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Nutritional security through utilization of uncommon green leafy vegetables for product development

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Abstract

The present study was conducted to collect information regarding physical, nutritional and product development potential of uncommon green leafy vegetables in Barabanki and Sultanpur district of eastern U.P so as to ensure nutritional security for rural masses. Total seven green leafy vegetables were identified as being uncommon/ rarely used as food namely *Kulfa Ka Sag*, *Babhni Ka Sag*, *Makoi Ka Sag*, *Khattibutti/ tinpatiya*, *Karemua Ka Sag*, *Poi Ka Sag* and *Bathua*. *Karemua* is found in all seasons but mainly in rainy seasons, *Kulfa ka sag* is available from March to May and *Tinpatiya* is available from November to December. Physical parameters of selected green leafy vegetables were recorded. The average length of leaves ranged from 0.75 to 8.50 cm and average weight/ leaf was 0.04 to 1.36 gram. The highest protein content among selected uncommon green leafy vegetables was found in *Babhni Ka sag* i.e. 5.30 per cent and least was observed in *Tinpatiya* i.e. 1.67 per cent on dry matter basis. Vitamin C value ranged from 11 mg to 179 mg per 100 gm. To popularize these uncommon green leafy vegetables among common people total twenty one green leafy vegetables based recipes were standardized. Highest protein content was found in *Karemua pakodi*, fat in *Makoi vada*, fiber in *Babhni khasta* and vitamin C in *Babhni paneer*. The developed products were subjected for sensory evaluation. All the developed products were very much liked by the semi-trained panel members. The cost per 100g of developed products was also determined.

Keywords: Nutritional security, uncommon green leafy vegetables.

Introduction

There is an ever-increasing gap between food supplies and population growth, particularly in the developing countries. The search for novel, high quality but inexpensive sources of food has always remained a major concern of all agencies involved in providing adequate food and improving nutritional status of the population. In this context, less familiar foods have a vital role to play as their economic value is beyond dispute.

Food items that are not being used for food at all or are being used on limited scale are termed as uncommon foods. India owns a rich biodiversity of such foods although few studies have been conducted to document the nutritive value of less familiar foods (Rajalakshmi and Geervani, 1994; Mohan and Janardhan, 1995) ^[10, 9] but information available is quite meagre.

For the development of any nation it is essential that its population should be healthy. As our country's population is growing at a fast rate, there is a great demand to provide nutritional security to all. To meet the nutritional requirement of the growing population through common sources is not possible. Therefore, to overcome the pressure exerted by the growing population, it has become utmost important to look for economic and easily available substitutes for the common available grains, vegetables and fruits.

Approximately, two-third of total dietary energy intake is obtained from twelve domesticated species: eight cereals (barely, maize, rice, rye, sorghum, sugarcane and wheat) and four tubers (Cassava, potato, sweet potato and yam). Besides the reduction of genetic diversity of plants species in human diets. The high dietary selectively practices has become another factors that cause difficulty in getting full complement of essential nutrients through daily diet which consequently lead to malnutrition and under nutrition (Milton, 2003) ^[8].

Furthermore, most of the foods consumed by people have been “upgraded” to an extreme through refined and modified processes using various food preparation techniques such as cooking, crushing, leaching and husking that causes in advertently reduction or removal of certain essential nutrients from the food (Legwaila *et al.*, 2009) [6]. On the another hand, increasing research on underutilized vegetables in different regions showed that most of these wild greens have great nutritional values and antioxidant properties which are comparable to those commercially cultivated vegetables (Maisuthisakul *et al.*, 2007 and Glew *et al.*, 2005) [7,3].

Many uncommon foods which were earlier available and were used by people to some extent in olden times have now changed. These are comparatively cheaper and had good nutritive value. With the modernization these uncommon food items have been replaced by expensive roots and vegetables.

In recent decade, a resurgence of interest has focused on underutilized plant species for their possible nutritional and medicinal value and to broaden the diversity of human diet (Afolayan and Jimoh, 2009) [2]. Many common or underutilized crop like Poi *i.e.* *Basell rubra*, Sorrel leaves *i.e.* *Oxalis corniculata*, Purslane *i.e.* *Portulaca oleracea*, Slender amaranth *i.e.* *Amaranthus viridis*, water spinach *i.e.* *Ipoemea aquatica*, etc have been reported to possess wide range of phytochemicals like flavonoids, tannins, phenols, glycosides etc. therefore their utilization by the common people needs to be encouraged.

Therefore, recognizing the need for investigation of uncommon food items in achieving nutritional security and in combating nutritional deficiency diseases. The aim of the present study was to explore the untapped uncommon source of good nutrition for the utilization of underutilized vegetables for the product development.

Materials and Methods

Locale of the study:

The survey was done in Barabanki and Sultanpur districts of Eastern Uttar Pradesh. Information regarding uncommon plant foods consumed in different blocks of Sultanpur and Barabanki districts was collected through group discussion and appraisal.

Physical parameters:

Colour and shape of the selected uncommon plant foods was observed by visual appearance. Length of 3 randomly selected leaves were measured with the help of tape/ scale and expressed in centimeters. Weight was recorded in leaves using electronic weighing balance.

Nutritional composition:

Moisture, crude protein, crude fat, crude fibre, ash and vitamin C were done by using standard procedure of AOAC, 1990 [1].

Dry matter: Moisture value was subtracted from 100, the difference gave values of available dry matter.

Carbohydrate: Values of moisture, crude protein, crude fat, crude fibre and total ash were subtracted from 100. The difference gave values of available carbohydrate.

$$\text{CHO (\%)} = 100 - (\text{Moisture} + \text{crude protein} + \text{crude fat} + \text{crude fibre} + \text{total ash}).$$

Energy value was calculated by factorial method.

$$\text{Energy (Kcal)} = 4 \times \text{CHO} + 4 \times \text{crude protein} + 9 \times \text{crude fat}.$$

Product Development

The collected uncommon green leafy vegetables were utilized for the preparation of various products such as Kulfa ka sag, Babhni ka Sakpahita, Babhni Paneer, Babhni ka paratha, khasta, vada, makoi paneer subji, Mathri, Chutney, Pakodi and Raita.

Nutritional evaluation of developed products:

The nutritional quality of the developed products was calculated by taking in consideration the chemical composition of the selected uncommon green leafy vegetables and values given in the food composition Tables compiled by Gopalan *et al.* (1976).

Sensory evaluation:

Sensory evaluation of the prepared products was done by a semi-trained panel of judges using 9 point Hedonic scale.

Economics of the developed products:

The cost of the developed products was calculated by taking into consideration the cost of raw materials and over head charges for the preparation of different recipes.

Results and Discussion

General information about selected uncommon Green Leafy Vegetables:

Seven types of uncommon green leafy vegetables were identified namely Kulfa ka sag, Babhni ka sag/ Jungali Cholai, Makoi/ Gurki Ka sag, Khatti-butti/ tinpatiya, Karemu/ Kalmi sag, Poi ka sag and Bathua (Table 1). Kulfa ka sag is available from March to May; Khatti-butti/ tinpatiya from November to December, Karemu sag in all season but mainly in rainy season in lakes, river, ponds etc. Poi ka sag is available from July to September. Bathua is available from December to March. Commonly these uncommon leaves are rarely used in preparations like sag, vada, sakpaitha, kasta, paratha, mathri, dal, chutney etc.

Table 1: General information about selected uncommon green leafy vegetables

S.No.	Common name	English name	Botanical name	Area of collection	Place of availability	Seasonal availability	Part used as foods	Common use
1.	Kulfa ka sag	Parsley/ pigweed/ hogweed	<i>Portulaca oleracea</i>	Bhadiya block of Sultanpur	Road side, garden side, drain side	March-May	Leaves and soft stem	Sag
2.	Babhni ka sag/ Jungli cholai	Slender amaranthus	<i>Amaranthus viridis</i>	Kudevar block of Sultanpur	Road side, drain side	Throughout year	Leaves	Vada, sakpahita, khasta, paratha
3.	Makoi/ gurki sa sag	Black shade/ night shade	<i>Solenum nigrum</i>	Banki block of Barabanki	Road side, garden side,	Throughout year	Leaves, fruits	Mathri, vada, daal

					drain side			
4.	Khatti-butti/ tinpatiya/ tipatiya	Indian sorrel	<i>Oxalis corniculata</i>	Banki block of Barabanki	Road side, garden side, drain side	November- December	Leaves	Chutney
5.	Karemua/ kalmi sag	Water spinach	<i>Ipomea raptans</i>	Deva block of Barabanki	Lake, river, ponds	Specially in rainy but found in all season	Leaves and soft stem	Vada, sakpahita, pakori
6.	Poi ka sag	Indian spinach	<i>Basella rubra</i>	Fatehpur block of Barabanki	Cultivated in raised crops	July-September	Leaves	Vada, sakpahita, pakori
7.	Bathua	Chenopodium leaves	<i>Chenopodium album</i>	Deva block of Barabanki	Garden side, lawn, in cultivated crop	December to March	Leaves	Sakpahita, raita, vada, pakodi, paratha, khasta

Physical parameters about selected uncommon Green Leafy Vegetables:

The data regarding physical parameters of uncommon green leafy vegetables are presented in Table 2. Kulfa ka sag (*Portulaca oleracea*) is radish purple in colour with oval

leaves having 0.75 cm length and 1.36 g average weight per leaf. The colour of leafy vegetables varied from light green, dark green to reddish purple. The length value of leafy vegetables ranged from 0.75-8.5 cm. Average weight per leaf varied from 0.078 to 1.36 g.

Table 2: Physical parameters of selected uncommon green leafy vegetables

S. No.	Common name	English name	Botanical name	Colour	Shape	Average Length (cm)	Average weight/ leaf (g)
1.	Kulfa ka sag	Parsley/ pigweed/ hogweed	<i>Portulaca oleracea</i>	Reddish purple	Oval	0.75	1.36
2.	Babhni ka sag/ Jungli cholai	Slender amaranthus	<i>Amaranthus viridis</i>	Green	Elongate	4.01	0.078
3.	Makoi/ gurki sa sag	Black shade/ night shade	<i>Solenum nigrum</i>	Dark green	Elongate	5.02	0.601
4.	Khatti-butti/ tinpatiya/ tipatiya	Indian sorrel	<i>Oxalis corniculata</i>	Light green	Heart shaped three leaves together	0.83	0.04
5.	Karemua/ kalmi sag	Water spinach	<i>Ipomea raptans</i>	Dark green	Elongate	8.50	0.207
6.	Poi ka sag	Indian spinach	<i>Basella rubra</i>	Dark green	Heart shape	7.50	0.507
7.	Bathua	Chenopodium leaves	<i>Chenopodium album</i>	Green	Elongate cerated	3.13	0.141

Nutritional composition of selected uncommon Green Leafy Vegetables:

On dry and wet basis the nutrient composition of selected green leafy vegetables is depicted in Table 3 and 4. The results revealed statistically significance differences in vegetables with respect to moisture content, dry matter, crude protein, total ash, CHO and energy content. The moisture content varied from 5.2 to 7.8 per cent. Crude protein content was found to be minimum (1.67%) in Khatti butti (*Oxalis corniculata*), while maximum value was found in Babhani ka sag (5.30%). Total ash content of various preparations varied from 1.20 to 7.18%. The carbohydrate content of leafy vegetables ranged from 72.9 to 87.52 per cent. The energy values ranged from 316 to 370 KCal/100g. According to

Gupta *et al.* (2014) [5] the moisture content of the fresh *Amaranthus paniculatus* and *Peucedanus graveolens* was 86.5 and 90 per cent whereas, dehydrated green leafy vegetables contained 4.9 and 7.4 per cent moisture, respectively. Ash content of the developed products varied from 0.39 to 44.2 g/100g. On fresh basis, moisture content of green leafy vegetables ranged from 74.04 to 91.36 per cent, protein content from 0.16-1.01 per cent, fat content from 0.03 to 0.56 per cent, crude fibre between 0.09 to 0.47 per cent and ash values between 0.01 to 3.27 per cent. Vitamin C content of the fresh green leafy vegetables was also determined. Highest vitamin C was found in the Babhani ka sag (179 mg/100g) and least vitamin C content was observed in Makoi ka sag (11 mg/100 g).

Table 3: Nutritional composition of selected uncommon green leafy vegetables (% on dry matter basis)

S.No.	Common name	English name	Botanical name	Moisture (%)	Dry matter (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Total ash (%)	Carbohydrate (%)	Energy (kcal)
1.	Kulfa ka sag	Parsley/ pigweed/ hogweed	<i>Portulaca oleracea</i>	7.80	92.2	2.03	0.36	1.03	2.40	86.38	357
2.	Babhni ka sag/ Jungli cholai	Slender amaranthus	<i>Amaranthus viridis</i>	6.50	93.50	5.30	1.82	2.50	7.17	76.71	344
3.	Makoi/ gurki sa sag	Black shade/ night shade	<i>Solenum nigrum</i>	5.20	94.80	3.90	1.19	1.18	7.18	81.35	352
4.	Khatti-butti/ tinpatiya/ tipatiya	Indian sorrel	<i>Oxalis corniculata</i>	6.70	93.30	1.67	1.50	1.09	1.52	87.52	370
5.	Karemua/ kalmi sag	Water spinach	<i>Ipomea raptans</i>	6.80	93.20	2.70	1.50	2.10	2.70	72.90	316
6.	Poi ka sag	Indian spinach	<i>Basella rubra</i>	7.20	92.80	1.88	1.50	1.26	1.20	78.32	334
7.	Bathua	Chenopodium leaves	<i>Chenopodium album</i>	6.40	93.60	4.35	0.31	1.13	3.02	84.79	359

Table 4: Nutritional composition of selected uncommon green leafy vegetables (% on fresh basis)

S. No.	Common name	English name	Botanical name	Moisture (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Total ash (%)	Carbohydrate (%)	Energy (kcal)	Vitamin 'C' (mg)
1.	Kulfa ka sag	Parsley/ pigweed/ hogweed	<i>Portulaca oleracea</i>	90.80	0.19	0.03	0.09	0.22	8.47	36	25.0
2.	Babhni ka sag/ Jungli cholai	Slender amaranthus	<i>Amaranthus viridis</i>	80.90	1.01	0.34	0.47	3.27	14.01	63	179.0
3.	Makoi/ gurki sa sag	Black shade/ night shade	<i>Solenum nigrum</i>	74.04	1.01	0.56	0.30	1.86	22.23	98	11.0
4.	Khatti-butti/ tinpatiya/ tipatiya	Indian sorrel	<i>Oxalis corniculata</i>	84.14	0.26	0.39	0.17	0.24	14.80	64	130.1
5.	Karemua/ kalmi sag	Water spinach	<i>Ipomea raptans</i>	88.70	0.30	0.16	0.23	0.30	10.31	44	30.0
6.	Poi ka sag	Indian spinach	<i>Basella rubra</i>	91.36	0.16	0.21	0.28	0.10	7.89	34	84.0
7.	Bathua	Chenopodium leaves	<i>Chenopodium album</i>	83.90	0.70	0.04	0.18	0.48	14.70	62	33.0

Standardization of products using uncommon Green Leafy Vegetables

Nutritional and sensory evaluation of products developed from uncommon green leafy vegetables (g/100g):

The collected uncommon green leafy vegetables were used for the preparation of variety of products. The standardized recipes indicating ingredients used, method of preparation cooked weigh and number of servings etc. are given in Table 5. The nutrient content of developed products is given in Table 6. The maximum protein content was found in Karemua pakodi (19.63%) and minimum (1.09%) in Kulfa ka sag. Fat

content of Makoi vada was highest (60.17%) and minimum 0.63% in Bathua sakpahita. Fiber content of Bathua raita was minimum 0.53% and maximum in Babhni khasta 18.24%. The calorie content of Babhni khasta was the highest 939 kcal and Bathua raita 52 kcal, the minimum vitamin C value was highest in Babhni paneer 118.85 mg/100g. Sensory evaluation and cost of products based on green leafy vegetables is given in Table 7. Babhni paratha, babhni khasta, makoi vada, Karemua ka sag, poi pakodi, vada and bathua khasta were liked very much. The cost per 100 g ranged from Rs. 2.5 for tipatiya chutney to Rs. 38.0/100 g for bathua raita.

Table 5: Product development using uncommon green leafy vegetables

S.No.	Name of Product	Ingredients used	Method	Cooked weight (g)/ No.	Number of servings
1.	Kulfa sag	Kulfa-100 g, Oil-10 ml, Salt-1/2 st. sp., Garlics-5-6 pieces, chillies-2-3	Washed and cut kufa leaves into small pieces. Heated oil in skillet, added chillies and cut garlic pieces. Added kufa leaves and cooked till done.	95	2
2.	Babhni/ Jungali cholai Sakpahita	Babhni leaves-100 g, Black gram dal-50 g, Asafoetida-a pinch, salt-1/2 st. sp.	Babhni leaves were washed and cut into small pieces. Babhni leaves were added to cleaned black gram dall. Salt and asafoetida were added. Then it was pressure cooked.	230	3
3.	Babhni/ Jungali cholai Paneer	Babhni leaves- 100 g, Paneer- 50 g, Tomato-100 g, Onion-1 small, Subji masala-1 st. sp., Salt-1/2 st. sp., Oil-20 ml	Babhni leaves were boiled and strained. Boiled leaves were ground in the mixture, cheese cube were fried. Oil was heated in a skilled and onion were fried till golden brown. Spices, salt and tomatoes were added and cooked for some time. Cheese cubes and paste of babhni leaves were added and cooked.	175	3
4.	Babhni/ Jungali cholai paratha	1. Babhni leaves-100 g 2. Wheat flour-100g, 3- Refined oil-40 ml, Omum seeds-1/2 st. sp., salt-1/2 st. sp., green chillies-2-3 pieces, Garlic-5-6 pieces	Babhni leaves were washed and boiled. Extra water was drained. Oil was heated in a skillet Green chilies and garlic were added. Boiled babhni leaves were added to it and fried for 5 min. Salt, omum seeds and fried babhni leaves were added to the wheat flour and dough was prepared. Balls of equal size were made. Rolled in the shape of paratha and shallow fried it from both sides.	315	4
5.	Babhni/ Jungali cholai Khasta	Babhni leaves-100g, wheat flour-100g, refined oil-60 ml, omum seeds- a pinch, salt-1/2 st sp.	Babhni leaves were boiled and strained, flow was sieved and little oil was added and rubbed with hand. Omun seeds and mashed babhni leaves were added to the wheat flour and dough was prepared using required amount of water. Small balls of equal size were made from the dough. Each ball was rolled into round shape and deep fried till golden brown.	253	8
6.	Makoi/ gurki Vada	Makoi leaves 100g, Bengal gram dal- 50g, Cumin seeds- a pinch, Salt-1/2 st. sp., green chillies-2-3, mustard oil-60 ml.	Bengal gram dal was soaked for 3-4 hours Cumin seeds, chillies and salt were ground along with the dal in the grinder. Makoi leaves were boiled and water was removed and mixed with the paste of Bengal gram dal. Vada was maded from the paste and deep fried.	108	4
7.	Makoi/ gurki Paneer subji	Makoi leaves -100g, Paneer-50g, Oil-20 ml, Onion-1 small, tomatoes-100g, chillies- 2-3 pieces, salt- 1/2 st. sp., Sabji masala-1 st. sp.	Makoi leaves were boiled and strained. Boiled leaves were ground in the mixture. Cheese cubes were fried in oil. Little oil was heated in skillet. Onion were fried till golden brown. Spices, tomato, salt, chilies were added and cooked for some time, paneer cubes and paste of makoi leaves were added and	200	7

			cooked for 5 minutes.		
8.	Makoi/ gurki Sakpahita	Makoi leaves-100g, Black gram dall-50g, Asafoetida-1 pinch, Salt-1/2 st. sp.	Makoi leaves were washed and cut finely. The leaves and water were added to black gram dal. Salt and asafoetida was added and pressure cooked	240	4
9.	Makoi/ gurki Mathri	Makoi leaves (dried)-10g, Refined wheat flour-50g, Wheat flour-50g, Refined oil-60 ml, salt- 1/2 st sp., Omum seeds- a pinch	Washed and dried makoi leaves in hot air oven, till dry, Sieved refined and whole wheat flour. Added omum dry makoi leaves salt little ghee. Kneaded well to make a soft dough. Rolled in shape of mathri and cut into small pieces and deep fried.	108	5
10.	Khatti-butti, tinpatiya/ tipatiya/ Chutney	Tipatiya leaves- 100g, Green chillies-2-3, garlic-2-3, Ginger-2g, Salt- 1/2 st. sp.	Washed tipatiya leaves. Ground tipatiya leaves, chillies, garlic and ginger in the mixer. Added salt in it.	95	5
11.	Tipatiya/ Tinpatiya/ Khatti-butti Dum-aloo	Tipatiya leaves-100g, Potato-200g, Salt-1/2 st. sp., Green chillies-2-3, Garam masala- 1/2 st. sp., Dum aloo masala- 1/2 st. sp., Oil-15 ml, Cumin seeds- a pinch, Dry mango powder- 1/2 st. sp.	Boiled potatoes, pealed and cut into small pieces. Tipatiya leaves, chilies and cumin seeds were made into paste. Heated oil in a skillet. Added boiled potatoes in it. After some time added tipatiya leaves paste, salt, garam masala, dum aloo masala, dry mango powder and cooked for some time.	230	4
12.	Karemua/ kalmi sag Pakodi	Karemua leaves-100g, Garlic-2-3, Green chillies-2-3, Salt- 1/2 st. sp., Bengal gram dal- 50g, Cumin seeds- 1/2 st. sp., chopped coriander leaves 1 st. sp., Oil-50 ml	Karemua leaves were boiled and drained. Coriander leaves, chillies, ginger, garlic and salt were added to the Bengal gram dal paste, karemua leaves were mixed and deep fried as pakodi.	136	3
13.	Karemua/ kalmi sag	Karemua leaves- 100g, garlic- 2-3, green chillies-2-3, Salt- 1/2 st. sp., Oil-20 ml	Washed and cut karemua leaves finely. Heated oil. Added chillies, garlic and karemua leaves. Then added salt and cooked till done.	168	2
14.	Karemua/ kalmi sag Paneer sabji	Karemua leaves-100g, Paneer-50g, Oil-20 ml, Onion- 1 small, tomato-100g, chillies- 2-3 pieces, salt- 1/2 st. sp., Sabji masala-1 st. sp.	Karemua leaves were boiled and extra water was drained. Boiled leaves were ground in the mixer. Cheese cubes were fried. Oil was heated in a skillet, onion were fried till golden brown, spices, tomato, salt, chillies were added and cooked for some time, paneer cubes and paste of karemua leaves were added and cooked.	180	4
15.	Poi Pakodi	Poi leaves- 100g, Rice flour- 50g, Turmeric powder- 1/2 st. sp., Salt-1/2 st. sp., Chillies-2-3 pieces, Oil 60 ml	Clean and cut poi leaves in small pieces. Made batter of rice flour. Added turmeric powder salt chillies and poi leaves mixed properly and deep fried in hot oil in the shape of pakodi.	180	7
16.	Poi Vada	Poi leaves 100g, Bengal gram dal-50g, Cumin seeds- a pinch, Salt- 1/2 st. sp., Green chillies-2-3, mustard oil-60 ml.	Bengal gram dal was soaked for 3-4 hours Cumin seeds, chillies and salt were ground along with the dal in the grinder. Poi leaves were boiled and water was removed Mixed it with the paste of bengal gram dal. Vada was made from the paste and deep fried in oil	110	4
17.	Bathua Raita	Bathua leaves-100g, curd- 100g, Black salt-1/2 st. sp., roasted cumin seed powder- 1/2 st. sp., coriander leaves, chillies-2-3 pieces	Bathua leaves were boiled and drained away the water. Leaves were mashed and mixed in curd. Black salt, coriander leaves, green chillies and roasted cumin seeds powder was added.	210	3
18.	Bathua Sakpahita	Bathua leaves-100g, Black gram dal-100g, Asafoetida- a pinch, salt- 1/2 st. sp.	Bathua leaves were washed, then added to black gram dal. Salt and asafoetida was added and then it was pressure cooked.	270	6
19.	Bathua Paneer sabji	Bathua leaves- 100 g, Paneer- 50g, Oil-20 ml, Onion-1 small, tomato-100 g, Chillies-2-3 pieces, Salt- 1/2 st. sp., Sabji masala-1 st. sp.	Bathua leaves were boiled and drained away water. Boiled leaves were ground in the mixer. Cheese cubes were fried till golden brown. Spices, tomato, salt, chillies were added to the oil and cooked for some time. Cheese cubes and paste of bathua leaves were added and cooked.	170	3
20.	Bathua Khasta	Bathua leaves-100g, Refined wheat flour- 50g, refined oil- 60 ml, whole wheat flour- 50g, salt- 1/2 st sp., omum- a pinch	Bathua leaves were boiled and strained. Salt, omum and mashed bathua leaves were added to the wheat flour. Shortening was done and dough was prepared. Small balls of equal size were made from the dough. Each ball was rolled into round shape and deep fried till golden brown.	130	4
21.	Bathua paratha	Bathua leaves- 100g, wheat flour-100g, Refined oil-40 ml, Omum seeds- 1/2 st. sp. Salt-1/2 st. sp., green chillies-2-3 pieces, garlic-2-3 pieces	Bathua leaves were washed and boiled. Extra water was drained away. Oil was heated in a skillet. Green chillies and garlic were added. Boiled bathua leaves were added to it and fried for 5 min. Salt, omum seeds and fried bathua leaves were added to the wheat flour and dough was prepared. Balls of equal size were made. Rolled in the shape of paratha and shallow fried it from both sides	310	4

Table 6: Nutrient content of products developed from uncommon green leafy vegetables (g/100 g)

S.No.	Name of product	Protein (%)	Fat (%)	Fiber (%)	Carbohydrate (%)	Energy (kcl)	Vitamin 'C' (mg)
1	Kulfa ka sag	1.09	5.6	0.55	1.82	62	13.51
2	Babhni ka sakpahita	1.52	1.09	11.10	39.66	198	77.82
3	Babhni paneer	9.57	18.97	1.38	46.15	409	118.85
4	Babhni paratha	5.52	13.81	8.87	41.53	312	56.82
5	Babhni khasta	7.01	26.61	18.24	57.82	939	72.17
6	Makoi vada	13.2	60.17	1.64	37.79	745	11.11
7	Makoi paneer	9.32	17.52	1.29	15.12	256	20.00
8	Makoi sakpahita	6.621	1.20	0.67	16.95	105	4.56
9	Makoi mathri	11.05	56.95	1.12	67.34	825	1.01
10	Tipatiya chuteny	1.39	2.08	0.90	7.96	55	18.33
11	Tipatiya dum aloo	2.11	7.69	0.82	23.6	172	27.86
12	Karemua pakodi	19.63	39.92	1.98	23.67	492	24.92
13	Karemua ka sag	1.54	12.28	1.20	1.31	122	17.00
14	Karemua paneer	9.69	19.08	1.94	14.43	259	32.77
15	Poi ki pakodi	2.68	34.45	1.77	30.14	430	44.44
16	Poi vada	11.16	59.63	3.01	43.07	751	77.27
17	Bathua raita	3.54	2.05	0.53	4.90	52	16.99
18	Bathua sakpahita	10.5	0.63	0.75	24.77	147	12.22
19	Bathua paneer	11.23	19.50	1.48	19.67	284	36.47
20	Bathua khasta	12.23	47.39	1.71	16.72	178	25.38
21	Bathua paratha	5.30	13.55	0.97	24.73	242	10.64

Table 7: Sensory evaluation & cost of products based on uncommon green leafy vegetables

S.No.	Name of product	Cost (Rs./100 g)	Sensory evaluation
1	Kulfa sa sag	2.72	Like slightly
2	Babhni/ Jungali cholai sakpahita	3.17	Like moderately
3	Babhni/ Jungali cholai paneer	10.63	Like extremely
4	Babhni/ Jungali cholai paratha	3.09	Like very much
5	Babhni/ Jungali cholai khasta	4.83	Like very much
6	Makoi/ Gurki vada	12.87	Like very much
7	Makoi/ Gurki paneer sabji	8.95	Like slightly
8	Makoi/ Gurki sakpahita	2.56	Neither like nor dislike
9	Makoi/ Gurki mathri	9.76	Dislike slightly
10	Tipatiya/ Tinpatiya/ Khatti-butti chuteny	2.5	Like moderately
11	Tipatiya/ Tinpatiya/ Khatti-butti dum aloo	7.34	Like moderately
12	Karemua/ Kalmi sag pakodi	9.25	Like moderately
13	Karemua/ Kalmi sag	4.14	Like very much
14	Karemua/ Kalmi paneer sabji	11.11	Like moderately
15	Poi pakodi	9.52	Like very much
16	Poi vada	11.27	Like very much
17	Bathua raita	38.00	Like very much
18	Bathua sakpahita	3.77	Like slightly
19	Bathua paneer sabji	12.35	Like moderately
20	Bathua khasta	10.76	Like very much
21	Bathua paratha	3.93	Like moderately

Conclusion

In our country with emerging economics, approximately two-third of total dietary energy intake is obtained from only few selected domesticated crops including rice, wheat, maize, barley, rey, sorghum, kasava-potato and sweet potato. Therefore, the results of the present study will be immensely useful in giving new ideas to promote utilization of untapped/ underutilized crops in our day to day life. Looking at their nutritional composition they may advocated for commercial cultivation. Bakla is rarely used for vegetable purpose, however contains substantial amount of protein. Babhni ka sag and Khatti-butti being a good source of vitamin C 179 mg/100g and 130 mg/100g may be cultivated so that their consumption may be popularized.

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