Introduction

Handbook of Indigenous Foods Involving Alkaline Fermentation
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https://doi.org/10.1201/b17195-6

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Introduction

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"Tell me what you eat, and I'll tell you who you are" – the statement made by the renowned French gastronome Jean Anthelme Brillat-Savarin in 1825 indicates that food is the signature character of a culture. Food is one of the key parameters of knowing a culture and learning about the people who nurture it. The values and traditions transcend through generations in the context of cultural dishes. Food shapes our culture; what we eat, how we get it, who prepares it, who shares the table, how it is served, and who eats first give a reflection of that culture. Food is more than a necessity of physical survival; the philosophy centering what we eat and with whom we eat breaks the barriers between individuals, communities, and even countries. Food can influence the social relationships and act as a method of cultural exchange. As the world gets smaller, regional delicacies get nearer, less foreign.

Food by its nature begins to spoil the moment it is harvested or prepared. Food preservation enabled ancient man to settle and live in one place and form a community. Foods were preserved by a range of "ancient" methods such as sun-drying, salting, cooling, canning, smoking, and fermentation. Each culture preserved their local food sources using the same basic methods of food preservation. These basic approaches are still being practiced in principle although significant technical advancements have been made that enable us to preserve food and obtain high quality, in accordance with the requirements of the present-day consumer. We no longer consume all of the kill or harvest immediately, but preserve some for later use.

Fermentation is one of the oldest and most valued technologies used for food preservation. Probably no other process has had such an impact on the nutrition habits and food culture of mankind.

A food is considered fermented when one or more of its constituents have been acted upon by microorganisms to produce a considerably altered final product acceptable for human use (Van Veen, 1957). Campbell-Platt (1994) re-defined fermented foods as "those foods that have been subjected to the action of microorganisms or enzymes so that desirable biochemical changes cause significant modification to the food."

The word "fermentation" is derived from the Latin meaning "to boil," since the bubbling and foaming of early fermenting beverages seemed closely akin to boiling. Fermentation was not invented, rather discovered. Indigenous or traditional fermentation processes are those that have been used for centuries, even before those were recorded in history (Hesseltine and Wang, 1980). Most of these processes were developed long before the existence of microorganisms was recognized. The history of fermented foods goes back as far in time as inscriptions were available. The Sumerians, Egyptians, Babylonians, and Assyrians had a culture of using barley to produce beer. A cuneiform inscription on a Babylonian rock from 2800 BC showed a recipe for the production of beer (Borgstrom, 1968). Records of shoyu (soy sauce) and miso (soy paste) production in China go back to around 1000 BC with the transfer of knowledge of these production processes to Japan occurring around 600 AD (Yokotsuka and Sasaki, 1998). Early Europeans were known to be making flat sour dough bread from rye in 800 BC. Around 100 BC, there were 250 bread bakeries operating in Ancient Rome (Pederson, 1979). The practice of preparing and consuming dahi (curd), dadhavat (milk product), and kali (fermented rice) in India are as old as 2000 BC (Prakash, 1961).

The objectives of developing indigenous fermentation technology were to carry over supplies from the time of plenty to those of want. It transpires an essence of knowledge and wisdom, gained by experience and based on trial and error. People might not be able to explain what was going on during storage and processing in terms of scientific language, but they certainly knew what they had to do to get the desired product (Dietz, 1984). The indigenous fermentation techniques pass as a trade from older to younger generations in the families. These methods were based on interdependent factors such as available raw materials, climatic zones, proximity to the sea, available energy source, topography, culture, and religion.

Besides preservation (extension of shelf life) indigenous fermented foods are prized for the following advantages: (a) enhancement of nutritional quality (such as vitamins, sterols, and essential amino acids and fatty acids during the production of Japanese natto), (b) increase in digestibility (for example, during Indonesian tempeh and natto production proteins are broken down to amino acids), (c) destruction of undesirable components (such as oligosaccharides, trypsin inhibitors, and hemagglutinin during the production of Indian kinema), (d) changing the physical state of a substrate (as in making tempeh, loose soybean cotyledons are bound together to make a solid cake, or in making shoyu, solid substrates are converted to a liquid product), (e) production of color (as in making Chinese angkak, rice is fermented with mold resulting in a brilliant purple-red color), (f) providing dietary variety where choice of food is limited, (g) masking of undesirable flavor (as in natto making the objectionable beany flavor gets removed) or production of improved flavor and aroma (as in cheese making), (h) fuel efficiency (where little or no heat is required, as in Korean kimchi production), (i) enhancement of medicinal values (as in Russian koumiss and kvass, which are used to treat pulmonary tuberculosis and cancer, respectively), and (j) ease in transport.

Over the centuries, fermentation has evolved and been refined and diversified. Today, a wide variety of food products is derived from this technology in households, small-scale food industries as well as in large enterprises.

In the case of alcoholic or acidic fermentations, the alcohol or acid content along with pH determines which microorganisms can survive, multiply, and carry out the fermentation. The presence or absence of oxygen also exerts an essential steering influence on which microorganisms develop sequentially. However, in case of alkaline fermentations, an alkaline pH in combination with ammonia controls the fermentation (Steinkraus, 1991). The increase in pH is due to the extensive hydrolysis of proteins to peptides to amino acids and finally liberating ammonia (Figure 1.1). While alcoholic fermentations are dominated by yeasts and acidic fermentations are dominated by lactic or acetic acid bacteria, respectively, alkaline fermentations are dominated by *Bacillus* spp., principally *Bacillus subtilis*. The alkaline pH makes the substrate adverse to the undesirable microorganisms (Steinkraus, 1996). Although in most cases the final pH would reach

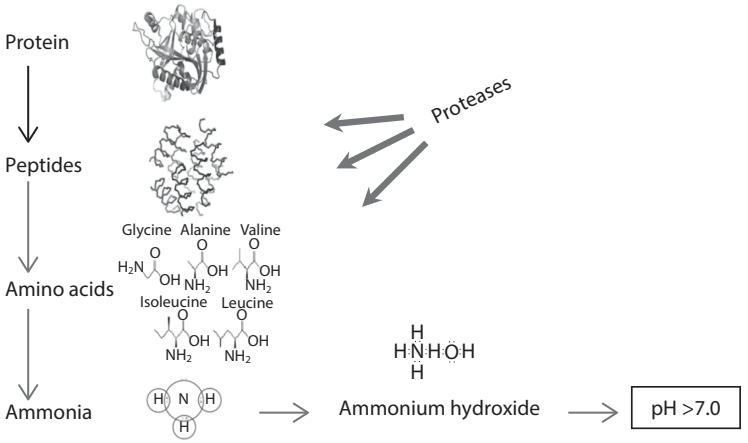

Figure 1.1 The principle of alkaline food fermentations.

values higher than 7, some foods, for example, fermented fish pastes and salt-rising bread, the pH remains restricted within 7.0 despite extensive hydrolysis of proteins because of a strong buffering capacity of the substrate and production of profuse amount of organic acids.

Alkaline-fermented foods (AFFs) constitute a group of less-known food products that are widely consumed almost exclusively in Asian and African countries (Figure 1.2). These are made using a range of protein-rich substrates. Interestingly, soybean-derived AFFs are exclusively confined to Asia; hence, Asia is considered as the

Figure 1.2 Locations indicating use of indigenous foods involving alkaline fermentation.

soybean-derived AFF belt. This is because the first domestication of soybean has been traced to the eastern half of North China in 1000 BC or perhaps a bit earlier. Soybeans were grown for centuries in Asia mainly for their seeds. These were used in preparing a large variety of fresh, fermented, and dried food products that were considered indispensable to oriental diets. In Africa, in the absence of soybeans, seeds of several wild as well as cultivated legumes and non-leguminous plants and leaves began to be used as the source of AFFs. Fish serves as an ingredient for AFF as well; fermented fish pastes and sauces are used in the coastal areas of mainly Asian countries.

The present treatise is a reference-cum-textbook documenting the AFFs that we have spotted, their indigenous preparation processes, properties, culinary use, nutritional quality, safety, and (potential) benefits. Here, many original and reference works from the authorities of their respective areas have been coordinated. This handbook bears the character of a textbook because it clarifies the principles of the processes, properties and role of the microbiota involved, the biochemical modifications, and their impact on perceived quality and benefits. Also, we have designed the book with a view on the future, challenges ahead on the road to up-scaling of production and industrial control of safety and quality. This happens to be the first book dedicated solely on AFFs, expanding the idea of Steinkraus (1996), who, in the preface of the second edition of his book, remarked "Since the first edition, it has become clear that there is a new, very important category of fermentations – those involving an alkaline reaction. I have prepared a chapter on the subject because these fermentations are likely to become even more important as scientists realize that, in addition to acidity and alcohol content, alkalinity is another way of controlling fermentations."

The content of the book is presented in eight more chapters. The diversity of indigenous fermented foods involving an alkaline reaction has been discussed in Chapters 2 and 3. The following Chapter 4 deals with the taxonomy, ecology, physiology, and genetics of predominant microorganisms occurring in AFFs. In Chapter 5, an attempt has been made to elucidate how the microorganisms or enzymes transform the raw ingredients into flavorsome, nutritious, and healthy products. Chapter 6 discusses the safety aspects of AFFs. What are the challenges associated with the technological aspects in modernizing AFFs

and how those hurdles could be crossed are focused in Chapter 7. The following chapter discusses the valorization of AFFs or the associated dominant microorganisms. Chapters 9 and 10 are concerned with the prospects and outlook (research needs), respectively, on AFFs.

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