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Understanding the Mechanisms of Achieving Food and Nutritional Security through Traditional Tuber Crops Foods: A Case Study among *Konyak* Tribes of Nagaland, India

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Abstract

Tropical tuber crops play a crucial role in securing the food and nutritional security of *Konyak* tribes from remote and backward region of Nagaland, India. Due to their high dry matter content, wide adaptability to soil and climatic conditions and ability to retain quality in semi-processed form for extended storage, tuber crops serve as "secondary staples" for *Konyak* community. An exploratory study was conducted among the *Konyak* tribes of Mon district, Nagaland to document traditional food recipes made from tuber crops and their role in food and nutritional security. A variety of recipes in fresh, dried and fermented forms were prepared from leaves, petioles, tubers/ corms and cormels of tuber crops by blending them with unique localized ingredients. Results revealed that tubers were used both as cereal substitutes and vegetable substitutes during lean season leading to food security. Besides supplying food throughout the year in both fresh and semi-processed form, tuber crops also helped to generate additional income for the tribes.

Keywords: Traditional foods, Tropical tubers, *Konkak* tribes, Nagaland, Mechanisms of Food and nutritional security

Introduction

Traditional food systems of indigenous tribes contain treasures of knowledge that have evolved over generations through continuous interaction of their cultures with local ecosystems (Kuhleinin, 2009). This evolutionary process has brought uniqueness to these foods by blending the cultural traits, sensory and healing qualities. Traditional foods are the food products of a particular culture which is made by blending unique local resources and culturally accepted in the community (Kuhnlein and Receveur, 1996). They are blend of socio-cultural meanings, acquisition and processing techniques, utilization patterns and nutritional consequences for people using the food. For centuries, these foods protected the indigenous tribes during natural disasters as well as lean crop seasons by supplying essential calories and other nutrients. Even when consumed in small quantities, traditional foods supply large amounts of essential nutrients than other foods (Schuster et al., 2011). Though indigenous tribes have nurtured these foods for generations, the market-liberation era has brought significant shifts in food choices owing to westernization of cultures. Despite being life-savers during lean season and disasters, these traditional foods are disappearing from tribal food baskets.

The Indian state of Nagaland (Fig. 1) is located in the North-Eastern Region of India spreading over an area of 16579 km^2 with a population of 1.9 Million. The temperature in Nagaland during the summer season

remains between the 15 °C to 30 °C, while in winter it drops as low as 4 °C. The altitude varies from 200 - 3800 above sea level, while the average annual rainfall ranges from 1300 mm - 2500 mm. Nagaland is located in one of the 25 hotspots of the world in terms of biodiversity (Mangathayaru, 2013). The state supports approximately 2431 species belonging to 963 genera and 186 families under angiosperms. Gymnosperms also register their presence with nine species, under six genera from five families (Nagaland Pollution Control Board. 2014). Predominantly a rural state (82.26% of rural population), the people of Nagaland depend on agriculture for the livelihoods. Food crops are rice, sorghum, wheat, pearl millet, barely, maize and pulses as well as commercial crops such as sugarcane, cotton, jute, potato, coffee, tea, cardamom etc were grown throughout the state. Other significant economic activities include forestry, tourism, insurance, real estate, and miscellaneous cottage industries.

The *Konyak* tribe

The *Naga* tribes of Indo-Mongoloid family, forms a major part of the Nagaland's population. Some of the major *Naga* tribes are *Angami, Chang, Konyak, Lotha, Phoms, Rengma, Sema, Pochury* and *Zeliang.* Among them, *Konyaks* are the warrior-*Nagas*, largest populated race in Nagaland and live in the north-eastern hilly district of Mon (Fig. 1). The *Konyaks* can be grouped into two groups, namely "*Thendu*" (People with tattooed face) and "*Thentho*" (White face) (National Informatics Centre, 2014). The famous festival of the *Konyaks,* "*Aoling Monyu*", is observed during the first week of April every year in order to seek blessings from God "*Yongwan*" for a good harvest. It is celebrated after completing the sowing of seeds in the new *jhum* fields which marks the end of the old year and beginning of New Year. The *Konyaks* are ruled by hereditary chiefs known as *Anghs*, and the institution of Anghship is only prevalent among the *Konyaks*. Though *Konyaks* are economically inferior to other *Naga* tribes, they shared a distinct symbiotic relationship with the eco-system and nurtured their food diversity through skillful blending of plants and animal resources. The high diversity of plant genetic resources has been maintained and managed by *Konyaks* through well-maintained home gardens and *Jhum* practices.

The Mon district (Fig. 1) is the home of a variety of tuber crops like cassava (*Manihot esculenta*), sweet potato

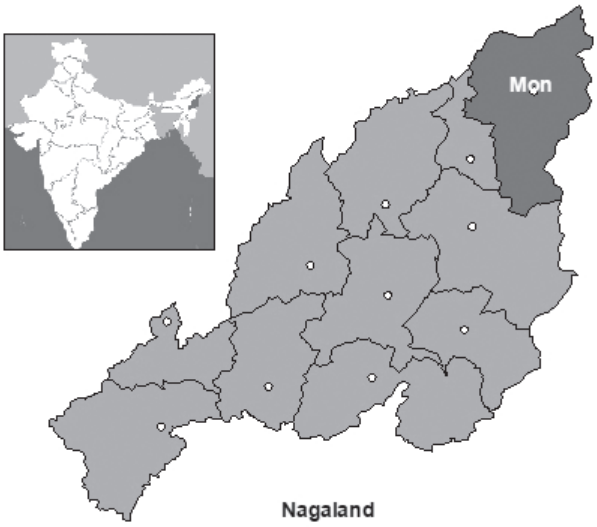

Fig. 1. Location map of Mon, Nagaland.

(*Ipomea batatas*), taro (*Colocasia* spp.) and yams (*Dioscorea* spp.) that occupy a prominent role in the *Konyak* food systems. In Mon district, tuber crops are found in both wild and cultivated conditions. Among tuber crops, taro is cultivated in large scale in both in *jhums* (shifting cultivation) and homestead conditions mostly as a mixed crop. Several studies indicated the richness of taro biodiversity in the Mon district and their role in *Konyak* food system (Bhan, 2009; Jamir et al., 2008). The tubers are consumed both in fresh and preserved form through a variety of recipes. The *Konyak*s utilize the tubers not only as foods but also as medicines to cure ailments (Jamir et al., 2008). Past studies conducted in North-Eastern India documented few tuber crops blended with soybean based foods (*Ao* tribe of Nagaland) (Singh et al., 2007) and taro based foods in Manipur (Devi and Kumar, 2010). However, there is no systematic study was conducted to document the tuber crops based traditional foods of *Konyaks*. The purpose of this paper is to document the preparation methods of tuber crops based traditional foods of *Konyak* tribes of Nagaland. The underlying mechanisms of securing food and nutritional security through traditional tuber crops foods are discussed.

Materials and methods

Since the research was aimed to document the traditional foods of *Konyak* tribes and assess their role in food and nutritional security, an exploratory research design was used. A multistage sampling procedure has been applied to select the study sample. After discussion with Nagaland

state government officials, two sub-divisions of Mon district i.e. Aboi and Mon were selected based on cultural ethnicity and diversity of traditional foods. Later, two villages from each sub-divisions i.e Nganching and Aboi (Aboi) and Lampong and Sheanghah (Mon) were selected with the assistance of Krishi Vigyan Kendra (KVK), Aboi, Mon district. Information on tuber crops based traditional foods were collected through Participatory Rural Appraisal (PRA) and Focus Group Discussions (FGD) methods. Among PRA tools, seasonal calendar and matrix ranking were used to identify the consumption patterns. The FGDs were selected since they provide a collective view of the community while eliciting non-verbal information (excitement, doubt, stress) during the sessions (Office of Quality Improvement. 2013). Two focus group discussions were conducted using the procedure given by Edmunds (1999) in selected villages, and 10 local representatives participated in each discussion. The focus group questions were developed by the research team, which were reviewed by KVK officials and village elders for content and comprehensibility. A semi-structured questioning route was used in the FGD to ensure consistency in questions asked across groups, yet allow for some flexibility in accordance with topics raised and level of participation within the groups. Questions were primarily aimed at exploring traditional tuber crops recipes and their preparation methods, sensory and nutritional benefits. After modifying the questions, they were pretested on a group of 20 local people. Each FGD ran for approximately one hour and were facilitated by a moderator and a note-taker. For triangulating the data collected, all discussions were audio-taped. On completion of FGD, the respondents in each village explained the cooking procedure of the recipes and demonstrated to the research team. Five elderly female for each village verified the cooking method and information collected during the FGD. After documenting tuber crops traditional foods, the role of tuber crops in securing food and nutritional security was collected from 80 randomly selected respondents (ten each for a village) using 24 hour recall method. The cereal substitution and vegetable replacement was calculated by asking respondents "How many times did you consume traditional tuber crops foods in place of cereal staple / vegetable in a week during crop lean season or period of non-working?", The substitution per week was calculated by dividing number of times the tuber crop traditional foods substituted cereals/ vegetables by total number of meals consumed in a week. If the respondents indicated skipping meals due to slow digestion of tubers (not hungry), it was counted as cereal replacement. Consuming leaves, petioles and tubers collected from forests during lean season was also counted for cereal / vegetable substitution. The prior informed consents were obtained from village/ community heads while documenting traditional foods.

Results and discussion

Food consumption patterns of *Konyak* tribes

Rice is the staple food of *Konyaks,* which is consumed thrice daily along with a meat dish, a boiled vegetable dish, and chutney (A pungent relish made of fruits, spices, and herbs). Maize and millets are also consumed in small quantities. Some common dishes consumed by *Konyaks* are fermented bamboo shoot, fish (fermented/smoked/ dried), fermented soybean, smoked pork and beef. Rice beer and black tea are common beverages consumed. Food consumption patterns of *Konyaks* varied with agricultural seasons and climate. While rice and millets are consumed throughout the year, maize consumption is restricted to June – October every year. Though tuber crops are consumed throughout the year in both fresh and processed form, their consumption is higher during lean season.

Traditional tuber crops foods

Among tubers, taro is widely consumed in both fresh and processed form. *Konyaks* consume the tender leaves, shoots, petioles, mother corms/ cormels of taro and prepare a variety of dishes from them. Some important taro landraces that are preferred for consumption are listed in Table 1.

Semi-processed taro leaf products like *Teangyakwan (Anishi), teangwan* and *teangkhoi* are prepared during harvest season and consumed throughout the year. Dried taro products are stored in bamboo baskets or cloth bags that are tied in a wooden structure placed above the earthen stove in the kitchen (Fig. 2). The heat and smoke emerged during cooking prevent the spoilage of these products. Various semi-processed foods and recipes from tuber crops consumed by *Konyak* tribes are listed in Table 2. The semi-processed foods of tuber crops are displayed in Fig 3 (a-e), while the household recipes are shown in Fig. 4 (a-f).

Fig. 2. Traditional Naga Kitchen

Table 1. Taro landraces preferred for consumption by *Konyak* tribes of Nagaland, India

Part of taro used	Local name of preferred landraces
Young Unfolded leaf	*Balsan, Balkedoh, Nalon, Kungnyak, Lama, Thungkho, Tunghcho, Tungphum, Tungtho, Toasa*
Young leaf	*Nalon, Tungcho, Toasa*
Matured fresh leaf	*Nalon, Lama, Thungkho, Tungphum, Tungtho, Toasa*
Matured dry leaf	*Balsan, Balkedoh, Nalon, Toasa*
Young petiole	*Balsan, Balkedoh, Nalon, Pungmathung, Tungcho, Tungtho*
Matured petiole	*Nalon, Tungcho, Toasa*
Mother corm	All landraces
Cormels	All landraces

Table 2. Glycemic index of tuber crops and other staple foods

Food	Glycemic index (Glucose = 100)
Sweet potato	70
Yam	54
White yam	62
Cassava	94
Eddoe taro	61
Dasheen taro	76
Tannia	60
White rice	89
Whole wheat kernels	30

Source: Atkinson et al., (2008); Harvard Medical School. (2014); Ramdatt et al., (2004)

Mechanisms of food and nutritional security

As discussed earlier, tuber crops play a crucial role in the food and nutritional security of *Konyak* tribes. In general, food security is defined as the state at which all people, at all times, have physical and economic access to sufficient,

Fig. 3. Semi-processed food products from tuber crops consumed by *Konyaks*, Nagaland. 3a. *Teangyakwan* or *Anishi*, 3b. *Teangwan*, 3c. *Fluo*, 3d. *Shouhwan*, 3e. *Penkhen Kheh*

Fig. 4. Tuber crops based household recipes consumed by *Konyaks*, Nagaland; 4a. *TeangyakhoiI,* 4b. *Teanghoi;* 4c. *Teang*; 4d. *Fluo Curry*; 4e. *Tungrhak*, 4f. *Tung Pai*

Table 3. The tuber crops based semi-processed foods consumed by *Konyaks* and their role in food and nutritional security

Name of the food	Tuber crop	Tuber crop plant part used	Type of processing	Mode of food and nutritional security	Preparation	Proportion of cereal or vegetable substitution during lean season (%)
Teangyakwan /Anishi (Dried taro leaf cakes)	Taro	Tender leaves	Natural fermentation followed by sun drying	Vegetable substitute	May-August	20
Teangwan (Dried taro tubers)	Taro	Small sized taro tubers	Sun drying	Cereal and vegetable substitute	October-November	29
Fluo(Dried leaves)	taro Taro	Mature leaves	Sun drying	Vegetable substitute	October - November	15
Shouhwan (Dried petioles)	taro Taro	Tender taro petioles	Sun drying	Vegetable substitute	May-August	10
Tunggan (Dried tubers)	taro Taro	Small sized taro tubers	Sun drying	Cereal and vegetable substitute	October-November	20
Penkhen Kheh (Cassava flour)	Cassava	Tubers	Chipping, sun drying and grinding	Cereal substitute	October-November	6

safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Food Programme, 2009). Tuber crops are found mostly wild in Mon district as the fresh tubers are available at "free-of-cost" to the tribes. The cassava and taro leaves are also used as pig feed in both fresh and dried forms. Few farmers harvest the wild taro and cassava leaves and sell in the local market to generate additional income to buy food. Since tuber crops can survive in disasters like flood and drought, they offer assured carbohydrate supply. Tubers are the major component of *Konyak* diet during lean season which cater to their energy and nutrient needs thereby providing food and nutritional security. Specific mechanisms through which the tuber crops provide food and nutritional security are discussed.

Prolonging satiety

Satiety is a feeling of fullness of stomach after the end of eating and prevents further eating before the return of hunger (Bellisle et al., 2012). Satiety helps in prolonging the hunger between two meals. The *Konyaks* consume boiled tubers (fresh or semi-processed) as snack in the early morning and evening along with black tea. Since these tubers are baked under half-burned charcoal, and cooled with low-temperature in during early morning, the starch becomes resistant to

Table 4. Tuber crops based household recipes consumed by *Konyaks* and their role in food and nutritional security

Name of the food	Tuber crop	Tuber crop plant part used	Type of processing	Mode of food and nutritional security	Consumption	Remarks
Teangyakhoi (Taro shoot Chutney)	Taro	Fresh, tender and curled taro shoots from 3 month old taro plants	Baking in traditional charcoal grilling	Vegetable substitute	May-August	Other key ingredients – Mixed with fermented soybean (*longpeang)* and wrapped *in Lylu/Molai* leaves before cooking
Teanghoi (Taro tuber curry)	Taro	Medium sized taro tubers	Boiling and frying	Vegetable substitute	All year	Special dish during *Aoling* festival of Nagaland Prepared with dried fish or dried buffalo/ pork meat on special occasions
Teang (Boiled Taro)	Taro	Mature taro tubers	Boiling	Cereal substitute	October-November	Consumed as snack during early morning along with *Mekhi* (a chutney made from dried bamboo shoots by mixing it with king chillies).
Fluo Curry	Taro	*Fluo* (Dried taro leaves)	Boiling	Vegetable substitute	All year	Other key ingredients - *Meishong* (fermented bamboo shoots), dried king chilly pieces
Tung Rahak Sui (Taro petiole curry)	Taro	tender, finger thick taro petioles with curled leaves	Boiling	Vegetable substitute	August-September	*Nulan* variety of taro is preferred

Tungkungsui (Taro petiole curry)	Taro	Mature but soft taro petioles	Boiling	Vegetable substitute	September to December	Other key ingredients - fermented bamboo shoot, *Akuni* (fermented soybean) or *Sukha mass* (dry fish)
TungrhakI (Taro leaf curry)	Taro	Tender, folded taro leaves	Baking	Vegetable substitute	October to November	Wrapped in Canna or banana leaves for baking
Tunkhon (Boiled taro tubers)	Taro	Big sized trao tubers	Boiling	Cereal substitute	October-November	Consumed as snack during early morning along with tea/ chutney.
Tung Pai (Boiled taro tubers)	Taro	Prepared from *Tunggan* (dried taro tubers)	Boiling	Cereal substitute	All year	Consumed with chutney or with *Suingan*.
Wukhen (Boiled / baked sweet potato tubers)	Sweet potato	White skinned sweet potato tubers	Boiling/ baking	Cereal substitute	October to November	Consumed as snack during early morning along with *Thung Rhekh chutney*
Suinik (Sweet potato rice)	Sweet potato	White skinned sweet potato tubers	Boiling	Cereal substitute	Consumed during rice harvest season (November to January).	Other key ingredients - sticky rice, *Akhuni* (fermented soybean) and dried fermented bamboo shoot
Khen Poi (Boiled yam tubers)	Greater yam	Yam tubers	Boiling	Cereal substitute	Lean season*: May-August	-
Khen Sui (Yam curry)	Greater yam	Yam tubers	Boiling	Vegetable substitute	December- March	Other key ingredients - seasonal vegetables

Penkhen An (Cassava bread)	Cassava	*Penkhen* (cassava flour)	Baking	Cereal substitute	Lean season: May-August	Baked while wrapped inside *Lylu* leaf	Considered as the food of affluent people.

* Lean season: Usually the cropping season where (i) cereals, vegetables and fresh tubers are costly or not available, (ii) high expenditure for crop management, (iii) Food grains stored at household are either reduced or exhausted

digestion (Asp, 1995) leading to slow digestion and lower glycemic response. Studies indicated that taro (51.22%) and yam (16.55%) starches have low digestibility (Aprianita et al., 2009). The glycemic index of various tubers along with staples is displayed in Table 2.

The low digestibility and gradual energy release keeps the *Konyaks* active during agricultural work and prolong their satiety (Grace, 1977). Absence of hunger helped the tribes to reduce the cereal consumed during breakfast or skip meals to preserve the food grains for longer time during lean season.

Cheap cereal substitutes

As the tuber crops are either wild or cultivated in low management conditions, the cost of cultivation is greatly reduced. The saving from low input and management was used for buying cereals and other staples during crop lean season or period of unemployment. Fresh and semi-processed tubers are either baked or boiled and consumed during early morning, there by reducing cereal consumption in the breakfast. Data presented in Table 3 indicates role of tuber crops as cereal substitutes and their extent to which they replaced cereals. Semi-processed tuber crops products like *Teangwan* (Dried taro tubers), *Tunggan* (Dried taro tubers) and *Penkhen Kheh* (Cassava flour) together replaced 55% of the cereals during lean season or period of unemployment indicating the importance of food security in the villages.

Vegetable substitutes

The *Konyak* diet consists of fresh plant parts and semi-processed products from tubers and other crops. During cropping season, they consume the taro tender leaves, shoots and petioles while the semi-processed tuber crops products are eaten during lean season. The *Konyak* women perfected an ambient storage mechanism where the semi-processed tuber crops products can be stored for ten months without spoilage and are consumed when other cereals or vegetables are costly or not available. As vegetable substitutes, they supply essential nutrients at cheaper cost. Data presented in Table 3 and 4 indicate that semi-processed taro products *Teangyakwan* (Fermented and dried taro leaves), *Fluo* (Dried taro leaves) and *Shouhwan* (Dried taro petioles) together replaced 45% vegetables during lean season or period of unemployment.

The traditional tuber crops help to achieve food and nutritional security for *Konyak* tribes by substituting cereals and vegetables at substantial levels (> 40%), besides generating additional income.

Conclusion

Tuber crops play a crucial role in the food and nutritional security of *Konyak* tribes of Nagaland. With the ability to prolong satiety, these cereal substitutes and vegetable substitutes, played significant role in securing food and nutritional security of *Konyak* tribes during crop lean season as well as in period of unemployment. Though this work is constrained by smaller sample size and lack of facilities to establish nutritional superiority of traditional tuber crop based foods over traditional staples, several tuber crops semi-processed foods

and recipes were documented in a comprehensive way. Considering the variety and diversity of the traditional tuber crops recipes consumed by *Konyaks*, there is an urgent need to initiate a larger programme to refine these recipes to enhance their nutritional quality.

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