could account for apparent increases in griddle use after the mid-first millennium C.E. Our study, however, does not support Wilding's (1989:308) suggestion that the paucity of early griddle fragments is because of the use of metal before ceramic griddles. Taita and flatbreads are not baked on metal griddles because temperatures cannot be controlled. Also metal usually replaced ceramic vessels and not the other way around (Arnold 1985:139; Dirar 1993:184).

Other factors should be considered. Christopher Ehret (1979, 1988) argues that linguistic evidence supports ancient cereal cultivation in the highlands. Cushitic languages are more ancient than Semitic languages in the region, the latter having been introduced during the first millennium B.C.E. by South Arabian colonists who established Pre-Aksumite urban centers for long-distance trade (Ehret 1988; Fattovich 1997; Phillipson 1998:45, 2000:473–474). A few centuries later, these foreign colonizers were assimilated into the local culture, however, they brought with them the Semitic languages which were adopted by local Ethiopians. Interestingly enough, the Semitic terms for tef, wheat, plough, barley and mashed chickpea are actually borrowed from Cushitic languages. Ehret (1979, 1988) suggests that the borrowing of Cushitic agricultural terms indicates that South Arabian colonists were not farmers, even though cereal farming must have been well established to support their urban centers (Bard 1997). Instead, colonists initially were political or occupational specialists and were distinct from local people in ethnicity, material culture, and language (Ehret 1988; Phillipson 2000). We speculate that these colonists had a different cuisine from the rural indigenous population, which did not include griddle bread, tef, or finger millet. This may explain the absence of these traits from Pre-Aksumite urban sites, and their growing presence during Aksumite times when foreign influences and tastes waned. More extensive excavation of rural Pre-Aksumite and Aksumite period

sites is needed to determine the nature of urban and rural relationships and cuisines.

CONCLUSION

Griddles are a widespread and appropriate technical choice for baking bread from starchy foods lacking gluten. This should not lead to the conclusion that griddle bread is a primitive antecedent to oven bread. An evolutionary sequence is sometimes invoked that views oven-baked leavened wheaten bread as the baker's apical achievement (Belderok 2000:7; Spicer 1975), a Westerncentric view rooted in a narrow definition of bread. Taita is part of a widespread African tradition of fermented foods (see Dirar 1993:208; National Research Council 1993). This is a skilled, highly developed tradition appropriate to the performance characteristics of indigenous, nongluten-forming foods.

Baking technology offers archaeologists another means to trace the development of bread in regional cuisines and the domestication and diffusion of starchy foods. The relationship between performance characteristics of specific foods and heat treatment technologies needs to be more closely linked in studies of technical choice. It is critical to note that performance characteristics are not the sole factor in determining technology. Baking technologies produce bread types that literally shape a culture's cuisine and bear social meaning. A cuisine is developed as part of interconnected everyday practices that work together smoothly and resist alternatives. We argue that in highland Ethiopia, griddle baking emerged with indigenous subsistence practices based on domesticated or wild tef, finger millet, and other starchy foods lacking gluten but was capable of adopting Near Eastern domesticates into a well-integrated sociotechnical system of cereal production.

DIANE LYONS Department of Archaeology, University of Calgary, Calgary, Alberta, T2N 1N4

A. CATHERINE D'ANDREA Department of Archaeology, Simon Fraser University, Burnaby, British Columbia, V5A 1S6

NOTES

Acknowledgments. This article is based on ideas we presented at the Society of Africanist Archaeologists meetings in Cambridge, July 2000. We are indebted to the people of Adi Ainawalid, in particular to the women who participated in stove experiments. We thank Mekelle University, and, especially, Dr. Mitiku Haile for logistical support. We also thank Zelealem Tesfay, Dereje Assefa, Daniel Gebre Zavier, Aklilu Haile Michael, and other interpreters from Mekelle University. We acknowledge the Authority for Research and Conservation of Culture Heritage, Addis Ababa, and the Mekelle Bureau of Tourism for permission to undertake ethnoarchaeological research. Thanks to Shannon Wood who prepared Figure 1, Dr. Barbara Winter for assistance with Figure 2, and to Andrew Barton, Emanuel Kessey, Michele Wollstonecroft, and Drs. Larry Pavlish, Edward Keihl, Christopher Ehret, Jacke Phillips, and Delwen Samuel for insightful comments.

1. Mogogos are also referred to as *metad* or *mtad* (Amharic). Locally the term *mogogo* refers to both the ceramic griddle and the entire stove. In this study, *mogogo* refers only to the ceramic griddle. Craven Walker (1933:81) notes that *tse'edut* (church griddles) have

a holy function. *Tse'edut* are not discussed in this study, or any others, to our knowledge.

REFERENCES CITED

- Abdel-Aal, El-Sayed M., Pierre Hucl, and F. W. Sosulski
1999 Optimizing the Bread Formulation for Soft Spelt Wheat. *Cereal Foods World* 44(7):480–483.
- Adams, William Y.
1977 Nubia Corridor to Africa. Princeton: Princeton University Press.
- 1986 Ceramic Industries of Medieval Nubia, vol. 1: Memoirs of the UNESCO Archaeological Survey of Sudanese Nubia. Lexington: University Press of Kentucky.
- Ambrose, Stanley H.
1984 The Introduction of Pastoral Adaptations to the Highlands of East Africa. In *From Hunters to Farmers: The Causes and Consequences of Food Production in Africa*. J. Desmond Clark and Steven A. Brandt, eds. Pp. 212–239. Berkeley: University of California Press.
- Anderson, O. D., and F. C. Greene
1989 The Characterization of High-Molecular-Weight Glutenin Genes from Genomes A and B of a Hexaploid Bread Wheat. *Theoretical and Applied Genetics* 77:689–700.
- Anderson, Seona, and Fusun Ertug-Yaras
1998 Fuel, Fodder and Faeces: An Ethnographic and Botanical Study of Dung Fuel Use in Central Anatolia. *Journal of Human Palaeoecology* 1:99–110.
- Anfray, Francis
1972 L'archéologie d'Axoum en 1972. *Paideuma* 18:60–78.
- Appadurai, Arjun
1981 Gastro-Politics in Hindu South Asia. *American Ethnologist* 8:494–511.
- Arnold, Dean E.
1985 Ceramic Theory and Cultural Process. Cambridge: Cambridge University Press.
- Arnott, Margaret Louise
1975 The Breads of Mani. In *Gastronomy: The Anthropology of Food Habits*. M. L. Arnott, ed. Pp. 297–307. The Hague: Mouton.
- Asiedu, J. J.
1989 Processing Tropical Crops. Hong Kong: English Language Book Society/Macmillan.
- Badi, S. M., and R. C. Hosney, and P. L. Finney
1976 Pearl Millet II, Partial Characterization of Starch and Use of Millet Flour in Breadmaking. *Cereal Chemistry* 53(5):718–724.
- Balfet, Helene
1975 Bread in Some Regions of the Mediterranean Area: A Contribution to the Studies on Eating Habits. In *Gastronomy: The Anthropology of Food Habits*. M. L. Arnott, ed. Pp. 305–314. The Hague: Mouton Publishers.
- Balter, Michael
1998 Why Settle Down? The Mystery of Communities. *Science* 282:1442–1444.
- Bard, Kathryn A.
1997 Environmental History of Early Aksum. In *The Environmental History and Human Ecology of Northern Ethiopia in the Late Holocene*. Kathryn A. Bard, ed. Pp. 19–28. Napoli: Istituto Universitario Orientale.
- Bard, Kathryn A., Rodolfo Fattovich, Andrea Manzo, and Cinzia Perlingieri
1997 Archaeological Investigations at Bieta Giyorgis (Aksum), Ethiopia: 1993–1995 Field Seasons. *Journal of Field Archaeology* 24:387–403.
- Barnes, P. J.
1989 Wheat in Milling and Baking. In *Cereal Science and Technology*. G. H. Palmer, ed. Pp. 367–412. Aberdeen: Aberdeen University Press.
- Bauer, Dan Franz
1977 Household and Society in Ethiopia. Michigan State University: African Studies Center.
- Belderok, B.
2000 Developments in Bread-Making Processes. *Plant Foods for Human Nutrition* 55:1–86.
- Bezuneh, Taye, and Asrat Feleke
1966 The Production and Utilization of the Genus *Ensete* in Ethiopia. *Economic Botany* 20:65–70.

- Boardman, Sheila
1999 The Agricultural Foundation of the Aksumite Empire, Ethiopia: An Interim Report. In *The Exploitation of Plant Resources in Ancient Africa*. Marijke Van Der Veen, ed. Pp. 137–148. New York: Kluwer Academic/Plenum.
- Boardman, Sheila, and D. W. Phillipson
2000 Archaeobotany. In *Archaeology at Aksum, Ethiopia 1993–7*, vol. 2. D. W. Phillipson, ed. Pp. 468–470. London: The British Institute in Eastern Africa.
- Bornstein-Johanssen, Annika
1975 Sorghum and Millet in Yemen. In *Gastronomy: The Anthropology of Food Habits*. M. L. Arnott, ed. Pp. 287–295. The Hague: Mouton.
- Braidwood, Robert J.
1983 The Site of Jarmo and Its Architectural Remains. In *Prehistoric Archeology along the Zagros Flanks*. Linda S. Braidwood, Robert J. Braidwood, Bruce Howe, Charles A. Reid, and Patty Jo Watson, eds. Pp. 155–207. Chicago: Oriental Institute.
- Brandt, Steven A.
1984 New Perspectives on the Origins of Food Production in Ethiopia. In *From Hunters to Farmers*. J. Desmond Clark and Steven A. Brandt, eds. Pp. 173–190. Berkeley: University of California Press.
- Brumfiel, Elizabeth M.
1991 Weaving and Cooking: Women's Production in Aztec Mexico. In *Engendering Archaeology*. Joan Gero and Margaret Conkey, eds. Pp. 224–251. Oxford: Blackwell.
1992 Distinguished Lecture in Archeology: Breaking and Entering the Ecosystem—Gender, Class, and Faction Steal the Show. *American Anthropologist* 94:551–567.
- Bruneton, Ariane
1975 Bread in the Region of the Moroccan High Atlas: A Chain of Daily Technical Operations in Order to Provide Daily Nourishment. In *Gastronomy: The Anthropology of Food Habits*. M. L. Arnott, ed. Pp. 275–285. The Hague: Mouton.
- Butler, Ann, Zelealem Tesfay, Catherine D'Andrea, and Diane Lyons
1999 The Ethnobotany of *Lathyrus sativus* L. in the Highlands of Ethiopia. In *The Exploitation of Plant Resources in Ancient Africa*. Marijke Van Der Veen, ed. Pp. 123–136. New York: Kluwer Academic/Plenum Publishers.
- Butzer, Karl W.
1981 Rise and Fall of Axum, Ethiopia: A Geo-Archaeological Interpretation. *American Antiquity* 46(3):471–495.
- Chazan, Michael, and Mark Lehner
1990 An Ancient Analogy: Pot Baked Bread in Ancient Egypt and Mesopotamia. *Paleorient* 16(2):21–35.
- Childs, S. Terry
1999 "After All, a Hoe Bought a Wife": The Social Dimensions of Ironworking among the Toro of East Africa. In *The Social Dynamics of Technology*. Marcia-Anne Dobres and Christopher R. Hoffman, eds. Pp. 23–45. Washington, DC: Smithsonian Institution Press.
- Clayton, W. D., and S. A. Renvoize
1982 Flora of Tropical East Africa, Gramineae (part 3):672–673. Rotterdam: A. A. Balkema.
1989 Genera Graminum Grasses of the World. Kew, UK: Royal Botanic Gardens.
- Coulter, T. P.
1984 Food—The Chemistry of its Components. London: Royal Society of Chemistry.
- Counihan, Carole M.
1999 The Anthropology of Food and Body. New York: Routledge.
- Counihan, Carole M., and Steven L. Kaplan, eds.
1998 Food and Gender, Identity and Power. the Netherlands: Harwood Academic Publishers.
- Crown, Patricia L.
2000 Women's Role in Changing Cuisine. In *Women and Men in the Prehispanic Southwest*. Patricia L. Crown, ed. Pp. 221–266. Santa Fe: School of American Research Press.
- Cushing, Frank Hamilton
1974[1920] Zuni Breadstuff. *Indian Notes and Monographs*, vol. 8. New York: Museum of the American Indian, Heye Foundation.
- Dagher, Shawky M.
1991 Traditional Foods in the Near East. In *Rome: Food and Agricultural Organization of the United Nations*. Rome: Food and Agricultural Organization of the United Nations.
- D'Andrea, A. Catherine, and Haile Mitiku
2002 Traditional Emmer Processing in Highland Ethiopia. *Journal of Ethnobiology* 22(2):179–217.
- D'Andrea, Catherine, Diane Lyons, Mitiku Haile, and Ann Butler
1999 Ethnoarchaeological Approaches to the Study of Prehistoric Agriculture in the Highlands of Ethiopia. In *The Exploitation of Plant Resources in Ancient Africa*. Marijke Van Der Veen, ed. Pp. 101–122. New York: Kluwer Academic/Plenum Publishers.
- DeBoer, Warren R.
1975 The Archaeological Evidence for Manioc Cultivation: A Cautionary Note. *American Antiquity* 40(4):419–433.
- DiBlasi, Michael C.
1997 Pollen-Analytical Approaches to the Study of Late Holocene Environmental History and Human Ecology on the Shire Plateau of Northern Ethiopia. In *The Environmental History and Human Ecology of Northern Ethiopia in the Late Holocene*. Kathryn A. Bard, ed. Pp. 45–80. Napoli: Istituto Universitario Orientale.
- Dirar, Hamid A.
1993 The Indigenous Fermented Foods of the Sudan. Wallingford, UK: CAB.
- Dobres, Marcia-Anne
1995 Gender and Prehistoric Technology: On the Social Agency of Technical Strategies. *World Archaeology* 27(1):25–49.
1999 Technology's Links and *Chaines*: The Processual Unfolding of Technique and Technician. In *The Social Dynamics of Technology*. Marcia-Anne Dobres and Christopher R. Hoffman, eds. Pp. 124–146. Washington, DC: Smithsonian Institution Press.
- Dobres, Marcia-Anne, and Christopher R. Hoffman
1999 Introduction: A Context for the Present and Future of Technology Studies. In *The Social Dynamics of Technology*. Marcia-Anne Dobres and Christopher R. Hoffman, eds. Pp. 1–19. Washington, DC: Smithsonian Institution Press.
- Dombrowski, Joanne C.
1971 Excavations in Ethiopia: Lalibela and Natchabiet Caves, Begemeder Province. Ph.D. dissertation, Department of Anthropology, Boston University.
- Dorsky, Susan
1986 Women of Amran: A Middle Eastern Ethnographic Study. Salt Lake City: University of Utah Press.
- Douglas, Mary
1975 The Sociology of Bread. In *Bread Social, Nutritional and Agricultural Aspects of Wheat Bread*. Arnold Spicer, ed. Pp. 7–26. London: Applied Science Publishers.
- Dufton, Henry
1970[1867] Narrative of a Journey Through Abyssinia in 1862–3. Westport, CT: Negro Universities Press.
- Ehret, Christopher
1979 On the Antiquity of Agriculture in Ethiopia. *Journal of African History* 20:161–177.
1988 Social Transformation in the Early History of the Horn of Africa: Linguistic Clues to Developments of the Period 500 B.C. to A.D. 500. In *Proceedings of the Eighth International Conference of Ethiopian Studies*, Volume 1. Taddese Beyene, ed. Pp. 639–651. Addis Ababa: Institute of Ethiopian Studies.
- Farb, Peter, and George Armelagos
1980 Consuming Passions. New York: Houghton Mifflin.
- Fattovich, Rodolfo
1975 The Contributions of the Nile Valley's Cultures to the Rising of the Ethiopian Civilization; Elements for a Hypothesis of Work. *Meroitic Newsletter* 16:2–8.
1977 Some Data for the Study of the Culture History in Ancient Northern Ethiopia. *Nyame Akuma* 43:34–75.
1988 Remarks on the Late Prehistory and Early History of Northern Ethiopia. In *Proceedings of the Eighth International Conference on Ethiopian Studies*, vol. 1. Taddese Beyene, ed. Pp. 85–104. Addis Ababa: Institute of Ethiopian Studies.
- 1990 Remarks on the Pre-Aksumite Period in Northern Ethiopia. *Journal of Ethiopian Studies* 23:1–33.
1997 The Peopling of the Tigrean Plateau in Ancient and Medieval Times (ca. 4000 B.C.–A.D. 1500): Evidence and Synthesis. In *The Environmental History and Human Ecology of Northern Ethiopia in the Late Holocene*. Kathryn A. Bard, ed. Pp. 81–105. Napoli: Istituto Universitario Orientale.
- Fattovich, Rodolfo, and Kathryn Bard, L. Petrassi, and V. Pisano
2000 The Aksum Archaeological Area: A Preliminary Assessment. Naples: Istituto Universitario Orientale.

- Flavell, R. B., A. P. Goldsbrough, L. S. Robert, D. Schnick, and R. D. Thompson
1989 Genetic Variation in Wheat HMW Glutenin Subunits and the Molecular Basis of Bread-making Quality. *Biotechnology* 7:1281–1285.
- Food and Agriculture Organization
1995 Sorghum and Millets in Human Nutrition. Food and Nutrition Series, no. 27. Rome: Food and Agriculture Organization.
- Garrad, A.
1999 Charting the Emergence of Cereal and Pulse Domestication in South-West Asia. *Environmental Archaeology* 4:67–86.
- Gashe, Berhanu A.
1985 Involvement of Lactic Acid Bacteria in the Fermentation of TEF (*Eragrostis tef*), an Ethiopian Fermented Food. *Journal of Food Science* 50:800–801.
- Gast, Marceau, and Jean Adrian
1965 Mils et Sorgho en Ahaggar Étude Ethnologique et Nutritionnelle. Paris: Arts et Métiers Graphiques.
- Gebrekidan, Berhane, and Belainesh GebreHiwot
1982 Sorghum *Injera* Preparations and Quality Parameters. Proceedings of the International Symposium on Sorghum Grain Quality. L. W. Rooney and D. S. Murty, eds. Pp. 55–66. Patancheru, India: ICRISAT.
- Gero, Joan
1992 Feasts and Females: Gender Ideology and Political Meals in the Andes. *Norwegian Archaeological Review* 25(1):15–30.
- Giroux, Michael J., and Craig F. Morris
1998 Wheat Grain Hardness Results from Highly Conserved Mutations in the Friabilin Components Puroindoline a and b. Proceedings of the National Academy of Science 95:6262–6266.
- Goody, Jack
1982 Cooking, Cuisine and Class: A Study in Comparative Sociology. Cambridge: Cambridge University Press.
- Gourdin, W. H., and W. D. Kingery
1975 The Beginnings of Pyrotechnology: Neolithic and Egyptian Lime Plaster. *Journal of Field Archaeology* 2:133–150.
- Hamer, John H.
1987 Participation and Change among the Sadama of Ethiopia. Tuscaloosa: University of Alabama Press.
- Harlan, Jack R.
1992 Crops and Man. 2nd edition. Madison, WI: American Society of Agronomy.
- Harris, Major W. Cornwallis
1844 The Highlands of Aethiopia, vol. 3. London: Longman, Brown, Green and Longmans.
- Hastorf, Christine
1991 Gender, Space, and Food in Prehistory. In *Engendering Archaeology: Women and Prehistory*. Joan M. Gero and Margaret W. Conkey, eds. Pp. 132–159. Oxford: Blackwell.
- Hastorf, Christine, and Sissel Johannessen
1993 Pre-Hispanic Political Change and the Role of Maize in the Central Andes of Peru. *American Anthropologist* 1:115–138.
- Hillman, Gordon C.
2000 Abu Hureyra 1: The Epipalaeolithic. In *Village on the Euphrates*. A. M. T. Moore, G. C. Hillman, and A. Legge, eds. Pp. 327–398. Oxford: Oxford University Press.
- Hobbs, Joseph J.
1989 Bedouin Life in the Egyptian Wilderness. Austin: University of Texas Press.
- Isaacs, Jennifer
1987 Bush Food Aboriginal Food and Herbal Medicine. McMahon's Point, Australia: Weldons.
- Jacob, Heinrich E.
1945 Six Thousand Years of Bread its Holy and Unholy History. New York: Doubleday, Doran and Co.
- Kaplan, Irving, Mark Farber, Barbara Marvin, James McLaughlin, Harold D. Nelson, and Donald Whitaker
1971 Area Handbook for Ethiopia. Washington, DC: U.S. Government Printing Office.
- Kobishchanov, Yuri M.
1979 Axum. London: Pennsylvania State University Press.
- Kramer, Carol
1982 Village Ethnoarchaeology Rural Iran in Archaeological Perspective. New York: Academic Press.
- LaPena, Frank R.
1978 Wintu. In *Handbook of North American Indians*, vol. 8: California. William C. Sturtevant, ed. Pp. 324–340. Washington, DC: Smithsonian Institution Press.
- Larsen, Hjalmar
1936 On Baking in Egypt during the Middle Kingdom. *Acta Archaeologica* 7:51–57.
- Leach, Helen M.
1999 Food Processing Technology: Its Role in Inhibiting or Promoting Change in Staple Foods. In *The Prehistory of Food*. Chris Gosden and Jon Hather, eds. Pp. 129–138. London: Routledge.
- Lechtman, Heather
1977 Style in Technology—Some Early Thoughts. In *Material Culture Styles, Organization, and Dynamics of Technology*. Heather Lechtman and Robert Merrill, eds. Pp. 3–20. New York: West Publishing.
- LeClerc, J. A., and L. H. Bailey and H. L. Wessling
1918 Milling and Baking Tests of Einkorn, Emmer, Spelt, and Polish Wheat. *Journal of the American Society of Agronomy* 10:215–217.
- Lemonnier, Pierre
1986 The Study of Material Culture Today: Toward an Anthropology of Technical Systems. *Journal of Anthropological Archaeology* 5:147–186.
- Lerche, Grith
1975 Notes on Different Types of "Bread" in Northern Scotland: Bannocks, Oatcakes, Scones, and Pancakes. In *Gastronomy: The Anthropology of Food Habits*. M. L. Arnott, ed. Pp. 327–338. The Hague: Mouton.
- Lévi-Strauss, Claude
1969 The Raw and the Cooked: Introduction to a Science of Mythology. New York: Harper-Row.
- Lewicki, Tedeusz
1974 West African Food in the Middle Ages. Cambridge: Cambridge University Press.
- Linton, Ralph
1924 The Significance of Certain Traits in North American Maize Culture. *American Anthropologist* 26:345–389.
- MacLagan, Ianthe
1994 Food and Gender in a Yemeni Community. In *Culinary Cultures of the Middle East*. Sami Zubaida and Richard Tapper, eds. Pp. 159–172. London: Tauris and Co.
- MacLean, Rachel, and Timothy Insoll
1999 The Social Context of Food Technology in Iron Age Gao, Mali. *World Archaeology* 31(1):78–92.
- MacRitchie, F.
1999 Wheat Proteins: Characterization and Role in Flour Functionality. *Cereal Foods World* 44(4):188–193.
- Martin, Louise, and Nerissa Russell
2000 Trashing Rubbish. In *Towards Reflexive Method in Archaeology: The Example at Çatalhöyük*. Ian Hodder, ed. Pp. 57–69. Oxford: Oxbow Books.
- McGaw, Judith A.
1996 Reconceiving Technology: Why Feminine Technologies Matter. In *Gender and Archaeology*. Rita Wright, ed. Pp. 79–110. Philadelphia: University of Pennsylvania Press.
- McIntosh, Susan Keech
1995 Pottery. In *Excavations at Jenne-Jeno, Hambarketolo, and Kaniana (Inland Niger Delta, Mali), the 1981 Season*. S. K. McIntosh, ed. Pp. 130–213. Berkeley: University of California Press.
- McQuitty, Alison
1984 An Ethnographic and Archaeological Study of Clay Ovens in Jordan. *Annual of the Department of Antiquities (Amman)* 28:259–67.
- Messing, Simon D.
1957a Further Comments on Resin-Coated Pottery: Ethiopia. *American Anthropologist* 59:134.
1957b The Highland-Plateau Amhara of Ethiopia. Ph.D. dissertation, Department of Anthropology, University of Pennsylvania.
- Miller, Naomi F., and Tristine Lee Smart
1984 Intentional Burning of Dung as Fuel: A Mechanism for the Incorporation of Charred Seeds into the Archeological Record. *Journal of Ethnobiology* 4(1):15–28.
- Munro-Hay, Stuart
1993 State Development and Urbanism in Northern Ethiopia. In *The Archaeology of Africa Food, Metals and Towns*. Thurstan

- Shaw, Paul Sinclair, Bassey Andah, and Alex Okpoko, eds. Pp. 609–621. New York: Routledge.
- National Research Council
1996 *Lost Crops of Africa*, volume 1: Grains. Washington, DC: National Academy Press.
- Nesbitt, R. Mark A.
1997 *Archaeobotanical Identification of Near Eastern Grass Caryopses*. Ph.D. dissertation, Institute of Archaeological Research, University College London.
- Nicholson, Paul T.
1989 *Experimental Determination of the Purpose of a "Box Oven."* In *Amarna Reports V*. Barry J. Kemp, ed. Pp. 241–252. London: Egypt Exploration Society.
- Nicolaisen, Johannes
1963 *Ecology and Culture of the Pastoral Tuareg*. Copenhagen: National Museum.
- Ochsenschlager, Edward
1974 *Mud Objects from Al-Hiba a Study in Ancient and Modern Technology*. *Archaeology* (27):162–174.
- Olmstead, Judith
1997 *Woman between Two Worlds*. Urbana: University of Illinois Press.
- Parker, M. L., and M. Urmeta, and R. M. Faulks
1989 *The Contribution of Flour Components to the Structure of Injera, an Ethiopian Fermented Bread Made from Tef (*Eragrostis tef*)*. *Journal of Cereal Science* 10:93–104.
- Parkyns, Mansfield
1966[1853] *Life in Abyssinia*. Great Britain: Frank Cass and Co.
- Pfaffenberger, Bryan
1992 *Social Anthropology of Technology*. *Annual Review of Anthropology* 21:491–516.
2001 *Symbols Do Not Create Meanings—Activities Do: Or, Why Symbolic Anthropology Needs the Anthropology of Technology*. In *Anthropological Perspectives on Technology*. Michael B. Schiffer, ed. Pp. 77–86. Albuquerque: University of New Mexico Press.
- Phillips, Jacke
2000 *Pottery and Clay Objects*. In *Archaeology at Aksum, Ethiopia, 1993–1997*, vol. 2. David W. Phillipson, ed. Pp. 389–399. London: British Institute of Eastern Africa.
- Phillipson, David W.
1993 *The Antiquity of Cultivation and Herding in Ethiopia*. In *The Archaeology of Africa Food, Metals and Towns*. Thurstan Shaw, Paul Sinclair, Bassey Andah, and Alex Okpoko, eds. Pp. 344–357. New York: Routledge.
1998 *Ancient Ethiopia*. London: British Museum Press.
- Phillipson, David W., ed.
2000 *Archaeology At Aksum, Ethiopia, 1993–7*, vols. 1 and 2. London: British Institute of East Africa.
- Pollock, Susan
1999 *Ancient Mesopotamia: The Eden That Never Was*. Cambridge: Cambridge University Press.
- Pomeranz, Yeshajahu, and J. A. Shellenberger
1971 *Bread Science and Technology*. Westport, CT: Avi Publishing Company.
- Prihoda, J., and J. Holas and J. Kratochvil
1993 *Rye Flour, Wholemeal Breads and Rye Breads*. In *Advances in Baking Technology*. Basil S. Kamel and Clyde E. Stauffer, eds. Pp. 20–37. London: Blackie Academic and Professional.
- Reid, Andrew, and Ruth Young
2000 *Pottery Abrasion and the Preparation of African Grains*. *Antiquity* 74:101–111.
- Rooney, L. W., and A. W. Kirleis, and D. S. Murty
1986 *Traditional Foods from Sorghum: Their Production, Evaluation, and Nutritional Value*. *Advances in Cereal Science Technology* 8:317–353.
- Roosevelt, Anna C.
1995 *Early Pottery in the Amazon*. In *The Emergence of Pottery Technology and Innovation in Ancient Societies*. William K. Barnett and John W. Hoopes, eds. Pp. 115–131. Washington, DC: Smithsonian Institution Press.
- Rowley-Conwy, Peter, and William J. Deakin and Charles H. Shaw
1997 *Ancient DNA from Archaeological Sorghum (*Sorghum bicolor*) from Qasr Ibrim, Nubia Implications for Domestication and Evolution and a Review of the Archaeological Evidence*. *Sahara* 9:23–36.
- Samuel, Delwen.
1989 *Their Staff of Life: Initial Investigations on Ancient Egyptian Bread Baking*. In *Amarna Reports V*. Barry J. Kemp, ed. Pp. 253–290. London: Egypt Exploration Society.
1999 *Bread Making and Social Interactions at the Amarna Workmen's Village, Egypt*. *World Archaeology* 31(1):121–144.
2000 *Brewing and Baking*. In *Ancient Egyptian Materials and Technology*. Paul T. Nicholson and Ian Shaw, eds. Pp. 537–576. Cambridge: Cambridge University Press.
- Serjeant, Robert B., and Ronald Lewcock, eds.
1983 *Sana' An Arabian Islamic City*. London: World of Islam Festival Trust.
- Schiffer, Michael B., and James M. Skibo
1987 *Theory and Experiment in the Study of Technological Change*. *Current Anthropology* 28(5):595–622.
- Shack, William A.
1974 *The Central Ethiopians*. London: International African Institute.
- Sheppard, Ronald, and Edward Newton
1957 *The Story of Bread*. London: Routledge and Kegan Paul.
- Shewry, Peter R., and Nigel G. Halford and Arthur S. Tatham
1989 *The High Molecular Weight Subunits of Wheat, Barley and Rye*. In *Oxford Surveys of Plant Molecular and Cell Biology Volume 6*. B. J. Miflin, ed. Pp. 163–219. Oxford: Oxford University Press.
- Shewry, Peter R., and Arthur S. Tatham, Francisco Barro, Pilar Barcelo, and Paul Lazzeri
1995 *Biotechnology of Breadmaking: Unraveling and Manipulating the Multi-Protein Gluten Complex*. *Biotechnology* 13:1185–1190.
- Shinnie, Peter, and Margaret Shinnie
1978 *Debeira West: A Medieval Nubian Town*. Warminster, UK: Aris and Philips.
- Simoons, Frederick J.
1960 *Northwest Ethiopia Peoples and Economy*. Madison: University of Wisconsin Press.
1994 *Eat Not This Flesh, Food Avoidances from Prehistory to Present*. 2nd edition. Madison: University of Wisconsin Press.
- Skibo, James M., and Michael Brian Schiffer
1995 *The Clay Cooking Pot: An Exploration of Women's Technology*. In *Expanding Archaeology*. James M. Skibo, William H. Walker, and Axel E. Nielsen, eds. Pp. 80–81. Salt Lake City: University of Utah Press.
2001 *Understanding Artifact Variability and Change: A Behavioral Framework*. In *Anthropological Perspectives on Technology*. Michael B. Schiffer, ed. Pp. 139–149. Albuquerque: University of New Mexico Press.
- Smeds, Helmer
1955 *The Ensete Planting Culture of Eastern Sidamo*. *Acta Geographica* 13(4):1–39.
- Spicer, Arnold
1975 *The History of Wheat and Bread*. In *Bread: Social, Nutritional and Agricultural Aspects of Wheat Bread*. Arnold Spicer, ed. Pp. 1–4. London: Applied Science Publishers.
- Stahl, Ann B.
1989 *Plant-Food Processing: Implications for Dietary Quality*. In *Foraging and Farming: The Evolution of Plant Exploitation*. David R. Harris and Gordon C. Hillman, eds. Pp. 171–194. London: Unwin Hyman.
- Stewart, Robert B., and Asnake Getachew
1962 *Investigations of the Nature of Injera*. *Economic Botany* 16:127–130.
- Swanton, John R.
1979 *The Indians of the Southeastern United States*. Washington, DC: Smithsonian Institution Press.
- Sweet, Louise E.
1960 *Tell Toqaan: A Syrian Village*. Ann Arbor: University of Michigan Press.
- Tannahill, Reay
1973 *Food in History*. New York: Stein and Day.
- Terrell, Edward, and Paul M. Peterson
1993 *Caryopsis Morphology and Classification in the Triticeae (Pooidae: Poaceae)*. Washington, DC: Smithsonian Institution Press.

- Tewolde, Berhan Gebre Egziabher, assisted by Yoseph Gebre Egziabher and Sue Edwards
1993 The impact of Modern Science and Technology on Human Rights in Ethiopia. *In* The Impact of Technology on Human Rights: Global Case-Studies. C. G. Weeramantry, ed. Pp. 189–242. Tokyo: United Nations Press.
- Van de Mieroop, Marc
1997 The Ancient Mesopotamian City. Oxford: Clarendon Press.
- Van der Leeuw, Sander
1993 Giving the Potter a Choice Conceptual Aspects of Pottery Techniques. *In* Technological Choices: Transformations in Material Culture since the Neolithic. Pierre Lemonnier, ed. Pp. 238–288. London: Routledge.
- Varisco, Daniel Martin
1997 Medieval Folk Astronomy and Agriculture in Arabia and the Yemen. Great Britain: Ashgate.
- Voigt, Mary M.
1983 Hajji Firuz Tepe, Iran: The Neolithic Settlement. Philadelphia: University of Pennsylvania Press.
- Walker, Craven H.
1933 The Abyssinian at Home. London: Sheldon Press.
- Weinstein, Matina
1973 Household Structures and Activities. *In* Anatolian Studies Journal of the British Institute of Archaeology at Ankara volume 23. David French, ed. Pp. 271–276. London: British Institute of Archaeology at Ankara.
- Weismantel, Mary J.
1988 Food, Gender, and Poverty in the Ecuadorian Andes. Philadelphia: University of Pennsylvania Press.
- Wilding, Richard F.
1989 The Pottery. *In* Excavations at Aksum. S. C. Munro-Hay, ed. Pp. 235–316. London: Memoirs of the British Institute in Eastern Africa, 10.
- Williams, P. C., and Fouad Jaby El-Haramain, W. Nelson, and Jit P. Srivastava
1988 Evaluation of Wheat Quality for the Baking of Syrian-Type Two-Layered Flat Breads. *Journal of Cereal Science* 7:195–207.
- Wright, Rita
1991 Women's Labor and Pottery Production in Prehistory. *In* Engendering Archaeology Women and Prehistory. Joan M. Gero and Margaret Conkey, eds. Pp. 194–223. Oxford: Blackwell.
- Wulff, Hans E.
1966 The Traditional Crafts of Persia. Cambridge, MA: MIT Press.
- Yamashita, Kosuke, and Masatake Tanaka, and Matsujiro Koyama
1957 Studies on the Flour Quality in Triticum and Aegilops. *Seiken Zihō* 8:20–26.
- Young, Ruth, and Gill Thompson
1999 Missing Plant Foods: Where Is the Archaeobotanical Evidence for Sorghum and Finger Millet in East Africa? *In* The Exploitation of Plant Resources in Ancient Africa. Marijke van der Veen, ed. Pp. 63–72. New York: Plenum.
- Zohary, Daniel, and Maria Hopf
2000 Domestication of Plants in the Old World. 3rd edition. Oxford: Oxford University Press.