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Indigenous knowledge of Northeast women on production of ethnic fermented soybean foods

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Several ethnic communities of Northeast India have invented the traditional technology of converting protein rich soybeans into flavoured fermented food with easy digestibility and bio-nutrients. This is exclusively carried out by the ethnic women in Sikkim, Manipur, Meghalaya, Nagaland, Mizoram and Arunachal Pradesh. Worth native knowledge of these women has been documented and six sticky fermented soybean foods have been listed out which include *kinema, hawaijar, tungrymbai, aakhone, bekang* and *peruyyan*.

Keywords: Ethnic fermented soybean foods, Fermented foods, Northeast India, *Kinema, Hawaijar, Tungrymbai, Aakhone, Bekang, Peruyyan*

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The traditional knowledge of the ethnic women of Northeast India has been greatly appreciated and recognized in the society. Their wisdom and native skills spans from cultivation to harvesting of agricultural produce, fermentation to culinary skills and production to marketing for local economy subsistence. Dry seeds of local soybeans are fermented into edible and flavoured product in Northeast India mainly due to bio-nutrients and flavour development of consumer's choice through innovative skill of mountain women. Soybean [*Glycine max* (L.) Merrill] is a summer leguminous crop, 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 1,500 m in Northeast. In Northeast, due to Mongolian population, consumption of different recipes of soybean is a tradition. Soybean is traditionally used to prepare various fermented and non-fermented recipes in the Eastern Himalayan regions of Nepal, India and Bhutan, which is primarily for improvement of sensory quality and nutritional value, rather than preservation[1]. Some of the common ethnic non-salted, sticky fermented soybean foods of Northeast India are *kinema* of *Nepali*, *hawaijar* of *Meitei*, *tungrymbai* of *Khasi*, *bekang* of *Mizo*, *aakhone* of *Sema Naga* and *peruyaan* of *Apatani*. The paper is aimed to document the role of Northeast Indian women on their traditional knowledge of soybean fermentation and culinary skills.

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Kinema

Kinema is a sticky fermented soybean food with ammoniacal flavour produced exclusively by *Nepali* women belonging to *Limboo* and *Rai* castes of Sikkim, Darjeeling hills, east Nepal and Bhutan[2]. It is similar to other Asians *Bacillus*-fermented sticky soybean foods such as *pe poke* of Myanmar, *natto* of Japan, *chungkukjang* of Korea and *thua nao* of northern Thailand. Yellow varieties of soybeans are soaked overnight and boiled until they are soft. Excess water is drained off and the cooked seeds are cracked lightly by a wooden pestle (*muslo*) in a wooden mortar (*okhli*) to split the cotyledons. (This step of cracking soybeans is recorded only in *kinema* process to increase the surface areas for speed fermentation by aerobic spore-forming *Bacillus* sp). About 1% of firewood ash is added to the cooked soybeans to maintain the alkaline condition of the product. (Addition of ash is also exclusively observed in *kinema* production, to make the alkaline conditions). Soybean grits are placed in a bamboo

basket lined with locally grown fresh fern (*Glaphylopteriolopsis erubescens*). This is covered in a jute bag and left to ferment naturally at ambient temperatures (20-35ºC) for 1-2 days above an earthen oven kitchen (Fig. 1). Completion of fermentation is indicated by the appearance of a white viscous mass on the fermenting soybeans and development of slight odour of ammonia.

Shelf-life of fresh *kinema* is for 2-3 days in summer and 5-7 days in winter without refrigeration. It can be preserved for several months by drying in the sun for 2-3 days. This native skill of *kinema*-making has been protected as a hereditary right and passed from mother to daughter, mostly among the *Limboo*. *Kinema* is eaten as a curry with boiled rice. Delicacy of *kinema* can be perceived by its appealing flavour and sticky texture. Fresh *kinema* is fried in edible oil, with chopped onions, tomatoes and turmeric powder. Salt and sliced green chilies are added and fried for 3-5 min. A little water is added to make thick gravy, and cooked for 5-7 min then the *kinema* curry is served with boiled rice. Dried *kinema* is sometimes mixed with leafy vegetables to make a mixed curry.

Kinema is sold in all local periodical markets, locally called *haats* of Darjeeling hills and Sikkim by rural women. Usually, it is sold by volume taking in a small silver mug containing 150-200 gm of *kinema*, and pack in the leaves of fig plant (*Ficus hookeriana*),

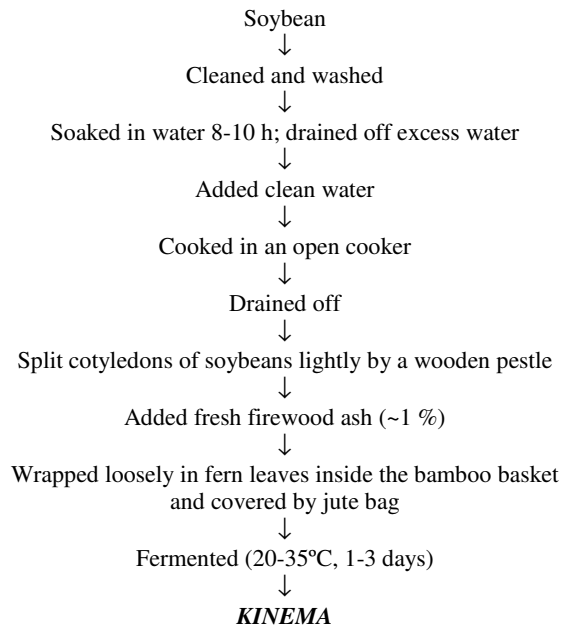

Fig. 1–*Kinema* production in Darjeeling hills and Sikkim by *Limboo* women

locally called *nevara*, and then tied loosely by straw. *Kinema* is produced by natural bacterial fermentation. The dominant and functional bacterium is rod-shaped endospore-forming *Bacillus subtilis* (*kinema* strains) along with *Enterococcus faecium*[3,4]. Yeasts *Candida parapsilosis* and *Geotrichum candidum* have also been isolated from market samples of *kinema*[5].

Hawaijar

Hawaijar is a traditional sticky fermented soybean food of Manipur, similar to *kinema*. It is prepared by *Meitei* women. Local varieties of small-sized soybeans are boiled without soaking, dewatered and packed loosely in a small bamboo basket lined with leaves of fig plant (*Ficus hispida*), or banana leaves. The basket is then kept in kitchen for natural fermentation for 3-5 days (Fig. 2). Production of typical ammonia flavour and mucilage in or on the cooked soybean seeds are the indications of good quality *hawaijar*. *Hawaijar* is eaten directly or used as a condiment or made into curry. *Hawaijar* is commonly sold in local markets throughout Manipur by the *Meitei* women. *Bacillus subtilis, B. licheniformis, B. cereus, Staphylococcus aureus, S. sciuri, Alkaligenes* sp*, Providencia rettgeri* have been isolated from market samples[6].

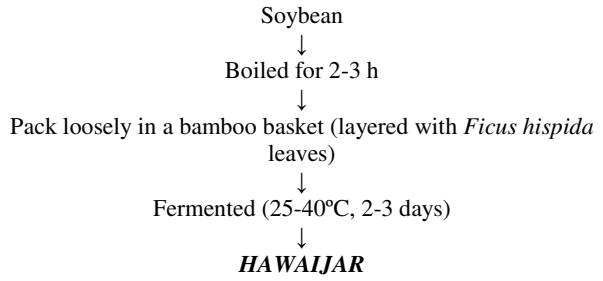

Fig. 2–*Hawaijar* production in Manipur by *Meitei* women

Tungrymbai

Tungrymbai, an ethnic fermented soybean food of *Khasi* in Meghalaya, is prepared by *Khasi* women[7]. Local soybean seeds are cleaned, washed and soaked in water for about 4-6 hrs. The outer skin is removed before cooking and is cooked for 1 hr till all the water is absorbed. Cooked beans are allowed to cool, packed with leaves of *lamet* (*Clinogyne dichotoma*) lined in the bamboo basket and covered by a thick cloth. The covered basket is kept over the fireplace for 3-5 days to get *tungrymbai* (Fig. 3). *Tungrymbai* is transferred from leaves to bowl, mashed and put into a container with water and boil till water evaporates,

and stir continuously. It is mixed with fried onion, garlic, ginger, chili, grinded black sesame and salt, and a thick curry is made and served as side-dish. *Khasi* women sell *tungrymbai* in the vegetable market of Meghalaya. *Bacillus subtilis* and *Bacillus* sp have been isolated from market samples[22].

Soybean
↓
Soaked for 4-6 h
↓
Outer skin removed by rubbing gently between the palms
↓
Cooked and dewatered
↓
Cool down to room temperature
↓
Packed in bamboo basket lined with leaves
↓
Basket is loosely covered with leaves and thick cloth
↓
Fermented (25-40^0 C, 3-5 days)
↓
TUNGRYMBAI

Fig 3–Preparation of *tungrymbai* in Meghalaya by *Khasi* women

Aakhone

Aakhone or *Axone* is an ethnic sticky fermented soybean food of Nagaland. It is prepared by *Sema Naga* women. Cooked soybeans are wrapped in leaves of banana or *Phrynium pubinerve* Blume (Marantaceae) or *Macaranga indica* Wight (Euphorbiaceae) and are kept above the fireplace to ferment for 5-7 days[8]. Fresh *aakhone* can be eaten within a week. It is preserved for longer periods by molding into paste, made into cakes and is dried above the fireplace, or in the sun and stored in containers for future consumption (Fig. 4). Fresh *aakhone* is made as pickle by mixing with chili, tomato and salt. The dried *aakhone* cakes are cooked with pork and are eaten as side-dish with boiled rice. *Sema Naga* women sell *aakhone* in local vegetable markets in Nagaland. *Bacillus subtilis* and *Bacillus* sp have been isolated from market samples[22].

Soybean
↓
Washed with water
↓
Boiled for 1-2 h
↓
Excess water drained off and cooled
↓
Coked soybean placed in container lined with banana leaves and covered loosely
↓
Kept near earthen-oven in kitchen
↓
Fermented (20-35^0 C, 6-8 days)
↓
AAKHONE

Fig. 4–Preparation of *aakhone* in Nagaland by *Sema* women

Bekang

Bekang is a fermented soybean food of Mizoram, prepared by *Mizo* women. Small sized soybeans are soaked for 10-12 hrs, boiled and wrapped in leaves of *Calliparpa aroria* (locally called *nuhlhan* in *Mizo* language) or leaves of *Phrynium* sp (locally known as *hnahthial*), and kept inside the bamboo basket. It is then kept near the earthen oven and fermented for 3-4 days. Sticky beans with ammmoniacal flavour are produced to get *bekang* (Fig. 5). It is consumed as curry with rice. *Bekang* is sold in local markets by *Mizo* women. *Bacillus subtilis* and *Bacillus* sp have been isolated from market samples[22].

Soybean
↓
Soak overnight
↓
Boil for 1-2 h
↓
Dewatered
↓
Wrapped in leaves
↓
Fermented (20-35^0 C, 3-4 days)
↓
BEKANG

Fig 5–Preparation of *bekang* in Mizoram by *Mizo* women.

Peruyyan

Peruyyan is an ethnic fermented soybean food prepared by *Apatani* women in Arunachal Pradesh. Soybean is washed with water and cooked till the beans become soft. The excess water is drained off and is cooled for sometime. The cooked beans are kept in bamboo basket (vessel) lined with ginger leaves, locally called as *taki yannii*. The basket is loosely covered with ginger leaves and is kept on the wooden rack above the fire place for fermentation. Between 3-5 days, the stickiness of the product is checked, and if the product is sticky enough then the product is ready for consumption (Fig. 6). It is consumed as a side dish with rice. It is sold in the market by *Apatani* women. *Bacillus subtilis, Bacillus* sp, lactic acid bacteria have been isolated from market samples[22].

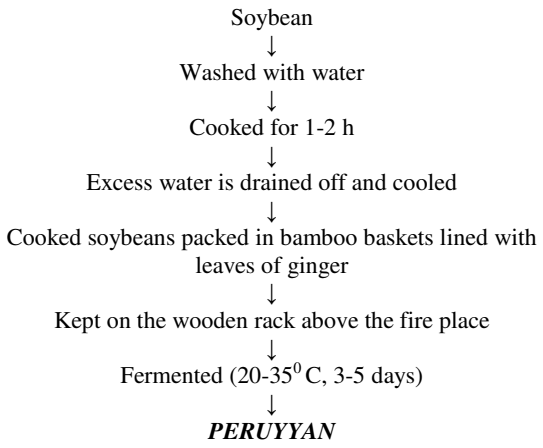

Fig 6–*Peruyyan* preparation in Arunachal Pradesh by *Apatani* women

Bio-nutrients in ethnic fermented soybeans

Ethnic fermented soybean food is the cheapest source of plant protein as compared to animal and milk products on the basis of protein cost per kg, which is easily accessible to rural poor of Northeast region. During *kinema* production, soya-proteins are hydrolyzed by proteolytic enzymes produced by *Bacillus subtilis* into peptides and amino acids which enhance digestibility in local diet[9]. A remarkable increase in water-soluble nitrogen and trichloroacetic acid (TCA)-soluble nitrogen contents are observed during *kinema* fermentation[10]. Total amino acids, free amino acids, mineral contents, and vitamin B-complex are reported to increase during *kinema* fermentation, and subsequently enrich the food value of the product[11-16]. Recently, increase in antioxidant activities in *kinema* has also been observed[22]. Increase in carotene and folic acid has been reported in *tungrymbai* [7].

Conclusion

The origin of fermented sticky soybean could also be accidental[17]. Some cooked soybeans could have been left after the meal, which turned into viscous stringy threads with a typical flavour in the next morning. This could probably be the origin of fermented soybean foods, subsequently developed by further innovation and demand of local people depending on agro-climatic conditions. It has been observed mild-strong flavorsome fermented soybean foods are popular among the Mongolian-origin races than the Aryans. This may be due to *umami* flavour[18], developed during proteolysis of soya-protein to amino acids in fermentation. The Mongolian people prefer the *umami* flovoured foods due to specific sensory development. This may be the reason why fermented soybeans are exclusively prepared and consumed by the Mongolian-origin races in Northeast India[1].

Though there is a good demand of ethnic fermented soybeans food among the local consumers in Northeast India, and also some women are contributing the subsistence of regional economy by selling the products, such ethnic products are not included in scheme of public sector banks or financial institutions, neither in the rural development programme and small-cottage industry scheme of any local government[19]. Ready-to-use pulverized starter culture for *kinema* production can be introduced to *kinema*-makers or similar sticky fermented soybean foods of Northeast India adopted to local conditions for more income generation and cost-effective[20]. Splitting of cotyledons and addition of ash during *kinema* production is the unique technique innovated by the *Limboo* women to make the product more alkaline favourable for growing *Bacillus* and also to accelerate the fermentation rate by increasing the surface areas. The scientific findings have correlated their indigenous knowledge and acknowledged innovative skills of mountain women. Ethnic fermented soybeans are one of the major food resources in Northeast India to supplement inexpensive, high plant protein food, with low fat/cholesterol content in the local diet as functional food [21].

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