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Traditional uses of multi-cob bearing *Murlimakai* primitive maize landrace from Sikkim state, India

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Sikkim is one of the most beautiful tourist hill states and land of traditional landraces of many crops and with incredible agro-biodiversity treasure. Multi-cob baring *murlimakai* is used for various purposes such as mouthwatering delicious foods preparation such as popcorn, chapati, roti, *chyakdung*. *Makkaiko chamal, makkaiko pitho, makkaiko laddu* and *makkaiko dalla.* Attractive artifacts mats, baskets, fruits and vegetable container baskets, bags and hats are prepared from ears and local beverage *jhand* and *rakshi* is prepared from the grans. Immediate conservation of this unique multi-cob bearing landrace either *ex situ* or *in situ* is necessary for future needs.

Keywords: Artifacts, Beverages, Foods, *Murlimakai*, Sikkim

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Maize is used for multiple purposes in our lives such as food, feed, fuel and other purposes. Maize crop residues serve as a good source for mulching in crop fields, preparation of compost, vermi compost and straw used as media preparation for mushroom production[1]. In India, maize is grown in all the seasons, i.e., *kharif* (rainy), *rabi* (winter) and summer. In 1962, one of the most primitive maize races in the world was found by two foreign scientists (EW Sprague and NL Dhawn) in various parts of Sikkim[2,3]. Sikkim harbors numerous morphologically diverse maize landraces that are still conserved and utilized by the farmers for various purposes. Some of the interesting trait-specific unique local types/ landraces reported from this region include *Banchareymakai* (high altitude maize with yellow, flint kernel), *Badamtopo* (popcorn), *Chakhouchujak* (aromatic, soft, sticky), *Chapthimakai* (white, dent type kernels), *Chujak*(aromatic, popcorn), *Darikincho* (small yellow hard kernels), *Fingdong* (aromatic popcorn), *Gadbademakai* (white kernels with some purple flint kernels), *Kaalimakai* (dark purplish black), *Kholakitthi* (sticky), *Kuchungdari* (orange colored popcorn, flint), *Kuchungtakmar* (mix yellow, white, purple and red kernels, flint), *Kukharey* (dwarf, high altitude), *Kukidolong* (flint), *Lachung maize* (multi coloured, tolerant to cold), *Nepali Sappa* (3 cobs/plant), *Pahelimakai* (yellow/orange flint), *Pahenli* (light dent), *Phensong* (cob up to 30 cm long), *Putalimakai* (multi-coloured), *Raathimakai* (dark red), *Sathiyamakai* (early-duration), *Setimakai* (white and soft), *Tanee* (popcorn) and *Tistamehdi* (flint)[4-6]. Occurrences of primitive landraces of maize in Sikkim and other Northeastern states of India in the Himalayas gave another hypothetical thought of origin. It is no mere accident though that Sikkim is the treasure of maize landraces and it is believed that Northeastern states are secondary centres of origin of this crop[1,7].

Artifacts are product of raw materials which are available in the surroundings as a source from plant, animal and other non-living objects. Sikkimese handloom, cane and bamboo and orchid dried leaves artifact product are famous for their artistic designs[8-10]. Traditional knowledge of wine preparation in Northeast India has been both unambiguous and tacit that has been codified into words or transferred from one generation to another through ages, thereby suggesting a sense of common or communal ownership amongst different communities[11]. The hill communities of India used several plants for distillation of alcoholic beverages. The alcoholic

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beverages locally known as *local daru/neet* prepared by indigenous method is a part of life and culture of these hill neighborhoods.

Scanty information on traditional diets, making artifacts from maize and traditional beverage preparation technology and associated plants used for such purposes were not thoroughly discussed. Keeping in view such gap in ITK documentation of *murlimakai* based on traditional knowledge approach, the present investigation has been carried out in hilly pockets of Sikkim which is mainly intended to apprise eroding this indigenous traditional knowledge prevalent among both rural and urban inhabitants.

Methodology

Sikkim is a one of the most beautiful and small states of India that has a wide range of eco-climatic conditions and is a treasure of biological diversity. It occupies an area of 7,096 km^2 lying between 27^o 05' to 28^o 07' N latitudes and 87^o 59'to 88^o 56'E longitudes, about 300 m to 8500 masl and bounded by Bhutan in the East, Nepal in West, Tibet in the North and West Bengal in the South. The present study focused on the kind of uses of traditionally cultivating *murlimakai* maize by indigenous people of Sikkim. Survey carried in different parts of North Sikkim and the data were collected and for the determination of ethnic use in their socio-cultural life, careful interaction with the hilly residing aboriginal experienced elderly people. Rapport building process has been established communication through a formulated the oral and semi-structured questionnaire-based interview with at least 15 local people were undertaken. Questionnaire-based household surveys, careful observation and documentation carried in preparation of local traditional dishes, artifacts and traditional beverage making process from *murlimakai* maize and the detailed process discussed.

Results and Discussion

Murlimakai consisting of notable variability in primitive popping type of kernels, smaller in size and more number of ears (3–9 ears on a single stalk) with lack of apical dominance, and relatively high placed ears origin at single smaller internodes, fewer kernel rows, tall with drooping tassels with fewer branches, prolific tillering and narrower leaves and stays green after maturity (Fig. 1 a-c). The kernels are very distinctly characteristic with small lemon yellow popcorn type kernels are arranged in the cob of 3-6 cm and it has religious importance among the Buddhist community. This maize is used traditionally in hilly areas of Sikkim as food like dried seeds used to make popcorn, green cobs harvested at the milk stage are ground to make *chapattis* or *rotis* or local bread and dried grains are partially roasted in oil and then made in the thick cup-shaped form called as *chyakdung*. Young green cobs eaten as roasted or boiled and maize grains are partially grounded and combination of rice with half equal ratio *makkaiko chamal* and powdered maize grain starch used to prepare *makkaiko pitho* or '*champa*' or '*Sattu*' sometimes it is prepared with the combination of wheat/barley. Maize flour used to preparation of local confectionaries *makkaiko laddu* and *makkaiko dalla*.

Maize cob ears having good aesthetic value which is used for making decorating items such as flower bouquets and hanging pendants and several gorgeous eco-friendly handcraft products are being made out of maize fibers are used in preparation of sitting mats (*makkaiko pira*), large mats (*makkaiko gundri*), baskets (*khoshyalako daalo*), fruits and vegetable container baskets, bags and hats (Fig. 2 a-e) which are very popular in Sikkim state. These eco-friendly mats are smooth and fine in structure and texture and comfortable.

Maize grains are partly coarse pulverized in wooden mortar and the hand pounded maize is transferred to the plastic/wooden containers by adding some water and mixed with local yeast and some plant materials and the top is covered with banana leaves (Fig. 3 a,b). The whole setup is allowed to remain undisturbed for 5-7 days. The fermented mash is squeezed with hands on metallic sieve (Fig. 3 c,d)

Fig. 1 a — Multi-cob bearing murlimakai; b,c: Dried cobs hanging on house tops

and the obtained highly nutritious yellow juicy liquid called *Jhand* (Fig. 4 a). Distillation was carried out in close process in which the distillate was collected in the metallic pot. In this, the distillation unit consists of a series of three metallic pots kept on fire. After completion of fermentation, the mash is now transferred to the lower metallic pot to the half of its capacity for distillation. Inside of this pot, another small pot is inserted and the vapors passed through the middle pot strike the bottom of the upper pot in which contains cold water. The vapors cool and the droplets collect in the middle pot. The water of upper pot is regularly changed to keep it cool and the whole setup is kept on fire for few hours (Fig. 4 b,c) and the distillate were collected in middle pot and transferred to the bottles called *Rakshi* (Fig. 4 d). The residue left after distillation is considered highly nutritious and is fed to cattle and poultry. Sometimes *rakshi* is prepared with a combination of millets, especially with finger millet.

Traditional beverages play an important role in the socio-cultural life of indigenous people of Sikkim. Most of the ethnic groups are fond of some alcoholic drinks particularly traditional made or the other. Cultural diversity in mountain regions is closely linked to biodiversity, having a symbolic relationship between the environment and cultures and between ecosystem and cultural identity. People are living in mountain hill regions are consume this *rakshi* during rough weather to cope with adverse climatic conditions prevailing in the area and also during festivals, birth, marriages, happy occasions, housewarming ceremony, feasts, hospitality and some magico-ritual ceremonies and even in the death ceremonies of the people of Sikkim. In some ethnic groups, traditional alcoholic beverage is kept along with the death body in the funeral. It is believed that, the departed soul may be happy in the heaven. People believe that this beverage gives strength to the body, acts as a blood purifier removes intestinal worms and provides relief in urinary troubles. Local people of the Sikkim still have a liking of *rakshi* and they enjoy it on some special occasions and lean months. According to some old people of this hill region, in earlier days almost all families had their own distillation units like other household appliances.

Agriculture in the foothills of Himalayan region unveils a lot of variation in crop diversity and crop composition due to the limitations in the form of lack of adequate irrigation facilities, high altitude, cold

Fig. 2 a — Display of artifacts by rural women; b: Makaikogundri; c,d: Makaikopira, e: Maize ears as decorating items

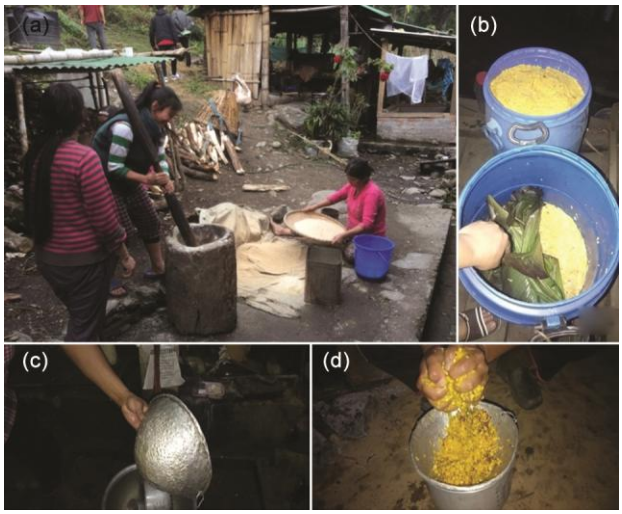

Fig. 3a — Partially handing ponding of maize, b: Fermentation in containers covered with banana leaves; c: local made sieve; d: Squeezing and sieving of fermented mash

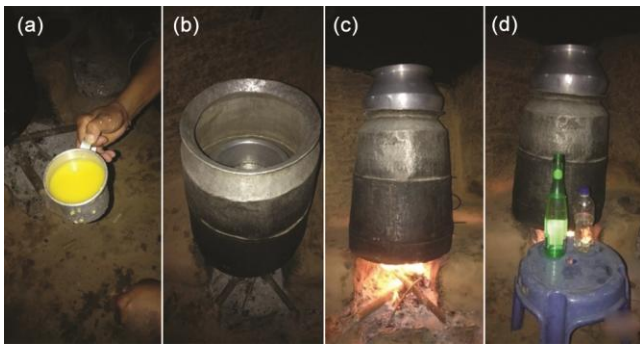

Fig. 4a — *Jhand*; b,c: Distillation unit and processing; d: Distillation unit with end product

climatic conditions, low soil depth, heavy rainfall, and small and scattered land holdings. Because of the fragile nature of hills, utilization of traditionally cultivated landraces wisdom is of paramount importance. Despite limited irrigation facilities, fragmented and small land holdings and non-availability of modern inputs, agriculture in Himalayas has supported its people for generations in adverse conditions and continued to remain even today the principal source of livelihood[12]. The indigenous maize farming system among the Sikkim folk is ecofriendly and sustainable and it is also advised that farmers may be encouraged to continue their existing traditional maize landraces in their own farms as a principal source of trait-specific germplasm. Due to harsh topography and climate and subsequent inaccessibility of the area, traditional mountain farming system in Sikkim were self-sufficient, self-contained, closed systems, which did not require any outside input. Fortunately, in Sikkim state, chemical fertilizers and pesticides are banned and the state was globally recognized as complete organic state in India. In this era of globalization, organically produced food grains from Sikkim can contribute to satisfy the local demand of organic produce and poor small and marginal farmers will be benefited.

The state Sikkim of India harbors several indigenous primitive aboriginal communities mainly *lepcha, gurung, tamang, pradha, sherpa, nepali, etc*. The food products prepared by this maize are very delicious, mouthwatering, healthy and easily palatable. The artifacts have unique intricate style, design and long life. The traditional artifacts are very popular among the travellers. Apart from the improvement made in this particular crafting sector, distinctive changes have not been documented on this particular crop. Such comprehensive and exclusive study on traditional handcrafts has been reported by several workers from different parts of India[8-10 &13-19]. Traditional beverages are refreshing, relaxing and will rejuvenate the body for which it is being appreciated by people for a long time. Even it became the tradition to use specific foods, artifacts and beverages in particular socio-religious rituals executed in the locality which has indirectly helped in survival of this secret recipes as well as the traditional knowledge regarding the preparation of those unique products. Another multi-cob bearing maize *puakzo* was reported in Mizoram state[7] and the major difference between these two landraces are, dark red coloured grains and the cobs originate at different nodes in *puakzo* whereas, in *murlimakai* the grains are in lemon yellow colour and cobs originate at single internode and both landraces are popcorn type.

Beverages are the drinks, which have stimulating and refreshing qualities and it occupies an important place among the Sikkim people. Generally beverages can be categorized as alcoholic and non-alcoholic. The non-alcoholic drinks are generally brain depressing and are used by small group of people special the tribal people. The methods for wine and beverage production among the tribes differ as all of them follow their own indigenous protocols employing different starter cultures, although most of them use similar substrates for fermentation[20]. In fact all the alcoholic beverages are much richer in calories than proteins and carbohydrates but are devoid of all the nutrients[21]. Traditional knowledge related to the use of natural resources surrounding man and it has been recognized as part of the essential information inherited through generations by the local communities and has played a key role in the livelihood. Nowadays, availability of much cheaper industrial beverages in the local market and growing modernization affects the traditional distillation of beverage preparation because of the time consuming process and this practice is restricted to some remote hilly pockets only. Such comprehensive and exclusive study on traditional alcoholic beverage preparations has been reported by several workers from various parts of the country[22-26].

Maize cobs are roasted on fire and sold along highways, which attract tourists and fetches income to the unemployed rural women. If the scientific package of its cultivation is promoted in scientific manner and could be blended with traditional knowledge, *murlimakai* can become a cash crop to the local people. Though, with passage of time traditional landraces are decreased with the introduction of modern high yielding varieties/hybrids in this region. Farmers in this region, after harvesting the maize cobs they used to hang in front of their respective houses and back yards for drying and keeping for next season planting material and offering for the birds also (Fig. 1 b,c). There is an immediate necessity for blending traditional methods of conservation either *ex situ* or *in situ* and cultivation of this unique multi-cob bearing *murlimakai* landrace with formal agronomic practices. For *in situ* conservation of this indigenous

landrace, it is imperative that the local community be mobilized to improve their understanding about this landrace in this region. Nevertheless, this traditional knowledge is getting rapidly eroded in younger generations due to lifestyle changes and culture in view of mass awareness of modernization. If the same trend continues this age old traditional practice would vanish in the days to come.

Conclusion

The transitory report presented in this paper especially making artifacts, preparation of traditional beverages and foods of this region require further research in biochemical and molecular aspects to prove their scientific validation for the nutritional potential of this unique *murlimakai* landrace. It is necessary to network and link institutions involved in agro-biodiversity related research, management and training in this region. A prolific research verdict on such line would enhance opportunities in the artifacts preparation and food security of this hilly state.

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Authors' Contribution

PKB: Conceptualization, supervision, draft writing-review and editing; and DR: Methodology, resources, and visualization

Conflict of Interest

The authors declare that no conflict of interest exists.

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