Products from traditional grains in Africa

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Background

Africa is rich in a wide range of less explored grain species, including sorghum and different types of millets. These grains represent an important source of dietary proteins, carbohydrates, fibre, vitamins, and minerals for mostly poor African people. These cereal grains are fermented into a large number of foods and beverages with improved texture, taste, aroma, keeping quality, nutritional value and digestibility, and microbial quality and with reduced antinutrient contents. In this article, we review some of the major traditional foods in Africa and discuss the research and development needed to bring those to sustainable high-value functional foods.

Traditional Cereal Grains in Africa

Cereal grains provide the major energy source for the vast majority of African people. The main traditional cereal grains grown and consumed in sub-Saharan African countries include sorghum and millets, fonio, teff, as well as some African maize, barley and oat cultivars [1]. In this paper, we focus on African sorghum and millets and some of the traditional foods made from them [2].

Sorghum (*Sorghum bicolor*) is an important food crop for Africa and ranks 5th in global cereal foods after wheat, rice, maize, and barley. There is a wide range of cultivars and germplasm in Africa, including white, yellow, brown and red seeded cultivars. Some of the dark coloured varieties contain condensed tannins, which are strong antioxidants but may have adverse nutritional value in case of limited iron availability. Red coloured varieties are grown because of better pest and bird resistance and better performance during malting. The red colour, of the testa, is appreciated in certain foods and in cases when it is not desirable, it is removed by decortication.

In addition to sorghum, millets, including pearl millet (*Pennisetum glaucum*) and finger millet (*Eleusine coracana*), are widely used in Africa. Of the other grasses related to sorghum and millet, we should mention teff and white fonio and black fonio. Teff (*Eragrostis tef*) is widely cultivated and used in Ethiopia and Eritrea and is used to make injera, which is a famous food that is now sold in immigrant restaurants in Europe and USA. *Digitaria exilis* (acha, fonio or hungry rice) and *Digitaria iburua* (iburu, black fonio or petit mil) are eaten as boiled kernels or as thin and stiff porridges similar to those of sorghum and millets discussed below.

Sorghum and millets contain relatively high levels of protein (7-11%) and fat (1.3-4.8%) [3], and are rich in B vitamins (niacin, B17, B6 and folic acid) and minerals (calcium, iron, potassium, magnesium, and zinc). Sorghum and millets are used, fermented or unfermented, in the preparation of a variety of attractive and nutritious

traditional foods and alcoholic and non-alcoholic beverages.

Fermented and non-fermented foods [4,5]

Grits, furah and couscous. Grits made from decorticated sorghum and pearl millet and cooked like rice are called lehta wagen in Botswana, nifro in Ethiopia, oka baba in Nigeria, and sori in Mali. In Northern Nigeria and Niger, furah is a highly viscous paste prepared by steam cooking of moist flour balls of pearl millet, followed by pounding in a mortar and rolling in millet flour. In West Africa, sorghum couscous, a steam granulated product, is made in a similar way to the wheat product of North Africa.

Stiff porridges. Acidic (pH 4), neutral (pH 6.5), and alkaline porridges (pH 8) are prepared from whole or decorticated sorghums and millets. Examples of neutral stiff porridges include bita (Niger), mafo (Somalia), mosokwane (Botswana), sadza (Zimbabwe), tõ (Nigeria, Ghana), boule (Chad, Mauritania), and ugali (Kenya, Uganda, Tanzania). Acidic porridges are made by sour dough fermentation (e.g. aceda in Sudan, dalaki in Nigeria, ting or bogobe in Botswana, and umqo, umphokoqo, and phutu in South Africa) or by mixing flour with extracts from acidic fruits, e.g. tamarind while alkaline porridges are obtained by the addition of potash wood ashes (e.g. tô in Mali). In Burkina Faso, tô is made acidic while it is made alkaline in Mali, and parts of Senegal and Guinea.

Thin porridges. Thin porridges can also be acidic, neutral or alkaline. Examples of thin porridges include bota or mahewu (Zimbabwe), edi (Uganda), motogo we tiny (Botswana), nasha (Sudan), ogi or koko (Nigeria, Ghana), rouye (Niger, Senegal), and uji (Kenya, Tanzania). Sorghum malt, pea powders and groundnut are sometimes added to improve the nutritional value of traditional porridges. Bushera (Uganda) is an example of a sour porridge prepared from malted and unmalted sorghum.

Breads. Sorghum and millets are not suitable for making raised bread because they do not contain gluten. Alternatively, a number of fermented bread types are prepared from these cereals in Africa. Kisra (pH 3.5) is very thin bread made in Sudan from fermented sorghum or millet or their mixtures. A thin batter is baked on a hot pan or a griddle for 30-40 seconds to produce a white kisra from decorticated kernels or dark kisra from millet and coloured sorghum cultivars. Injera is internationally popular Ethiopian/Eriterian porous bread (*ca* 6 mm thick) made primarily from teff but can also be made from sorghum and millets. For the preparation of injera preparation, flour is fermented for about 48 hours and then mixed with an equal amount of gelatinized fermented flour to hasten secondary fermentation. The batter obtained is allowed to stand for 2-3 hours to bubble before being poured onto a hot griddle in a centrifugal manner from the edge to the centre, covered with a lid, and allowed to bake for 1-3 minutes.

Beverages. A number of alcoholic and non-alcoholic beverages are prepared from sorghum and millets in Africa. Beer is made from brewed sorghum and millet throughout the non-Islamic parts of Africa. Beers containing unfiltered particles reserve minerals and vitamins. Traditional opaque beer of low alcohol content is called chibuku (Zimbabwe), dolo (Mali and Burkina Faso), impeke (Burundi), merrisah (Sudan), pito (Nigeria) and talla or tella (Ethiopia).

Obiolor is a fermented non-alcoholic drink made by fermentation of a concentrated hot water extract of sorghum-millet (4:1, w/w) malt mixture. A very thin form of kisra made from fermented fine white sorghum endosperm, spread as a very thin solution and

baked on a mildly hot griddle is mixed with cold water and sugar to provide a refreshing drink called abré or abreh in Sudan. Another Sudanese drink, hulu-mur or abré Ahmar, is prepared by cooking an ungerminated sorghum flour (variety *feterita*) fermented for 24 hours into a thick porridge (aceda), mixing it when cooled with an equal amount of sorghum malt flour, red hibiscus extracts and spices, and allowing them to undergo simultaneous amylolysis and fermentation for a period of 3 days in a closed jar. The resulting red-coloured sweet-sour fermented dough is baked like a thick kisra on hot-plate. The resulting bread sheets are dried, stored, and occasionally soaked in water and sugar and cooled to provide a refreshing drink, especially in the fasting month of Ramadan.

***Biscuits and snacks*.** Sorghum and millet flours can be used in the preparation of a number of biscuits and snacks that can be useful for individuals with gluten intolerance. Sorghum snacks may include steamed products, leavened products, shallow-fat-fried products, and popped-sorghum.

Fermentation biotechnology in Africa

Africa has a long history of knowledge in food fermentation biotechnology, which still needs to be explored and exploited. It is well known that fermentation adds several benefits to the food including:

1. generation and enhancement of flavors, aromas, and textures,
2. preservation of nutrients,
3. enhancement of the bioavailability of essential amino acids and vitamins, and
4. detoxification of harmful components, and
5. minimization of cooking times and fuel requirements.

Fermentation practices in Africa are largely based on inherited small scale home and village experiences, generally time and labour intensive and with limited knowledge and control of the microflora and enzymatic activities involved in the processes (Haard *et al*,. 1999). The fermentation practices and microfloral populations associated with it needs to be systematically studied and documented to aid in the development of standardised starter cultures necessary for future industrial production. An important aspect in connection with this is the fair and proper handling of the intellectual property rights especially when it comes to partnership with less educated and less aware villagers.

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