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Traditional Fermented Foods and Beverages of Darjeeling and Sikkim—a Review

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ABSTRACT

The various ethnic groups of the Darjeeling district of West Bengal and Sikkim consume a variety of fermented foods including kinema (based on soya beans), gundruk (Brassica campestris *leaves), sinki (radish,* Raphanus sativus), *mesu (bamboo shoots), churpi (milk), shel roti (rice preparation) and jnards (beers). These have not previously been investigated, and their method of preparation and consumption are reported here. The flora of murcha, the starter culture of jnards, contains mainly* Pediococcus, *yeasts belonging to the genera* Saccharomycopsis, Pichia *and* Saccharomyces *and the moulds* Rhizopus *and* Mucor.

Key words: Kinema, gundruk, sinki, mesu, churpi, shel roti, jnard, murcha, fermentation, soya bean, *Brassica campestris*, *Raphanus sativus*, bamboo shoots, milk, rice, yeasts.

1 INTRODUCTION

A food is considered fermented when one or more of its constituents has been acted upon by microorganisms to produce a considerably altered final product acceptable for human use (van Veen 1957). Fermented foods are important components of the

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diet as staples, adjuncts to staples, condiments and beverages. There is a wide variety of fermenting substrates, such as cereals, pulses, soya beans, flowers, milk, fish, meat, etc. Fermentation increases the digestibility of pulses (van Veen and Schaefer 1950). In some fermented products containing spices and salt, the keeping quality is considerably enhanced and shelf life is prolonged. Other attributes are improved flavour and appearance and reduced cooking time. Fermented foods provide variety in the diet (Batra and Millner 1976). Increased levels of water-soluble vitamins have been reported in tempeh (Wang and Hesseltine 1966; Rajalakshmi and Vanaja 1967; van Veen and Steinkraus 1970).

About 70% of the inhabitants of the Darjeeling district of the state of West Bengal and about 90% in the state of Sikkim (a total of 1·15 million people) traditionally consume large quantities of fermented foods and beverages. Some ethnic groups are economically dependent upon these local products. The fermentation techniques are passed on as trade secrets in the families of certain communities, a practice protected by tradition. The common fermented foods and beverages of the region include kinema, gundruk, sinki, mesu, churpi, shel roti and a variety of jnards. Although there is information on the availability of kinema from Darjeeling, Sikkim and Nepal (Batra and Millner 1976), gundruk and sinki from Nepal (Karki *et al* 1983), and thumba from Darjeeling, Sikkim and Nepal (Batra and Millner 1976; Hesseltine 1979), in the cases of mesu, churpi, shel roti and other kinds of jnard there is no record.

The aim of this review is to assess the ethnic value, nature, method of preparation and mode of consumption of these fermented products, much of which information has not hitherto been generally available.

2 FOODS

2.1 Kinema

Although traditionally used by the Nepalese, kinema is now popular among the Lepchas and Sikkimese who call it respectively 'satlyangser' and 'bhari'. The kinema production process is shown in Fig 1. Soya beans (*Glycine max* (L) Merr) are washed, soaked in water overnight, cooked by boiling and cooled to room temperature. They are then crushed lightly with a wooden ladle to split the kernels. A small amount of firewood ash is added and blended with the whole soya bean grits which are traditionally wrapped with banana (*Musa paradisica* L) or *Leucosceptrum canum* Smith leaves; polythene bags are also sometimes used. The wrapped mass is covered with sackcloth and kept in a warm place, usually above an earthen oven in the kitchen, for 1–2 days during summer or 2–3 days in winter. The desired state of fermentation is indicated by the formation of mucilage and an unpleasant ammoniacal aroma. Kalimpong kinema has a darker brown colour but is less mucilaginous than the kinema from elsewhere. The product is very similar to Indonesian tempeh and Japanese natto.

Kinema (Fig 2a) is used to give a pleasant, nut-like flavour to curry. It is also dried, fried in edible oil and mixed with salt, onion and chillies to produce pickle.

Soya beans (1 kg)
↓
Washed
↓
Soaked in water (3 litres, 8–10 h)
↓
Excess water drained off
↓ ← Water
Cooked
(1–1·5 h in open cooker or 10–12 min in pressure cooker)
↓
Excess water drained off
↓
Cooled
↓
Crushed to grits
↓ ← Firewood ash (*c* 1 g)
Mixed
↓
Wrapped
↓
Fermented (25–35°C, 1–3 days)
↓
Kinema (*c* 2·5 kg)

Fig 1. Flow sheet of kinema production.

Fig 2. Kinema (a), gundruk (b) and sinki (c), as sold in markets.

Fresh kinema keeps for a maximum of one week. The shelf life is often lengthened to one month by drying in the sun or by keeping on earthen ovens in kitchens.

2.2 Gundruk

The word 'gundruk' is derived from the Newari word 'gundru' (the Newaris being one of the ethnic groups of the Nepalese). It is traditionally used by the Nepalese, but is now popular among all the ethnic groups of Darjeeling and Sikkim. The fermenting substrate for gundruk is usually 'rayo' (*Brassica campestris* L var *cumifolia* Roxb) leaves. Other leaves such as radish (*Raphanus sativus* L), shimrayo (*Cardamine hirsuta* L var *sylvatica* Link), cauliflower (*Brassica oleracea* L var *botrytis* L), etc are also used. Gundruk (Fig 2b) is usually prepared during the months of December to February when the weather is less humid and there is an ample supply of the vegetables. Prepared in other seasons, particularly during the monsoon, it is said to decay rapidly and to have an unpleasant flavour. The preparation (Fig 3) takes about a month. Leaves are dried in the sun (1–2 days depending on the weather). The dried leaves, after a mild crushing, are soaked briefly in hot water and, hand-pressed in a perforated tin or earthen jar with a heavy article such as a large stone to remove surplus water. They are then kept in a warm and dry place for 15–22 days. In the village process a hole of diameter and depth of ~1 m is dug in the ground and dried by fire, and a 30-cm layer of banana or bamboo leaves is placed in the bottom; the dried crushed leaves of the vegetables to be fermented are placed above this layer and covered with a further layer of banana or bamboo leaves. Heavy stones are added to compress the substrate. The holes are sometimes finally covered with a layer of cow dung. The leaves are allowed to ferment *in situ* until a fermentation odour develops (15–22 days). The gundruk is taken out and dried in the sun for 2–4 days. It has a shelflife of about one year.

A very similar product, known as 'pani [water] gundruk', is commonly prepared and consumed in the Pedong area (in the Kalimpong subdivision of the Darjeeling district). Rayo leaves are sun dried for 2–3 days, crushed lightly, soaked in hot

Fresh vegetables
↓
Sun dried (1–2 days)
↓
Crushed coarsely
↓
Soaked briefly in hot water
↓
Squeezed heavily to drain excess water
↓
Fermented
(warm and dry place, 15–22 days)
↓
Sun dried (2–4 days)
↓
Gundruk

Fig 3. Flow sheet for gundruk production.

water, drained and kept in a vat containing warm water (30–35°C) for only 3 days. They are then squeezed and sun dried for about 7 days. Inhabitants of this region usually prefer pani gundruk to common gundruk for its sour taste, easier preparation and greater resistance to spoilage.

Gundruk is typically used as a base for soup and as a pickle. The soup is made by soaking gundruk in water for 2 min, squeezing out the liquid and frying the residue along with tomato, onion and dried chilli powder. The fried mixture is then boiled in rice water, or in water supplemented with wheat flour, and the soup is served hot as an appetiser. The pickle is prepared by soaking gundruk in water, squeezing and mixing with salt, oil, onion and green chillies.

2.3 Sinki

Like kinema and gundruk, sinki (Fig 2c) was formerly confined to Nepali communities but is now consumed by all the ethnic people of this region. 'Sinki' is a Newari word. The method of preparation is similar to that of gundruk except that the substrate is the tap roots of radish (*Raphanus sativus* L) and the fermentation takes 30–40 days. The season of its preparation, its mode of consumption and its shelflife are similar to those of gundruk.

2.4 Mesu

This, originally confined to the Nepalese, has become a common food used by all the people of this region. The Lepchas call it 'sitit'. Young edible bamboo ('choya bans' or 'tama', *Dendrocalamus hamiltonii* Nees, or 'karati bans', *Bambusa tulda* Roxb) shoots are finely chopped (1–1·5 cm × 0·3–0·7 cm) and traditionally put into a bamboo vessel or into a glass bottle, tightly packed and capped to provide an airtight environment. The material is allowed to ferment at ambient temperature (20–25°C) for 7 or 8 days. Mesu is usually prepared in the months of June to September. It has a sour taste and a strong ammoniacal odour. A very common pickle is produced by mixing mesu with salt and green chillies. It is also used for preparing curry by frying and mixing with cooked meats. The naw-mai-dong of Thailand is similar.

2.5 Churpi

This fermented cow's milk product is commonly used by the Tibetans inhabiting this region. Two different kinds of churpi, soft and hard, are available. The soft type is prepared in both hilly and terai areas (the plain land of the Darjeeling district which is at the foot of the hills) and the hard type is restricted to the high altitudes (1300–4000 m) of the Darjeeling district and North and East Sikkim.

Soft churpi (called 'kachcha churpi' by the Nepalis and 'chuiw' by the Lepchas) is prepared (Fig 4) from cow's milk. The milk, boiled or unboiled, is kept in a wooden vat at room temperature for 24 h. Often the cream is allowed to separate and the milk is curdled by boiling. The casein is wrapped tightly in a piece of muslin cloth and allowed to drain for 3–5 h. The churpi is consumed as a condiment by mixing with sliced radish or cucumber; it is also mixed with meats, vegetables and spices to prepare curry.

Hard churpi ('churpi' to the Nepalis; 'chura' to the Sikkimese; 'khamum' to the

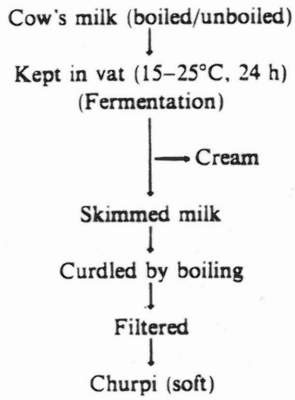

Fig 4. Flow sheet for soft churpi production.

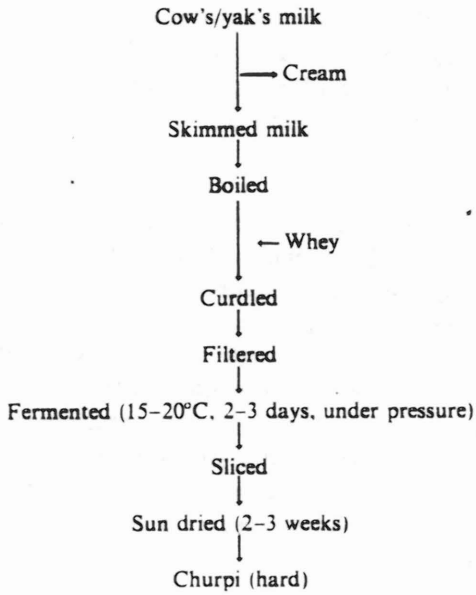

Fig 5. Flow sheet for hard churpi production.

Lepchas) is prepared (Fig 5) from cow's or yak's milk. The cream is separated from milk by centrifugation and the skimmed milk is boiled and curdled by adding whey. After filtration, the casein is wrapped tightly with a cloth and cured at room temperature (15–20°C) for 2–3 days under pressure of about 0·25 kg/cm^2 made with the aid of heavy stones. The cheeses are sliced and allowed to sun dry for 2–3 weeks. This type of churpi becomes very hard and, having a low moisture content, can be stored for a number of years. Churpi is sweet in taste and is used in much the same way as chewing gum. Chu-ra, a kind of cheese similar to hard churpi, has been reported to be commonplace in Tibet, Nepal and north-east India (Batra and Millner 1976).

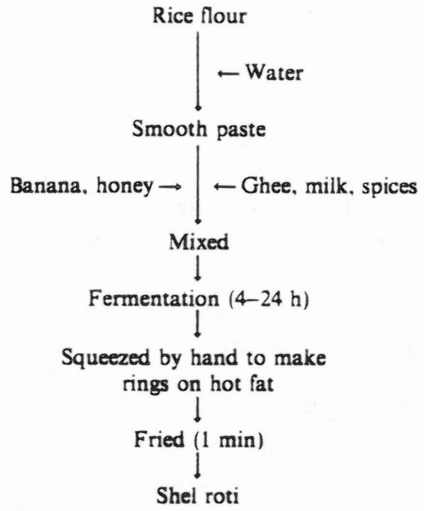

Fig 6. Flow sheet for shel roti production.

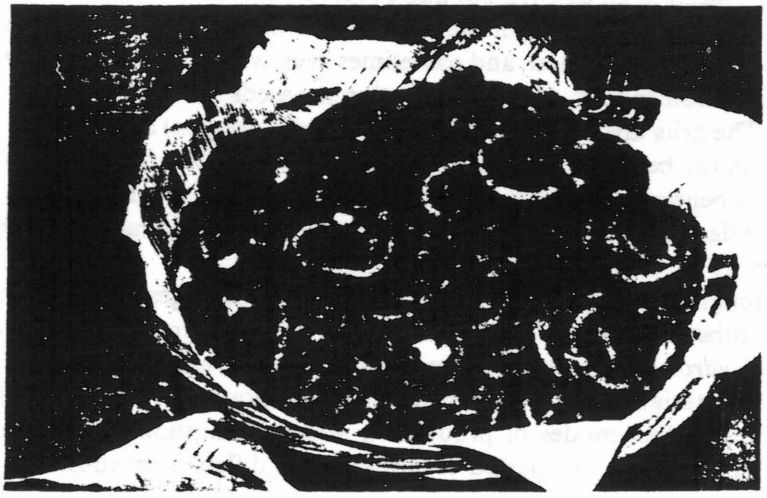

Fig 7. Shel roti as marketed.

2.6 Shel roti

These are ring-shaped fried foods eaten traditionally by the Nepalese of hilly regions. They are usually prepared (Fig 6) by mixing rice-flour paste (rice 1 kg and water 1 litre) with banana (two small pieces), honey (100 g), ghee (100 g) and some spices. Sometimes, instead of banana and honey, sodium bicarbonate (3 g) and sugar (200 g) are added. The well mixed batter is allowed to ferment for between 4 h (during summer) and 24 h (during winter). The leavened batter is squeezed by hand and deposited as continuous rings into hot fat. These rings (Fig 7) are fried and served hot.

3 BEVERAGES

3.1 Jnard

Jnard is a common drink in the region, and is traditionally prepared by almost all Nepalese and Tibetans. This slightly acidic, alcoholic beverage is now prepared by small cottage industries. The word 'jnard', derived from the Mangaranti language (the Mangarantis being one of the ethnic groups of the Nepalese) is known by many synonyms ('chiang' by the Tibetans, 'chii' by the Rong, 'toongba' by the Nepalese, who take jnard in a bamboo vessel; the word 'toongba' actually means the bamboo vessel in which the jnard is consumed). Jnard is the fermentation product of finger millet (*Eleusine coracana* Gaertn), locally known as 'kodo' or 'marua', and is commonly cultivated in the Kalimpong area of the Darjeeling district and at lower altitudes (up to 1300 m) in Sikkim. Finger millet seeds are sometimes supplemented with a small amount of wheat or corn grains. The seeds are boiled in an open cooker for about 30 min and spread on leaves, preferably of banana plants. Murcha, the starter culture, is powdered and sprinkled on the boiled and cooled seeds. After thorough mixing, the seeds are piled in a heap and kept for 24 h. They are then usually placed in an earthen pot and covered with leaves followed by cow dung. In urban areas the seeds are allowed to ferment in a polythene bag. If air is allowed access to the fermentation, and sometimes even when the pots are kept airtight, the product becomes sour. After fermentation the seeds are kneaded to remove the seed coats. The grits are placed in a bamboo vessel (toongba) and water is added. After ~ 10 min the beverage is ready to drink (normally through a bamboo straw). This liquor is believed to be a good tonic, especially for post-natal women. Thumba, a very similar kind of beverage, has been reported to be produced in India (Batra and Millner 1976; Hesseltine 1979).

Although the term 'jnard' is commonly used for finger millet beers, beers from other substrates such as maize, rice, wheat, bajra, sweet potato, ginger, *Rhododendron* flowers, etc are also called jnards, the name of the beer deriving from the raw material used for the fermentation eg 'makai jnard' (maize beer), 'vate jnard' (rice beer). Their modes of production and consumption are similar to those of toongba. However, the period of fermentation differs from substrate to substrate.

4 STARTER CULTURE

Murcha is not a food but a starter culture used for several beverage fermentations commonly consumed locally. 'Murcha' is a Nepali word; the Lepchas use the word 'thamik' and the Limbu (one of the ethnic groups of the Nepalese) 'khesung'. Trade in murcha is protected as a hereditary right of certain castes of the Nepalese (particularly Limbu and Rai) and the Lepchas. Figure 8 illustrates the sequential addition of ingredients. Rice (glutinous and non-scented), soaked in water overnight (10–12 h), is placed in a large wooden mortar. A few pieces of the root of 'sweto-chitu' (*Plumbago zeylanica* L), commonly used by the Lepchas of Bongbusty, Kalimpong), a few leaves of 'vimsen pathe' (*Buddleja asiatica* Lour), and certain spices such as ginger and chilli, are blended using a heavy wooden

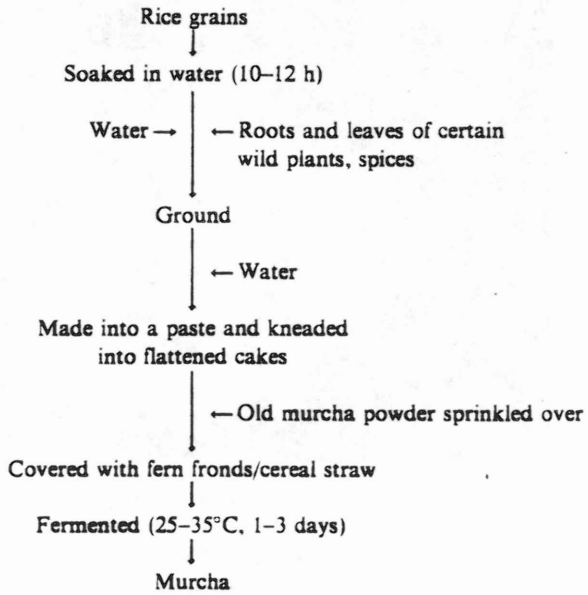

Fig 8. Flow sheet for murcha production.

pestle. Water is added to make a thick paste which is kneaded to give flattened cakes 2–5 cm in diameter. Old murcha is powdered and sprinkled over the new cakes which are then wrapped in fern fronds with the fertile side (bearing the sori) touching the cake. The cakes are placed on a straw-covered bamboo floor above kitchen ovens and covered successively with fresh fronds, dried fronds, straw and finally sackcloth. They take 1–3 days to dry at 25–35°C. This method is practised by the Rai and Limbu communities. The Lepchas cover the cakes with rice straw instead of fern fronds. After air drying, the cakes are dried in the sun, and dry adhering fronds are removed. Murchas remain active for several months at room temperature. In markets, murchas (Fig 9) are sold by the piece.

The microflora of murcha was studied using nine samples from Nepal and India kindly supplied by Dr T Karki, Kathmandu, Nepal. Dilution plates on appropriate nutrient agars were made, into which inhibitors were incorporated. The murcha samples showed similar populations of bacteria, yeasts and moulds. In each group only a few species regularly occurred in large numbers. The bacterial count ranged from $5{\cdot}5 \times 10^5$ to $2{\cdot}1 \times 10^8$. Most of the isolates belonged to *Pediococcus pentosaceus* Mees. Sixteen isolates were examined and found to vary in their ability to grow at 45°C. They grew well aerobically at both pH 5 and pH 9 but failed to grow in 4% NaCl. In general they failed to utilise mannitol, sorbitol, glycerol, sorbose, lactose, sucrose, arginine and starch but utilised trehalose. There were some exceptions with mannitol and sucrose, and fermentation studies with these species on rice as substrate indicated that they were not significant contributors to the breakdown of cassava and rice starch. Their role may be to give flavour to the product. Similar results were obtained with products from Indonesia, the Philippines and China.

The yeast population in the nine samples was very high, ranging from $5{\cdot}4 \times 10^6$ to

Fig 9. Murcha cakes as marketed.

$6{\cdot}1 \times 10^8$, and the mould count was $1{\cdot}5 \times 10^6$ to $2{\cdot}8 \times 10^8$. As with the bacteria, the variety of yeast and mould species was very restricted. Thus, of the 26 yeast strains, 19 were *Saccharomycopsis fibuligera* (Linder) Klocker, one was of *Pichia anomala* (Hansen) Kurtzman and another was a *Saccharomyces* sp; the other five were unknown. *S fibuligera* utilises starch, grows well on cellobiose and has a fermentation temperature of 35°C. It requires pyridoxine for growth and fails to grow on arabitol and glucuronate.

The moulds in the murcha starters are restricted to species of *Rhizopus* and *Mucor*, all members of the Mucorales. The *Mucor* species are mostly *M circinelloides* van Tieghem group and *M indicus* Lendner. Unlike most fungi, the murcha strains of *Rhizopus* and *Mucor* will grow under strict anaerobic conditions as long as CO_2 is supplied (Hesseltine *et al* 1985). This accounts for the fact that they are the only moulds that occur in murcha. Murcha, unlike ragi (a similar product), does not have *Amylomyces* as a part of the regular flora. Interestingly, the moulds and yeasts survive for years in a dry state at 4–5°C. For example, plating out of the four-year-old murcha samples revealed both *Rhizopus* and *Mucor* to be alive in all samples and able to grow vigorously. The *Rhizopus* species appear to belong to the *R chinensis* Saito and *R oryzae* Went *et* P Geerlings groups.

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