Adaptations of culturally and nutritionally important traditional foods in Eastern Himalaya: A case study with Adi women of Arunachal Pradesh

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Adi tribal women living in far-flung areas of mountainous ecosystems of Arunachal Pradesh have evolved tremendous amount of traditionally knowledge (TK) to identify, collect, process and use biological resources as foods, nutrition and ethnomedicines. In this article, we discuss about the use of culturally important indigenous biodiversity used by Adi women as food, nutrition and ethnomedicines. Data reported in this study is based on three projects completed with Adi tribe in Arunachal Pradesh. Information pertaining to study was collected using conventional and participatory methods. Results reveal that Adi women are knowledgeable in accessing indigenous biodiversity to use in making culturally, nutritionally and medicinally rich foods. A number of uncultivated indigenous plants and crop resources are adapted to prepare traditional foods. Beside, a large number of wild animals and insects are integral part of food system. Most of the foods are consumed in boiled forms, fermented and alcoholic beverages. Few most commonly consumed indigenous plants are onger (Zanthoxylum rhetsa), poi (Basella rubra), dhenkiu saag (Diplazium esculentum), marsang (Spilanthes acmella), ongin (Clerodendrum colebrookia), kalbu (a creeper) and rori (a herb) and considered most dependable food plants. These ethnobotanicals are source of income and as well as the part of adaptive strategies on food security during the climatic variability. The other species such as banko, champa, fayong, gende, kekir, kopí, koppir, koroi, mamang, marsang, onger, ongin, oyik, paput, etc. are observed as part of both food and ethnomedicines. A number of fermented foods and alcoholic traditional beverages are consumed by Adi tribe, and make them novel in food habits from others. Adi have rich socio-cultural capitals to sustain adaptive practices associated with traditional foods.

Keywords: Adi women, Indigenous biodiversity, Cultural capital, Traditional foods, Ethnomedicines

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Indigenous knowledge and learning of biodiversity based traditional food systems refers to a process of active interaction and acquisition of the body of knowledge which is unique and developed by group of people native to a specific geographical area 1-3. Presently much concern has been expressed worldwide at the on-set of sever threat encountered by such culturally and nutritionally rich biodiversity based traditional foods and learning systems. Some mechanisms pertaining to traditional knowledge of local foods are lost through the climatic variability, erosion of vernacular languages, cultural erosion, disintegration of joint family system and learning chain4-8. India is rich in indigenous knowledge relating to foods and nutrition. The plants and animals used in traditional foods play multiple roles such as to maintain nutritional and medicinal security. Though, with passage of time, system of continuing traditional foods is decreased with modern foods 9,10. In any community, women play an important role in teaching and intergenerational transfer of traditional foods and related knowledge systems. They possess immense knowledge of varieties of plants, their fresh and fermented products; and their usage in food and medicines to attain nutritional security 2,3,11. Women do their own informal experimentation through trial and error, and develop formulations and protocols of a particular food which could be important for a season, time, cultural occasions and nutritional enrichment12.

The role of women and the way it impacts intrinsic value of local knowledge in adaptation of food systems, and food preparation are critical to be
understood, interpreted and disseminated\textsuperscript{1,10,13}. Hence, a systematic learning of food based knowledge systems is the urgent need of the hour and views which this article attempts to explore, characterize and document the traditional foods consumed by Adi women of East Siang district, Arunachal Pradesh. In present paper, we discuss knowledge, ethnomedicinal and culture related aspects of important traditional foods adapted by Adi tribe.

**Study areas and research methodology**

The Adi (also Abor) is a major collective tribe living in the Eastern Himalayan hills of Arunachal Pradesh, India. They are mostly found in sub-tropical regions of districts: West Siang, East Siang, Upper Siang, Upper Subansiri and Dibang Valley. The studied district East Siang of Arunachal Pradesh, India spread in 4,005 sq km and is situated between 27.3\textdegree\textit{E} to 29.42\textdegree\textit{E} North latitude and 94.42\textdegree to 95.35\textdegree East Longitude. History withstanding, Arunachal Pradesh has a large areas under forest (82.0\%) at various altitudes with waterfalls, glades and groves which make base for wild foods, medicines and subsistence survival of local tribes. To carry out this study, Pasighat circle of East Siang district (Pasighat) was selected purposively based on the ethnicity, dependency of local people on forest resources, culturally-laden region, diversity and endemism (both on land and in surrounding waters) and plant resources, and diversity of ethnic groups among Adi tribe (Pasi, Padam, Monyong and Pangi). A representative number of 5 villages namely Poglek, Mirmir, Balek, Sibut and Mirbuk were selected randomly for conducting this study.

In each village, participatory ‘recipe contest’ was organized with the help of a team consisting community leaders (Gaon Burha- customary chief, members of village Panchayat) and formal scientists to explore the diversity in culture and plants based traditional foods in a rapid manner\textsuperscript{13,14} (Table 1). Each food prepared from indigenous plants and animals were assigned a score 1 to calculate total value of score of an individual participating woman. Based on highest score obtained by a woman, a list of winners was announced among the participants. The recipe contest winners were rewarded with the first, second, third and two consolation prizes. Women receiving a score 1 for plant based food was considered a knowledge score\textsuperscript{13,14}. Based on the mean score, the difference between villages and respondents was analyzed. Later on these winners (25, five from each village) were interviewed separately to understand the collection, processing, use in various aspects and other dynamics of traditional food related resources. There were total 5 young (below 35 yrs), 8 middle age (40-45 yrs) and 9 old age (50 to 80 yrs) winners.

Data were collected through three projects on traditional foods implemented from 2004 to 2008. Supplementary information pertaining to the types of vegetation and animals and methods of preparing foods, perceived cultural, nutritional and medicinal values were gathered using several participatory rural appraisal (PRA) tools. While interviewing, open-ended questions were kept in interview schedule. The focus group discussion (FGD) was adopted to discuss and verify the complex issues like processing of fermented foods and traditional alcoholic beverages and sources of collection of indigenous materials. According to the CBD (Convention on Biological Diversity) recommendations,\textsuperscript{15} prior informed consent (PIC) was obtained from studied women and men to maintain the ethics of preserved knowledge systems of its property owners and acknowledge them properly. In case if knowledge was the part of public domain, then consent of community leader was obtained. Explanatory research design (qualitative approach) was adopted to present results. ‘Z’ test was applied to test significance of knowledge difference among different age groups. Using descriptive statistics such as percentage and mean, the data were analyzed to draw inferences. ‘Z’ test was applied to test significance of knowledge variability among Adi women.

**Results**

1. **Knowledge of Adi women about traditional foods**

We observed that onger (Zanthoxylum rhetsa), poi (Basella rubra), dhenkia saag (Diplazium esculentum), marsang (Spilanthes acmella), ongin (Clerodendrumcolebrookianum), kalmu (a creeper) and rori (a herb) are most commonly used leafy vegetable by the Adi women. These species are not only the part of food, but also the most dependable source of income and livelihood. During the off season and when climate is harsh and variable, these plant species provide sustainable base for food, nutritional and livelihood security to Adi women.

Adi women posses a wide range of knowledge about traditional foods prepared from ethnobotanicals and indigenous crops species. Though, this knowledge of traditional foods varies from one village to another (Fig. 1). Old women were observed to be
significant rich from middle age and younger group of Adi women about harvesting number of plants and preparing food from them (Fig. 2). In general, Adi women depend on their own crops for the food they eat, supplemented by forest ethnobotanicals and wild games and fish caught in the river. A range of traditional foods prepared from ethnobotanicals exist. These ethnobotanicals are accessed from community forests (morang) and jhum land. There are several forms of food preparation and processing methods used prior to consumption of these foods (Fig 3). The form of foods and use pattern vary based on the food habits among various sub-tribes (Padam, Pasi, Minyong and Pangi) of Adi community.

A large percentage of respondents practice the combined adaptive strategy of growing their own food and collecting edible forest products (25%), and in addition there are group who exclusively depend on forest food collection to augment their dietary needs (35%), and those who exclusively depend on their own crops for food (40%) (Fig. 4). Various other strategies followed by Adi community include subsistence hunting for foods. While there is considerable use of edible forest plants, this does not always represent a "free" good for the Adi households living near the town, since they do not find time to go far away in the wood forest for food collection.

Members of the settlement who have migrated to the area earlier remember other forest food as survival food, particularly the pith of certain tubers and fruits like wild jackfruit and chestnut. These were considered as foods for drought and necessary until 1970s until the wet rice fields and homegardens were well-established. Presently however, these foods have become rare items in the diet of villagers. Some of these forest foods have made the transition from being considered hardship food to delicacies fit for social and cultural celebrations.

2. Perceived ethnomedicinal values of traditional foods

Some of the ethnobotanicals are consumed by Adi women as food with an intention to cure the disease and improve health (Table 2). Similarly, some ethnozoological resources like bear’s gallbladder is used as food during the malaria, high fever and tuberculosis diseases. Women considered that boiled ethnozoological resources like bear’s gallbladder is used as food during the malaria, high fever and tuberculosis diseases. Women considered that boiled

| Table 1—Approach and steps applied in organizing recipe contests among Adi women to observe foods diversity based adaptations and recording information |
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| Steps | Process and approach |
| One | Writing letters to community chief (Gaon Burha), Head Masters of primary and junior high schools and village Panchayat |
| Two | Forming a multi-disciplinary participatory team involving experts from biodiversity, anthropology and rural sociology, food and nutrition, health, home science, and key knowledge holders of village where recipe needs to be organized |
| Three | Fixing a meeting with stakeholders (women of different age groups interested to participate in recipe contests) |
| Four | Deciding date of recipe contest. Minimum 10 days are given to have preparation. Further it is ensured that at least minimum 10-15 women should participate in recipe contest of each village |
| Five | Community campaign through audio-visual and print media to make aware the local women. Objective is to inculcate interest about use value and conservation of indigenous plant and animals species used in making traditional foods |
| Six | Inviting elder women and other knowledge holders of each village to mobilize rural women for participation |
| Seven | Women discuss, learn and collect uncommon food crops/ethnobotanicals/animals species (threatened and endeared species of animals are not allowed to use in this contest) from different sources |
| Eight | Preparation, processing and cooking foods on the fixed date of event. The alcoholic beverage such as apong and fermented foods like Namsing peron, namdung, etc. are allowed to prepare in advance provided the process and ingredient used are explained before the judges who evaluate recipe and foods on fixed date |
| Nine | Assembling in Mosup (community hall) by women and presentation/demonstration of prepared traditional foods along with plant samples those were part of food preparation |
| Ten | Evaluation of recipes and foods presented by participating women by participatory team and deciding scores. Scoring is done on the basis of following indicators: novelty of use of species, degree of ethnicity applied in making food, taste and flavor, number of foods and apparent nutritional values |
| Eleven | Deciding recipe contest winners as 1st, 2nd, 3rd and one consolation winner on the basis of highest scores obtained by respective woman |
| Twelve | Recognizing, respecting and honoring recipe contest winners either in same village in a well arranged meeting or inviting the winners in regional/state/national events to honor them formally |
systems are wild talab (a herb belong to onion family) and kekir (crop from Gingiberaceae family). Some of the foods made from green koppi, teeta baingan (Solanum sp.) and papaya, and apong (alcoholic beverage) are considered as laxatives while roasted seeds of wild jackfruit and pumpkin are believed to be the hot foods.

4.1 Fermented foods
We found some foods which are consumed in fermented forms and beverages by Adi tribe. These foods are presented as:

4.1.1 Siye (Yeast tablet) used in fermentation of local beverages
A paste made from the local rice is prepared as major stuff. Simultaneously, paste from the green leaves of rukji (Cyclosorus extensus), tender shoot of koppi (Solanum khasianum), belang (wild jackfruit) and sugarcane are also prepared. Both the paste is mixed together and shaped into flat balls, and kept on dried leaves of rukzi leaves. In addition, the powder from the old tablets of siye is poured as the culture on the newly made tablets to increase their strength. The tablets are then covered with rukji leaves and left for over 4-5 days, then dried over the fireplace in the Adi traditional drier (called perap). The yeast tablets while drying should not be placed too close to the fire, but kept at a certain distance, spread on the borang (the third and last shelf of drier) above the fireplace where the tablets will remain warm but not too hot. These newly made tablets are called siye.

4.1.2 Kala apong (traditional alcoholic beverage)
The apong is prepared by adopting following steps: The variety of rice amkel is taken and de-husking is done in traditional crusher. The husk of rice is roasted in iron container to make charcoal (Fig. 5). The separated rice grains are half boiled and mixed with husk charcoal. Two to three tablets of siye (yeast of approx 20 g) for per 5.0 Kg grain is mixed
uniformly in it. Now this paste is kept in bamboo basket lined with ekkam leaves (Phyrinum pubenerve). Nowadays plastic buckets are preferred by people living near towns to avoid the search for ekkam leaves. After about 3-4 days in winter and 5-6 days in summer, the paste is completely fermented and produces a special flavor of apong (Fig. 6). Then after, it is filtered using byor jung made of bamboo and cane species (Fig. 7). Beverage prepared by this method is called poro and product is named kala apong (Fig. 8) and is used after adding desired quantity of water. The apong prepared from indigenous rice (amkel) is sweeter in taste. The method of filtration of kala apong varies according to community. For example Galong tribe use arung as traditional method of filtering apong, while Minyong-subtribe of Adi, use tansul. Sometimes people consume the mixture called pakot (fermented paste) directly without filtering it or making it into a liquid form. This apong can be prepared from finger millet also. Apong prepared from finger millet is considered stronger than apong prepared from rice. For preparation of alcoholic beverage from finger millet, 4-5 days incubation period during summer and 7-10 days during winter is required to ferment the grains. The beverage made from local rice requires only 2-3 days fermentation during summer and 3-4 days in winter.

4.1.2.1 Filtration of apong

In the preparation of apong, filtration through a bamboo filter (called byor jung) is required. In a large-diameter bamboo section, one small hole is made in the side of the internodes, with the upper end kept open. Small pieces of ekkam leaves are placed at the bottom and one leaf is placed at the hole to block it lightly. From the top, fermented slurry is poured into the filter, followed by hot boiling water. The cool beverage which first comes out of the hole is used to make the apong; later, warm liquid comes out which has neither much taste nor strength.

4.1.2.2 Keeping quality of apong and use protocol

The local alcoholic beverage called apong—produced in bulk – can be kept for 3-4 days, otherwise the quality and taste will be deteriorated. This beverage should not be taken when a person is ill or under medical treatment, except in cases of general sickness when it is taken along with local forest foods to maintain health. The bitterness of apong can be minimized or neutralized by mixing in the wood-ash of the hollock tree (Bunopithecus hollock).

4.3 Ponkang

Rice of indigenous variety of paddy Amkel is cooked and left for cooling. After this, the siye tablet is mixed into it. This mixture placed and packed into green leaves of ekkam and is left for two days in winter and one day in summer for fermentation. Ponkang could be of two types: one is used just after the fermentation of one day rice, while second category is used after the two days of fermentation and adding little amount of water into it (Fig. 9). This food is more preferred during winter not in summer, and can be given to child also, but in small quantity.

4.4 Peret namsing

Leguminous seeds such as cow pea, kidney bean or black gram roasted and boiled for about 40 minutes, and allowed to cool. Seeds are then packed in airtight conditions in the green leaves of ekkam and kept above the perap (traditional drier) near fireplace for one week to allow fermentation. Then it is mixed with salt, takeng (indigenous ginger), tomato, chilly and other flavorings and further consumed after frying or roasting.

4.5 Peron naming

Dried soybeans are cleaned, washed and boiled in water for 30-40 min until they soften. After being cooled they are packed in ekkam leaves. The leaf wrapped packets are bound with bamboo or cane rope and hung near the kitchen on the perap for fermentation and allowed to ferment for 10-12 days in summer and 25-30 days in winter.

4.6 Fermented namdung (Perilla ocimoides)

Seeds of namdung are taken and roasted in aluminum container. The seeds are then crushed and wrapped in ekkam leaves. The wrapped bundles of ekkam leaves are kept nearby traditional drier to allow fermentation for 6 days in winter and 3 days in summer. After this, the bundles of ekkam leaves are opened and transfer the semi-fermented seed in new ekkam leaf for roasting on wooden ash. After the roasting, now it is ready to eat after adding some local spices.

4.7 Ngosing (fermented fish)

Local breed of fish ngopi is collected from forest stream and or Community River. The fishes are cleaned properly. Now they are put in the green leaves of ekkam and packets are made. These packets wrapped with ekkam leaves are then transferred in a utensil for boiling. After the boiling, fishes are kept for a while to drain out the water from fish body. Now common salt along with chilli and ginger are added to
It. This mixture is then put into green bamboo cylinder and made airtight. The bamboo cylinder is left for 4 days in winter and 2 days in summer for fermentation of fishes. To have proper fermentation during winter, the bamboo cylinders are kept nearby traditional drier (perap). After this bamboo cylinder is opened and fermented fishes are consumed. In case of too old fermented fish, it can again be put into ekkam leaves and roasted further to improve the taste.

4.8 Esing engin (tapioca based beverage)

The tapioca tubers are dig out from jhum land and washed properly. Peal is separated from the tuber and after cleaning, slices are made from tuber. These slices are boiled for about 30 minutes. The water is decanted and boiled tubers are left out for cooling. Then after, slices are spread and yeast tablets (siye) are mixed with it. A paste is made and put into utensil. This paste is kept it for 3 days in summer and 6 days in winter for allowing having fermentation. Paste is squeezed and liquid is collected. After adding the water, this liquid is taken as traditional beverage called esing engin apong.

5.0 Bamboo based fermented foods

A wide range of diversity exists in fermentation process of bamboo shoots, traditionally evolved by Adi women through the informal learning. The Adi women prepare bamboo shoots into three major forms. First one called ekung which is fermented by two methods. Second one is dried shoots called eyup, and third one is used in fresh from, called eting. Fresh
one is consumed directly after boiling with several indigenous leafy vegetables.

5.1.1 Ekung (fermented bamboo shoot)

To have ekung, there are two methods for its preparation:

5.1.1.1 First method

Required quantities of bamboo shoots are collected by women from the forest areas. After peeling, small slices are made. Inside the bamboo made basket (called papur), ekkam leaves are placed at bottom, on which slices are kept in layers and pressed. On the top, slices are covered properly with ekkam leaves to make the basket airtight. The basket is left for 5-6 days in summer and 8-10 days in winter for complete fermentation. The fermented bamboo shoot thus prepared is called ekung.

5.1.1.2 Second method

The required quantity of bamboo shoots are collected and put in the edung (cylinder, open from one side and made from local variety of bamboo ‘eye’). The slices are properly pressed and made airtight with the ekkam leaves. The edung is left for over 4-5 days for fermentation and shoots are ready to use. These days almost every household of Adi women has replaced traditional method of bamboo fermentation with the method of using plastic bucket where the chance of either absorption or leaching of fermented liquid is less than the traditional method. The fermentation process in this method is faster than the previous method irrespective of whether it is winter or summer.

Up to 1980s, there was a unique tradition of processing the bamboo fermentation to reduce the cyanide percentage. Cyanide causes several diseases/disorders related to nervous system, miscarriage, abnormal child birth and goiter problems. Due to this, still old aged women advise the pregnant women not to eat any bamboo based food product unless it is rigorously processed. For reducing the cyanide percentage at the time of processing the bamboo shoots, 2-3 small size holes were made inside the edung. During the period of fermentation, these edungs are kept near the water stream or river bank in such a manner so that stream water touches to the bottom of edung. Thus, the toxic compounds are leached out. It also helps to maintain the temperature inside the edung. The bamboo shoots processed by this method were quite tasty and have good keeping quality than other methods. With the passage of time, this traditional wisdom has been eroded at an alarming rate among the younger generation.

5.2 Use of bamboo based foods

The fermented bamboo shoot is used by mixing with a large number of local vegetables and ethnozoological recipes. Adi women reported that small fishes break easily into small pieces during cooking. To minimize it and improve the taste, ekung is added into it. Ekung is mixed not only with large number of leafy vegetables, but also in pork, mithun meat (Bos frontalis), etc. The ekung is used in many cultural occasions and festivals like Solung, Etar and Aran. During off season, the need of bamboo shoots is fulfilled by champa fruit (Dillenia indica).

The fresh raw bamboo shoots after making into small pieces are also added with different forest leafy vegetables, insects and ethnozoological foods. For example, dried bamboo shoots (tenga) are mixed with a caterpillar of bengi tree (Cassia siamea) and boiled. It is preferred for quick recovery of the weak person. Fresh bamboo shoots are mixed with marsang (Spilanthes acmella) leaves along with sibol chilli (an indigenous variety) and dilap (indigenous onion) and boiled together. Similarly, bamboo tenga is mixed with koppir (Solanum sp.), ginger and chilli (a local variety sibol) for making a chutney. The same leafy vegetables as well as lai saag (leafy mustard), tapioca leaves and sweet potato leaves are mixed with dried bamboo tenga and boiled together for consumption. The preparation of ethnic foods using dried bamboo shoot varies according to the season and is mostly used during winter.

6. Cultural capital and traditional foods: ways of learning and exchange of foods

A rich and diverse cultural capital exists with the life style of Adi women and tied with nutritionally rich traditional foods. On various occasions like festivals, definite kind of wild local plants and games are collected from forest, and cooked after mixing together. In topu dance (war dance of Adi), a group of Minyong tribe (Adi-subtribe) performs this dance in the Mosup (community hall-made of bamboo and wooden). During the dance, the people often collect dried meat of mithun (Bos frontalis), pork, dry fish, apong (alcoholic beverage made of indigenous rice/ finger millet/maize/tapioca rich in protein), firewood and local rice. These food materials are commonly cooked in mosup and eaten during the
dance. Similarly, in other festivals like *aran* (March 7), *etor* (May 15) and *solung* (September 1) *miri* (community priest) dance and collect dried forest animals’ meat and other local food materials from each household. This is cooked commonly in *mosup* and share with community members. During the dance, they sing local songs signifying the values of plants, forest, water, mountain, etc and their relativity with *Adi* food habits. During the *aran* festival of *minyong* community, songs are sung by only male gender and the group who perform it is called *yongjong*. This *yongjong* contact every household and perform the dance. In the gift the host of *yongjong* offers dried meat of rat, *mithun*, and local rice. The collected food materials are coked by this *yongjong* in the community hall and consumed by the villagers presently. In the transitional villages, the *yongjong* has started selling of collected food materials while during the past the surplus amount of food was used to exchange with other food materials of neighboring tribes.

In every marriage local rice, meat, *apung*, fish, *kebung* (*Ratuja bicolor*), pork and *mithun*’s meat are major food items. *Adi* women perceive that some of the foods like local rice, orange, jackfruit, pineapple, banana and pork are income generating foods. *Mithun, kebung, apung* and local rice are considered as the income elastic and prestigious foods offering to special guests.

7. Communication of food based knowledge

There are number of indigenous sources and ways of communicating and transferring food based knowledge systems from one generation to another (Fig. 10). Many of the traditional foods of *Adi* women are traditionally learned over generations. Inter-tribal marriage systems in particular or customary marriage systems provide an opportunity to the *Adi* women to exchange food based knowledge systems that improve recipes and related learning process. Whenever a lady joins a family (primary social institution) after marriage, contestation for culinary supremacy starts in a subtle manner and finally the family members make some recipes continue as they were evolved in the long past and some are modified, or created totally afresh.

Sometimes even in formal gathering, group of women from different tribes belonging to other states of North-East India perform indigenous dances and sing folk songs containing themes of nature, agriculture and foods of tribal life style. These cross cultural relations maintain communal harmony; and transfer food related knowledge from one place to another. The cultural capitals of *Adi* community help in evolving, and maintaining the informal knowledge networks; and commutating the related messages.

**Discussion**

The knowledge variability about traditional foods among women of different villages might be on account of extent of availability of plants from forest and jhum land used in foods\(^1\). A large gap about traditional knowledge on foods was observed among different age groups. This variability could be an indication of knowledge erosion among younger generation, and less interest to consume traditional foods, and opportunity for learning and interacting with nature\(^1\). Fragile ecosystems compelled *Adi* to explore and adapt rich bioresources as part for their food systems, and that has been further enriched cultural diversity from sub-tribes of *Adi* community (Fig. 11). Culturally rich traditional foods prepared from the ethnobotanicals and ethnozoological resources are not only an integral part of the *Adi* diet, but are rich in nutrition as well. The richness in nutrition and medicinal values may be governed by organic cultivation system, types and nature of plants and animals. These traditional foods consumed by *Adi* women play multiple roles such as in nutritional and

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1. Footnote here.

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![Fig. 10—Sources of communication and transfer of food based knowledge systems](image1)

![Fig. 11—Constraints and opportunity framework of Adi community for evolution of traditional knowledge and adaptation system](image2)
medicinal security both. Thus, these foods provide scope to screen for testing of their potential for identifying neutraceuticals compounds. Whether such food after refinement and value addition can be added into mid day meal programmes or not, is a matter of thought and debate.

Interestingly, a considerable number of fermented foods (legumes, cereals and oil based) are consumed by Adi women. The foods are process of natural adaptation from time immemorial on account of ecological compulsions. According to nature of foods, these might be rich in protein since they are processed through fermentation and also added with meat/fishes. The reason for consuming fermenting food could be due to the climatic factors, such as high rainfall, high humidity in weather and thus high probability of spoilage of foods. Therefore, women have developed location specific skill to ferment and store these foods for longer usage. Similarly, the traditional alcoholic beverages prepared from indigenous rice and finger millet- rich in protein, are consumed most often. The preparation and more frequent use of such beverage might be on account of availability of preparing materials, cultural novelty and biological demand of human body. For example, after a daylong physical works in jhum land, women return in evening to their home. In evening and before the dinner, they take fermented rice (noggin), and residue of apong with green leafy vegetables and tubers. These foods both provide quick energy and relief from body pain as perceived by Adi women (85.9%)\(^{10}\).

A collective action proceeded by a women is intermingled with rich cultural heritage of priceless capital. It ensures the exchange of local foods while providing an opportunity to learn and share nutritionally rich foods among the members of Adi community. A culinary competition organized in this study was able to provide diversity and status of food based knowledge systems. The experiences gained through series of recipe contest provided lessons that, this can be helpful to document indigenous knowledge of women about various uses of biodiversity in foods; identify culinary diversity within a village; understand how the wild (uncultivated domain) and the domesticated plants and animals are blended together- for example chutney made of shrimp, local ginger and kopi (Solanaceous sp.) for making foods, how 'weeds' and other wild ethnobotanicals become ingredient for recipes, and how taste, flavour, health, medicinal and cultural uses are combined in the process. The culinary skills of women on biodiversity access, use and conservation also provide a clue to learn about sources of knowledge and institutions who nurturers it. For example among Adi women, reglap is the informal rural social group who go to forest for gathering forest based products for food and medicines. This group also makes an informal channel in marketing the local food products made of forest and non-forest ethnobotanicals. Thus, reduces time in forest during food collection and drudgery also.

The method and approach of selection, preservation and processing of a food species indicated adaptive skill of Adi women. Such adaptive practices can become part of longer strategies of adaptive research on food systems for harsh ecosystems of Eastern Himalaya. There could be a number of problems in maintaining chain of ethnicity and traditional foods. However, the culinary skill of women could provide us a sound database and complete information about village biodiversity and community knowledge on food and medicine based knowledge systems and source for formulating hypothesis on nutritionally rich foods. This knowledge base could also provide us long-term lessons and insights, which could be of great importance for research; and education polices for sustainable use, and conservation of culturally important food resources and continuing this adaptation further. The culture, perhaps, manifests most uniquely through culinary creativity of women.

Conclusion and policy implications

Culturally rich traditional foods, prepared by Adi women from ethnobotanicals and wild games are perceived to be nutritionally and medicinally rich and calorie limited than similar foods cultivated conventionally. Recipe contests provide invaluable source of learning to preserve traditional foods and related biodiversity by raising awareness about the value of traditional foods in health and nutrition and empowerment of women. In rapidly growing nuclear family system, the younger generation does not have opportunity and interest to interact with elders for learning the local foods. It is happening due to the influence of cultural erosion; and economic and technical factors that are emerging threats to social relations and learning chain of traditional food based knowledge learning. In such transitions, the recipe contest thus can provide a good source of informal education to enhance and rebuild the learning chain
about plant based culturally and nutritionally rich foods among younger generation and parents.

The dependency of Adi women on ethnobotanicals and the role of these plants in food security cannot be ignored. The self-sufficient native people living in close connection with nature and maintaining their cultural foods are an inextricable part of natural adaptation. Scouted and screened best traditional food practices after pooling from different villages can be used to develop new products for income generation and women empowerment with value addition to enhance nutritional qualities. The emerging issues on women livelihoods, food security and empowerment need more closure and sound policies to ensure the equity and justice with women who are more knowledgeable and conservator of biodiversity and related resources. Involvement of students, teachers and local communities in collaborative investigations of local foods and related health, nutrition and environmental issues can create a new critical awareness about values of traditional foods. Systematic documentation, characterization, refinement, validation and value addition of traditional foods are needed to be interlinked with government policies, education and research systems for providing scientific and technical base for traditional foods and conservation led adaptation of related biodiversity.

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