CHAPTER 11

Interventions Using Wild Edibles to Improve the Nutritional Status of Khasi tribal Women

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INTRODUCTION

The Northeastern region of India is inhabited by a number of small and large tribes and in comparison to the rest of India this area is predominated with tribal population of upto 75%. Meghalaya is one of the seven sister states in the Northeastern part of India where 85.5% of the population is tribal (NCHS, 1987). Khasis, Garos and Jaintias are the three main tribes of Meghalaya. The entire region represents a unique set of topography, economic, sociological and cultural conditions which differ mostly from the rest of the country (Parvathi Easwaran et al., 1989). In the past the people of Meghalaya have lived in isolation, entrenched in tradition and identity (Shreeranjan, 2001). Though the tribal society has made much headway towards development, the rural areas of Meghalaya are still steeped in tribal traditions without many influences from the outside. Agriculture by Jhum (slash and burn method) cultivation and animal husbandry are the main occupations of the tribal population (Ramakrishnan et al., 1992). In Meghalaya where industrialization is virtually non-existent, a major part of the population depends on agriculture for their livelihood.

The Khasi society is matrilineal and women play an important role as part of the major work force of the tribal community. The health and nutrition of the entire family rests on their shoulder as tribal women primarily take all decisions related to family nutrition. The typical Khasi meal consisted of a plateful of rice, one or two pieces of meat and vegetables including potato. The diet is monotonous and has very little change in terms of the methods of preparation. The only spices used in cooking are turmeric, salt, ginger and green chillies. This typical meal is eaten twice or thrice a day (Agrahar-Murugkar and Pal, 2004). Though the typical Khasi diet is still being followed subtle changes are being observed due to influences from the outside world. This was especially true for people who have higher income and/or who worked outside the village in the city (Agrahar-Murugkar et al., 2005). A study on the nutritional profile of Khasi tribal women demonstrated that there was a deficiency of key nutrients in the diets (Agrahar-Murugkar and Pal, 2004). One of the reasons for this could be that wild edibles, which were consumed traditionally, are now on the decline. Due to the climatic conditions in Meghalaya greens are perennial in the state. Wild edibles like *Houttuynia cordata, Fagopyrum cymosum*, *Alternanthera philoxeroides, Plantago major* etc are abundant in the nearby forests of the state. With receding forests and change in the lifestyle, the dietary consumption of the wild edibles is on the decline.

Therefore a study was conducted to study the interventions using wild edibles to make up for the dietary deficiencies of key nutrients in the diets of Khasi tribal women.

METHODOLOGY

Our institute, for the purpose of agricultural extension activities has adopted thirteen Khasi villages in Ri-Bhoi district, Meghalaya. As a part of a larger study on tribal women of Meghalaya funded by the World Bank through the National Agricultural Technology Project this study was conducted in these 13 tribal villages. The area under the study is largely rural and is governed, apart for the regular administration by the "Durbar Shnong" or Village Council. Before actual collection of data, the Headmen or "Rangbah Shnong" of the respective villages were contacted to get their formal permission to conduct the study. The Headman was also the node for collection of preliminary information of his village as well as introduction to the villagers. A basic questionnaire was administered to the head of each of the household who in the Khasi tribe is a woman, to elicit basic statistics of the village like age, occupation, educational status, physiological status (of the women of the household) and the income pattern including income from land and livestock of all the members of the household. Based on this information the Households of the village were stratified on the "Means of livelihood". Twenty-five Households were chosen from these strata using probability to size (Agrahar-Murugkar and Pal, 2004). Seven hundred and thirty five women in total were

respondents in this study out of which 362 were non-pregnant and non-lactating (NPNL), 78 pregnant (P) i.e. in the second and third trimester and 295 lactating (L) i.e. up to six months after the birth of the child.

Information of the food consumption pattern and nutritional status was collected with the help of personal interviews and administering different types of questionnaires to the respondents. Food consumption pattern was determined using the food frequency questionnaire. It provided a list of food groups, frequency of consumption of these groups and commonly consumed food items under each group. The respondents were asked how much and how often they ate each item on the list. The items consumed were categorized into cereals, pulses, flesh foods, green leafy vegetables, other vegetables, roots and tubers, fruits, dairy products, flesh foods, fats and oils and sugar and jaggery. After this 24- hour recalls were administered to the respondents. In this procedure the respondents were asked to list all the foods and beverages consumed during the previous day. The interviews and 24-hour recalls and food frequency questionnaires were administered between July 2001 and June 2002. On return from the villages the data in the forms were filled onto a specially designed computer program on Fox pro 2.6. This program maintained all the details of all the information in the 13 villages. The package calculated the frequency of food consumption and the amounts of particular food groups consumed daily by each of the respondents (Agrahar-Murugkar and Pal, 2004) .The nutrient composition of the diets was calculated by the computer program using the food composition database tables by Gopalan et al. (1998), which contains accurate quantities of particular nutrients in 100g of each food. The nutritive composition of the diet of the participants was then compared to the Recommended Dietary allowances of Indians. The dietary deficiencies of nutrients were described in the results of the study by Agrahar-Murugkar and Pal (2004) and were used in this study as the reference for the dietary deficiencies in women observed.

Sample Collection: The villages in the Ri-Bhoi district of Meghalaya and the local markets in and around these villages were surveyed for the study. The main local market -Iewduh, situated in the capital of Meghalaya, Shillong was also surveyed. The Headman of each village or Rangbah Shnong was contacted to gain entry into the villages to carry out the survey. The Headman was also the mode for collection of preliminary information of the villages as well as introduction to the villagers. Rapid rural appraisal method was used to identify the most commonly consumed unconventional foods in the area. These samples were then gathered from different areas and processed as described below.

Sample Preparation*:* The green leaves from the forests and the markets were first washed to remove mud and other extraneous material**.** The leaves were blotted dry till the excess moisture was absorbed. The leaves were then cut into small pieces. The thick stalks and other inedible portions were discarded. The samples were then weighed and dried in the oven at 60^0 C. After complete drying the sample was ground to obtain a fine powder. This powder was sealed and stored in vacuum desiccators until used further for analysis.

Analyses

Micronutrients: The ash obtained after combustion in the muffle furnace was used to prepare the ash solution, which was in turn used for the estimation of calcium. Calcium was precipitated in acidic medium as insoluble calcium oxalate by adding saturated ammonium oxalate solution. The precipitate was dissolved in dilute sulphuric acid (1:9), heated and the oxalic acid thus released was titrated against standard potassium permanganate solution in warm condition (60°C) to get the calcium content of the sample (Raghuramulu et al., 1983). The micronutrients Fe were determined by atomic absorption spectrophotometric method. The samples, which were digested in a tri acid solution of H_2SO_4, HCl and HNO_3 were passed through AAS using different lamps and, calibrated for different micronutrients.

The β- carotene was estimated by Food Research and Analysis Centre (New Delhi) using by the method given by Siong et al., 1995.

All the samples were analyzed in duplicates for the analyses done. Results were accepted only when the duplicates were within 0.05% of each other.

RESULTS AND DISCUSSION

On observing the dietary deficiency of key nutrients in comparison to the RDA in NPNL, P and L women (Table 1) it was found that calcium, iron and b-carotene was deficient in all the physiological states observed. In calcium the maximum deficiency was for L women (666 mg/d), followed by P (554.5 mg/d) and NPNL (33 mg/d). Consumption of Dairy products being virtually non-existent in this community could be a major reason for this dietary deficit. The tribals require the realization that pregnant

women need more calcium as compared to women in other physiological states. There is no special diet being followed for pregnant women, who only eat to appetite (Agrahar-Murugkar and Pal, 2004) .In the case of iron (mg/d) the highest deficiency was seen in the case of P women (39.68), followed by L women

Table 1. Deficiency of key nutrients in comparison to the RDA in Khasi women

Physiological Status	*NPNL*	*P*	*L*
Sample size	362	78	295
Micronutrient Status			
Calcium mg/d	367	445.5	334
RDA	400	1000	1000
Dietary Deficiency	33	554.5	666
Iron mg/d	29.02	20.32	18.99
RDA	30	60	30
Dietary Deficiency	0.98	39.68	11.1
b-carotene mg/d	1562.7	2311.3	1084.5
RDA (mg)	2400	2400	3800
Dietary Deficiency	837.3	88.7	2715.5

(11.11). In P women the dietary deficit was marginal. Though the women consume green leafy vegetables regularly the amount they habitually consume does not increase in pregnancy. Again the increased need of the body for this important micronutrient needs to be stressed. The highest deficiency of β-carotene (mg/d) was observed in L women (2715.5) followed by NPNL (837.3) and P women (88.7). In a land where carotene rich vegetables and fruits are plentiful its dietary deficiency is unexpected. However in comparison with RDA's the intake of this essential vitamin in inadequate in the diets of NPNL women and lactating women since carotene rich foods are important revenue earners and are sold in the market.

There are many ways to enhance the intake of key nutrients but dietary interventions must be feasible and consistent with existing food preferences. In this case of Khasi women, since the land is fertile and yields a wide variety of foods, minor modifications in the food habits using locally available ingredients, done with the help of nutrition education programs and community development programs could be the key to solving the nutritional deficits in Khasi women. Toward this goal a total of 27 unconventional green leafy vegetables consumed by the Khasi tribals were identified with the help of a rapid rural appraisal survey and these were collected from the forests and markets of the East Khasi hills. In the present study, 26 could be taxonomically identified. Only one herb, "Jangew" consumed by the tribals was not identified scientifically. All the green leaf species in the present study were found to be seasonal and the availability of the leaves ranged from April to October coinciding with the absence of the cultivated species of greens (Table 2).

The analyses of the wild edible greens (Table 3) revealed that calcium ranged from 2.2 mg % in *A.viridus* to 665.8 % in *F.cunea.* On the fresh weight basis the calcium content of *B.roxburghii* (337 mg %) compares well with the conventional *Amaranthus* species with calcium contents of around 350 mg % (Gopalan et al., 1989) and unconventional sources like *Chenopodium album* with content of 444 mg % (Katiyar et al., 1985). Leaves containing high amount of calcium showed high levels of fibre as well which could render some of the calcium unavailable e.g.

Table 2: Sample / local name, Botanical name and Seasonality of wild edibles.

Local name	*Botanical name*	*Seasonality*
Jaut	*Allium schoenifolium*	April-May
Jalyngiar	*Sonchus oleoraceus*	April-September
Khlien syiar	*Centella asiatica*	-do
Skor blang	*Plantago major*	-do
Jamyrdoh	*Houttyunia cordata*	-do
Jarain	*Fagopyrum cymosum*	-do
Jakhain	*Sonchus arvensis*	April-October
Duhania Khlaw	*Eryngium foetidum*	May-June
Jatira	*Corydals sibiricus*	May-July
Jyllang	*Allium ampelloprassum*	April-September
Jangew	*Unidentified*	May-September
Tyrkhang	*Diplazium esculentiem*	April-July
Mahong	*Spilanthes acmella*	May-October
Ong put	*Alternanthera philoxeroides*	-do
Bat pied	*Commelina benghalensis*	-do
Bat saw	*Polygonum alatum*	-do
Jalang shor	*Emilia sonchifolia*	-do
Kynbat Dkhiew	*Oxalis corniculata*	April-October
Jalong	*Vernonia altissimifolia*	April-October
Dieng jajew	*Begonia roxburghii*	May-October
Thylleij masi	*Ficus cunea*	-do
Jada saw	*Amaranthus viridus*	April-October
Jarsong	*Hibiscus sabdariffa*	May-October
Jajew maw	*Begonia Rubro-venia*	-do
Trysim khlieng	*Commelina diffusa*	-do
Jamahek	*Dillenia indica*	-do
Jhur kteih	*Nasturtium officinalis*	April-September

B.roxburghii was rich in calcium also contained 23.9 g % of fibre (Agrahar-Murugkar and Subbulakshmi, 2005) meaning that some of the calcium could be unabsorbed. Another factor, which affects calcium availability, is the amounts of oxalic acid present in the leaves, which forms insoluble crystals with calcium, thus preventing absorption. Information on the oxalic acid content of wild plants is also scanty. However, it can be presumed that moderate to high quantities of oxalic acid is present in the wild samples as in case of the domesticated counterparts, which could interfere with calcium absorption.

Green leaves like spinach often prescribed in therapy for iron deficiency anemia contain around 14 mg % of iron. In comparison to that the wild leaves contained iron between 0.2 mg% in A. *schoenifolium* and 16.7 mg % in *O. corniculata*. Many of the leaves like *P.major* (8 mg %) and Jangew (5.7 mg %) also contained good quantities of iron and have been traditionally used as therapy for anemia by Khasi tribals. The method of consumption is also interesting as they are eaten raw as "*chutney*" with addition of lime-juice augmenting iron absorption. However, it must be noted that these iron rich leaves also exhibited high fibre content (Agrahar-Murugkar and Subbulakshmi, 2005) that might decrease the absorption of iron. In spite of this it is heartening that the leaves are a fairly good source of iron.

The richest source of carotene is green leafy vegetables in general and these leaves also have shown to be in the best range. The highest amount of β-carotene was seen in *S. acmella* (6105.7 mg %), followed by *S. oleoraceus* (4051.6 mg %), *F. cymosum* (2708.4 mg %) and *F. cunea* (2537.9mg %). The rest of the samples showed negligible amounts of the vitamin.

Table 3: Micronutrient profile of wild edibles

Sample name	*Ca*	*Fe*	*β-carotene*
	μg % on fresh weight basis		*μg % on fresh weight basis*
A. schoenifolium	99	0.2	6.7
S. oleoraceus	291.5	1.7	4051.6
C. asiatica	204.6	4.7	37.5
P. major	427.8	8.0	46.0
H. cordata	89.7	3.3	28.6
F. cymosum	217.0	1.5	2708.4
S. arvensis	170.0	3.2	13.8
E. foetidum	235.5	4.6	43.7
C. sibiricus	99.4	1.0	0.3
A.ampelloprassum	98.4	-	4.6
Jangew	200.9	5.7	1979.3
D. esculentiem	47.89	1.6	1.3
S. acmella	213.4	1.2	6105.7
A. philoxeroides	135.6	1.0	11.9
C. benghalensis	172.9	1.5	13.8
P. alatum	121.9	1.1	65.7
E. sonchifolia	137.0	3.0	190.6
O. corniculata	161.4	16.7	49.9
V. altissimifolia	200.6	1.8	22.7
B. roxburghii	336.5	2.2	41.5
F. cunea	665.8	1.1	2537.9
A. viridus	2.2	1.2	795.4
H. sabdariffa	225.5	0.4	21.5
B. rubro-venia	269.0	0.6	-
C. diffusa	86.9	11.6	41.2
D. indica	216.6	0.7	-
N. officinalis	92.2	0.6	

Wild edibles rich in micronutrients (Table 4) revealed that among the wild edibles good sources of calcium (mg %) included *F.cunea* (665.8), *P.major* (427.8) and *B.roxhburghii* (336.5). *C.diffusa* (11.6 mg%) and *O.corniculata* (16.7 mg %) were rich in iron and wild edibles rich in β-carotene (mg %) included *S. acmella* (6105.7), *S.oleoraceus* (4051.6), *F.cymosum* (2708.4) and *F.cunea* (2537.9).

In general around 50% of the micronutrients from plant sources are available to the human body. In that case the availability of calcium from the rich sources as an average would be 238.4 mg%. Therefore, in case of NPNL women 100g of any of these sources like *B.roxhburghii*, *P.major* and *F.cunea* would more or less take care of 50% of the RDA and also take care of the dietary deficit of 33 mg/d easily. In case of P women since the requirement of calcium is high the amount of wild edibles would need to be doubled to at least 200g/d. In this case the good sources on an average would provide around 476 mg of calcium. This would be 47.6% of the total RDA and 85.76% of the dietary deficiency of 554.5 mg/d in P women. Similarly in the case of L women also the dietary deficit is high and needs an increase in consumption to 200g/d. If this is achieved then the good sources can take care of 47.6% of the total RDA of calcium for lactating women and 71 % of the dietary deficiency of 666 mg/d.

With regard to iron good sources like *C.diffusa* and *O.corniculata* contain an average of 14.2 mg% of iron. At an availability of 50% we can consider that around 7 mg % may be available. This amount can take care of the dietary deficit of 0.98 mg/d in NPNL women and also fulfill 23% of the RDA. In the case of P women the requirement for iron doubles as compared to the NPNL levels. Therefore to make up for the deficiency of nearly 40 mg/d increased amounts of green leaves should be incorporated in the diet. An amount of 200g/d of these good sources would make up for 35% of the dietary deficit and 23.3 % of the RDA for the mineral. The requirement

Table 4: Wild edibles rich in the nutrients deficient in the Khasi diet

Mineral	*Good sources*
Calcium (mg %)	*B. roxburghii* (336.5), *P.major* (427.8) *F.cunea (665.8)*
Iron (mg %)	*C. diffusa*(11.6) *O. corniculata* (16.7)
Carotene (mg %)	*S. acmella* (6105.7) *S. oleoraceus* (4051.6) *F.cymosum* (2708.4) *F.cunea* (2537.9)

for iron in L women is similar to that of NPNL women and 100g of *C.diffusa* and *O.corniculata* can take care of 63.6 % of the dietary deficit and 23.3 % of the total RDA.

Among wild edibles rich in b-carotene rich sources can provide an average of 3851 mg/d and with the availability of 50% the amount comes to 1925 mg/d. In case of NPNL women this amount is much higher than the dietary deficit of 837.3 mg/d and also takes care of 80% of the RDA. The requirement of b-carotene in P women is similar to that of NPNL women. Since the women consume greater amounts of food during pregnancy (Agrahar-Murugkar and Pal, 2004) the dietary deficit of the nutrient is marginal and consumption of wild edibles can easily take care of the dietary deficit observed in P women. However the requirement of the vitamin during lactation is much higher at 3800 mg/d. Good sources can take care of both the RDA and cover up the dietary deficit if the amount consumed is increased to 200 g/d.

Though these unconventional foods still form a part of the traditional Khasi diet its consumption is slowly on the decline with more and more of the tribal population shifting to agriculture. This could result in alteration of the dietary profile of the tribals with a risk of nutritionally lower quality of diet. The nutritional quality of the diet may decline with agricultural development unless edible wild species that provide essential micronutrients are considered part of the total food system, as the nutritional content of some wild species is superior to widely raised domesticated foods.

SUMMARY AND CONCLUSION

The present study shows that most of the green leaves have high levels of β-carotene, folic acid, ascorbic acid, iron and calcium. Therefore, these leaves could form an important part in combating dietary deficiencies of vitamin A, iron and calcium, which are the primary causes of night blindness and other vitamin A related deficiencies, anemia and osteoporosis especially among women and children in India. Due to its therapeutic value these leaves could form a part of low cost nutritional therapy that has been advocated by the Indian government to combat these serious deficiencies.

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KEYWORDS Nutritional Status. Khasi. Tribal Women. Wild Edibles. Nutrient Content. Dietary Deficit

ABSTRACT Seven hundred and thirty five women of three physiological states Non-Pregnant Non Lactating, Pregnant and Lactating were respondents of the study to ascertain dietary deficiencies of important micronutrients like calcium, iron and b-carotene. Twenty-seven wild green edibles were selected on the basis of rapid rural appraisal and analyzed for the contents of the micronutrients. On observing the dietary deficiency of key nutrients in comparison to the Recommended Dietary Allowance it was found that calcium, iron and b-carotene was deficient in all the physiological states observed. Wild edibles rich in calcium (mg %) included *F.cunea* (665.8), *P.major* (427.8) and *B.roxhburghii* (336.5). *C.diffusa* (11.6 mg%) and *O.corniculata* (16.7 mg %) were rich in iron and wild edibles rich in â-carotene (mg %) included *S. acmella* (6105.7), *S.oleoraceus* (4051.6), *F.cymosum* (2708.4) and *F.cunea* (2537.9). If around 50% of the micronutrient were considered available to the body then the wild edibles could take care of around 83% of the dietary deficit of the nutrients and around 52% of the recommended levels for the nutrients. This in the cases of iron and b-carotene would be fulfilled if the amount consumed were doubled to 200g/d where the requirements were high as in case of pregnancy and lactation. Therefore, these leaves could form an important part in combating dietary deficiencies of vitamin A, iron and calcium, which are the primary causes of

night blindness and other vitamin A related deficiencies, anemia and osteoporosis especially among women and children in India. Due to its therapeutic value these leaves could form a part of low cost nutritional therapy that has been advocated by the Indian government to combat these serious deficiencies.

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Human Ecology Special Issue No. **14:** 83-88 (2006)
Ecology, Culture, Nutrition, Health and Disease
Kaushik Bose, *Guest Editor*