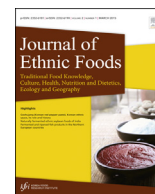




Contents lists available at ScienceDirect

Journal of Ethnic Foods

journal homepage: <http://journalofethnicfoods.net>

Review article

Naturally fermented ethnic soybean foods of India



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ARTICLE INFO

Article history:

Received 15 January 2015

Received in revised form

22 January 2015

Accepted 6 February 2015

Available online 26 February 2015

Keywords:

Bacillus

ethnic foods

kinema

naturally fermented soybeans

ABSTRACT

Kinema, *hawaijar*, *tungrymbai*, *bekang*, *aakhone*, and *peruyaana* are naturally fermented ethnic soybean foods of India; they are popular among the Mongolian-origin races in the Eastern Himalayas. *Bacillus subtilis* is the dominant functional bacterium in all naturally fermented soybean foods of these regions. Although there is a good demand for ethnic fermented soybean foods among local consumers in north-east India, the production is limited to household level. A ready-to-use pulverized starter culture for *kinema* production can be introduced to *kinema*-makers or similar sticky fermented soybean foods of north-east India and adapted to local conditions for additional income generation. Ethnic fermented soybeans are one of the major food resources in the Eastern Himalayas; they supplement inexpensive, high-digested plant protein in the local diet with low fat/cholesterol content and high nutritive value as well as antioxidant and other health-promoting properties.

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1. Introduction

In the Eastern Himalayas, soybean [*Glycine max* (L.) Merrill, family Leguminosae, sub-family Papilionaceae] is grown under rain-fed conditions in upland terraces as a sole crop as well as a mixed crop with rice and maize up to an elevation of 1500 m (Fig. 1). Soybean, locally known as *bhatmas* in Nepali language, is traditionally used to prepare various fermented and nonfermented recipes in the Eastern Himalayan regions of Nepal, India, and Bhutan [1]. Soybean was probably introduced into India from China through the Himalayas several centuries ago and some believe that soybeans were also brought via Myanmar by traders from Indonesia [2]. Two indigenous varieties of soybeans “yellow cultivar” and “dark brown cultivar” (Fig. 1) are grown between May and June and harvested in November. Locally grown soybeans are harvested, and the dry seeds of soybeans are naturally fermented into a flavorful and sticky product in eastern parts of Nepal, Darjeeling hills, Sikkim, north-eastern regions of India, and southern parts of Bhutan close to the Mongolian races. Some of the common ethnic nonsalted sticky fermented soybean foods of the Eastern Himalayas are *kinema* (Nepal, Darjeeling hills, Sikkim, and south Bhutan), *hawaijar* (Manipur), *tungrymbai* (Meghalaya), *bekang* (Mizoram), *aakhone* (Nagaland), and *peruyaana* (Arunachal

Pradesh) (Table 1). This article will examine the characteristics, microbiology, and health benefits of *kinema* as well as *hawaijar*, *tungrymbai*, *bekang*, *aakhone*, and *peruyaana*.

2. Kinema production

Kinema is an ethnic fermented soybean food of the Nepali community in the Eastern Himalayas; it is a sticky, slightly alkaline product with a slight ammoniacal flavor that is produced by natural fermentation. It is a whole-soybean fermented food with a sticky texture, gray tan color, and is flavorful [8]. During traditional production of *kinema*, the small-sized (~6 mm) “yellow cultivar” soybean dry seeds are selected, washed, and soaked overnight (8–10 h) in water. Soaked soybean seeds are taken out and put into a container with fresh water, and boiled for 2–3 hours until they are soft. Excess water is drained off and the cooked soybean seeds are placed into a wooden mortar (locally called “okhli”) and are cracked lightly using a wooden pestle (locally called “muslo”) to split the cotyledons. This practice of cracking the cooked seeds of soybeans is observed only during *kinema* production, unlike other similar fermented soybean foods of Asia and north-east India, probably to increase the surface area for speed fermentation by aerobic spore-forming *Bacillus* spp. Approximately 1% of firewood ash is added directly to the cooked soybeans and mixed thoroughly to maintain the alkaline condition of the product. Soybean grits are placed in a bamboo basket lined with locally grown fresh fern called (*Glaphylopteriolopsis erubescens*). The basket is covered with

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Fig. 1. Soybean cultivation in Sikkim, India.

a jute bag and left to ferment naturally at ambient temperatures (25–40°C) for 1–3 days above an earthen kitchen oven (Fig. 2). During summer, the fermentation time may require 1–2 days whereas in winter it may require 2–3 days. In eastern Nepal, local consumers prepare dark brown local varieties of soybean seeds rather than yellow-colored seeds for making *kinema* [9]. Similarly, they commonly use *Ficus* (fig plant) and banana leaves as wrapping materials instead of fern fronds. Other methods remain the same. Completion of fermentation is indicated by the appearance of a white viscous mass on the soybean seeds and the typical *kinema* flavor with a slight odor of ammonia.

The shelf-life of freshly prepared *kinema* (Fig. 3) is 2–3 days in summer and a maximum of 1 week in winter without refrigeration.

It may be prolonged by drying in the sun for 2–3 days. Dried *kinema* is stored for several months at room temperature. Preparation of *kinema* varies from place to place and is still restricted at the household level. It is interesting to note that mountain women use their indigenous knowledge of food production to prepare *kinema*. This unique knowledge of *kinema*-making has been protected as an hereditary right and passed from mother to daughter, mostly among the Limboo.

Kinema is eaten as curry with steamed rice. The delicacy of *kinema* can be perceived by its appealing flavor and sticky texture. Fresh *kinema* is fried in vegetable oil, with chopped onions, tomatoes, and turmeric powder. Salt and sliced green chillies are added and fried for 3–5 minutes. A little water is added to make

Table 1
Naturally Fermented Soybean Foods of India.

Product	Sensory features and nature	Microorganisms	States in India	References
<i>Aakhone</i>	Alkaline, sticky, paste	<i>B. subtilis</i> , <i>Proteus mirabilis</i>	Nagaland	Singh <i>et al.</i> (2014) [3]
<i>Bekang</i>	Alkaline, sticky, paste, curry	<i>B. subtilis</i> , <i>B. brevis</i> , <i>B. circulans</i> , <i>B. coagulans</i> , <i>B. licheniformis</i> , <i>B. pumilus</i> , <i>B. sphaericus</i> , <i>Lysinibacillus fusiformis</i>	Mizoram	Chettri and Tamang (2015) [4]
<i>Hawaijar</i>	Alkaline, sticky	<i>B. subtilis</i> , <i>B. licheniformis</i> , <i>B. amyloliquefaciens</i> , <i>B. cereus</i> , <i>Staph. aureus</i> , <i>Staph. sciuri</i> , <i>Alkaligenes</i> sp., <i>Providencia rettgers</i> , <i>Proteus mirabilis</i>	Manipur	Jeyaram <i>et al.</i> (2008) [5], Singh <i>et al.</i> (2014) [3]
<i>Kinema</i>	Alkaline, sticky; curry	<i>B. subtilis</i> , <i>B. licheniformis</i> , <i>B. cereus</i> , <i>B. circulans</i> , <i>B. thuringiensis</i> , <i>B. sphaericus</i> , <i>Ent. faecium</i> , <i>Cand. parapsilosis</i> , <i>Geotrichum candidum</i>	Sikkim, Darjeeling hills, Assam	Sarkar <i>et al.</i> (1994) [6], Tamang (2003) [7]
<i>Peruyaan</i>	Alkaline, sticky, side dish	<i>B. subtilis</i> , <i>B. amyloliquefaciens</i> , <i>Vagococcus lutrae</i> , <i>Ped. acidilactici</i> , <i>Ent. faecalis</i>	Arunachal Pradesh	Singh <i>et al.</i> (2014) [3]
<i>Tungrymbai</i>	Alkaline, sticky, curry, soup	<i>B. subtilis</i> , <i>B. licheniformis</i> , <i>B. pumilus</i>	Meghalaya	Chettri and Tamang (2015) [4]

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