



Buckwheat, Amaranthus and Rice bean- Value Added Products



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All India Coordinated Research Network (AICRN) on Under-utilized
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Buckwheat, Amaranthus and Rice bean- Value Added Products

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Foreword

Hilly terrains of Himachal Pradesh represent several diverse eco-geographic pockets for cultivation of hardy crops specifically buckwheat, amaranthus and rice bean and many others, thereby playing a vital role in improving the economy of the state. These traditional plant species having significant food and industrial potential remained under-utilized. Nevertheless, benefits of these species are manifold as these contribute to livelihoods and food security. These crops are highly nutritious and possess quality proteins with high amounts of limiting amino acids like lysine and methionine which are low in other major cereals.

There has been an increasing awareness among people about the beneficial aspects of these traditional crops. Buckwheat, amaranthus and rice bean are the potential crops with remarkable properties and enormous untapped commodity resource which can help to meet the increasing demand of food and nutrition as well as industrial needs. Among the different under-utilized crops, buckwheat is the most important crop of the mountain regions above 1800 amsl elevation both for grains and greens. Similarly the cultivation of amaranthus is most wide spread in the mountain regions above 1500 amsl and extends up to 3000 m elevation in the hills. Rice bean is one of such underutilized pulse crops, which could be utilized in future farming system and attracted the attention of breeders and agronomist because of its high grain yielding ability, nutritional status, tolerance to diseases and pest associated with other pulses and for its multipurpose uses.

Keeping the significance of these crops of future, the authors planned to document the under-utilized crops in the shape of booklet and attempt has been made to utilize these crops for the preparation of value added products. This booklet contains the complete and concise information on various value added recipes which are standardized and compiled in a simple manner and supported with suitable photographs for complete understanding of the readers. It is hoped that the booklet "Buckwheat, Amaranthus and Rice bean- Value Added Products" will prove very useful for the researchers, planners, entrepreneurs and consumers. It is also hoped that this endeavour of the authors would be of immense value and help to those interested in consumption of such health foods. There is a great need for establishment and strengthening of market linkages for promotion of such products. I appreciate the efforts made by authors for bringing out this comprehensive publication.



Dr S K Sharma
Vice- Chancellor
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Palampur
27th April, 2011

Preface

The underutilized plant has promising economic value and economically important for nutritional and medicinal values and found in high altitude regions of Himachal Pradesh, Jammu and Kashmir and Garwhal and Kumaon regions of Uttrakhand. The under-utilized crops are plant species that are used traditionally in different food preparations and staple diets in most the tribal regions in India. Among the different under-utilized crops buckwheat is most important crop of the mountain regions above 1800m elevation both for grains and greens and occupies large area and extends from 1800 m to more than 4500 m in the Himalayas. Amaranthus are widely distributed through the temperate and tropical region and cultivated as minor crop in different areas of the world. Legumes are next to cereals as the source of protein in human diet and rice bean is one of the under-utilized pulse crops and principally used for human consumption in the form of split bean.

The acceptability of buckwheat flour in preparation of extruded products viz. curls, vermicelli, pasta and noodles was studied. The products are mainly prepared mainly from refined wheat flour. In case of curls and vermicelli the acceptable levels of buckwheat flour supplementation were 25 to 50 per cent but pasta, spaghetti and noodles require stiff type dough and the gluten plays an important role in such type of products. Methodologies developed/ standardized for utilization of amaranths in popped form in bakery and confectionery items at household and cottage levels are useful for establishing entrepreneurs. Similarly, the utilization of rice bean for the preparation of various value added products will help people to harness the nutritional properties and adding variety to the diets.


The recipes in the booklet have been based on the R & D work carried out under the project on "All Indian Coordinated Research Network on Under-utilized Crops" and compiled and improvised to suit the Indian conditions and the basic ingredients available. Keeping the great significance of these under-utilized in view, there is scope for technological interventions to promote entrepreneurs and other related units in the areas where the production is sufficient for empowerment of the target groups. Keeping in view the hardy nature of these crops, comparatively less input in cultivation, significant nutritional and medical importance and wide acceptability in a number of value added products, the R&D must respond in following

ways to make the cultivation and utilization of underutilized crops a sustainable process.

The Authors are grateful to the "National Bureau of Plant Genetic Resources (NBPGR), New Delhi for providing financial assistance in the form of Adhoc project under which the booklet is published. We sincerely express our gratitude towards Dr. S. K. Sharma Vice-Chancellor, CSKHPKV, Palampur, Dr. R. P. Dua, ADG (FFC), Dr. D. C. Bhandari Network Coordinator of the project, Dr. S. P. Sharma Director of Research, Dr. Shubhangna Sharma Dean College of Home Science, Dr. S. R. Malhotra Professor (FSN) and Dr. C. P. Awasthi Professor (Biochemistry) for their constant guidance and persistent encouragement.

Sincere thanks are due to Dr. D. S. Phogat and Dr. Hanuman Lal from NBPGR, New Delhi for constant encouragement and support. We are also grateful to Dr. J. C. Bhandari, Head (Crop Improvement), Dr. Y. S. Paul, Head (Organic Agriculture) & Dr. Neelam, Assistant Scientist (Organic Agriculture) for constant support. Promotion and popularization of the buckwheat, amaranths and rice bean based value added products can be carried out through imparting trainings to SHGs, NGOs and mahila mandals or krishik mahila smooths in the areas where such crops are cultivated. There is a great need for establishment and strengthening of market linkages for promotion of such products.

Palampur
27th April, 2011


Dr YS Dhaliwal
Head of the Department

Introduction

Hilly terrains of Himachal Pradesh represent several diverse eco-geographic cultivation pockets which are more suitable for cultivation of hardy crops specifically buckwheat, grain amaranth/*choli*, rice bean, adzuki bean and many others, thereby playing a vital role in improving the economy of the state. Global food security has become increasingly dependent on only handful of crops and underutilized and neglected species fall within the broad basket of "minor crops". The use of two terms *viz.* underutilized and neglected crops has the advantage to pinpoint two crucial aspects which are at the core of the status of these species, *viz.* the degree of attention paid by users and the level of research and conservation efforts spent on them. The underutilized crops are also referred by other terms such as orphan, underexploited, underdeveloped, lost, new, novel, promising, alternative and traditional crops. Variability in most of the commercially grown crops has been exploited to almost their fullest extent for crop improvement, so emphasis has recently been laid on exploitation of underutilized crops where there are large possibilities of exploiting the less exploited variability.

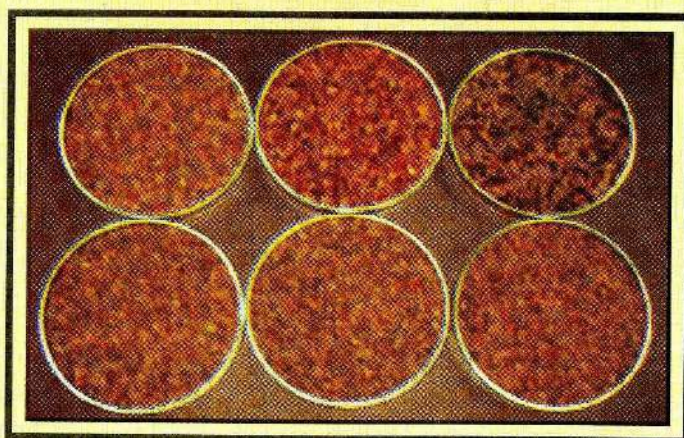
1.1 Buckwheat

Among the different under-utilized crops buckwheat is the most important crop of the mountain regions above 1800m elevation both for grains and greens. It occupies large area and extends from 1800 m to more than 4500 m in the Himalayas. It is a multipurpose crop- the tender shoots are used as leafy vegetables and the flowers and green leaves are used for extraction of rutin (glucoside) used in medicines. The flower produces honey of very good quality. The seed of the crop is used in a number of culinary preparations as well as alcoholic drinks. The nutritive value of buckwheat is superior as compared to millet or even the cereals like rice and wheat. It is a rich source of proteins, minerals vitamins and fat. Buckwheat proteins have better amino acid composition with high level of lysine, which is generally deficient in the proteins of most of cereals and millets. The crop helps in soil binding and checks soil erosion during rainy seasons and is a good green manuring crop. The other importance of buckwheat as a food is its great effect in reducing the risks to person exposed to radiation hazards in the high mountain areas.

Buckwheat belongs to genus *Fagopyrum* of family Polygonaceae. Two cultivated species, *viz.*, *Fagopyrum esculentum* Moench (common or Japanese buckwheat) and *Fagopyrum tataricum* Gaertn, (Tatary buckwheat) and the perennial wild species, *Fagopyrum cymosum* Meisnn are important in this genus. The perennial wild species *Fagopyrum cymosum* native to India and China is considered to be the progenitor of both (*Fagopyrum esculentum* and *Fagopyrum tataricum*). *Fagopyrum esculentum* is an herbaceous plant, erect annual with hollow stem, swollen nodes and alternate triangular leaves. The inflorescence is axillary and terminal cyme with densely clustered dimorphic flowers of white, pink or red colour. *Fagopyrum esculentum* originated in temperate eastern Asia. This species is cross pollinated and self-sterile. *Fagopyrum tataricum* is an herbaceous taller and coarser annual with short internodes and narrow, arrow shaped leaves. The flowers are all one type

and borne on axillary racemes with inconspicuous light green sepals. This species is self fertile. Buckwheat is cultivated in a number of countries as a food and fodder crop. In Europe, particularly in Russia, it constitutes one of the main food crops. It is also grown in USA, Canada, France, Germany, U.K., Denmark, Poland, Holland, Sweden, Australia, Bulgaria, Rumania, Italy, Japan, South Africa, Brazil China, Nepal and Bhutan. In India, the crops are widely grown from Jammu and Kashmir in the west to Arunachal Pradesh in the east. In the lower hills it is more often raised as a leafy than as a grain crop. Its higher concentration was observed in the high mountains of Himachal Pradesh (Chamba, Pangi, Lahaul and Spiti, Mandi, Kulu, Shimla and Kinnaur), Uttar Kashi, Chamoli, Pauri and Pithoragarh districts of Uttar Pradesh hill and in Darjeeling, Siliguri, Assam, Nilgiris and Palni hills in the South.

Buckwheat is a short duration crop (3 to 4 months) and require moist and cool temperate climate to grow. Therefore, it is specially suited as a crop for short summer at high altitudes in Ladakh, Lahaul-Spiti, Kinnaur and other similar areas in India. Tartary buckwheat stands cold better than common buckwheat and hence it is found commonly at high altitudes, as crop growing is possible. Although buckwheat is known to grow on poor soils, application of manure has shown beneficial effects. Buckwheat is suited to all types of soils, but it is cultivated mostly poor fields. It thrives best on sandy well drained soils. The seed rate varies from 60-80 Kg/ha for *Fagopyrum esculentum* and 40-50Kg for *Fagopyrum tataricum*. The seed is usually broadcast and field is ploughed and planked. In Himachal Pradesh sowing of buckwheat is done from May to June. Row to row and plant to plant distance is maintained 30 cm and 10 cm respectively. Chemical fertilizer (N:P:K) may be applied in the proportion of 40:20:20. Ripening of buckwheat seeds is not uniform and delayed harvesting result in shattering of seeds therefore when 70 – 80 per cent crop is matured it is harvested and tied in bundles and these bundles are dried and the seeds are collected by thrashing. Himpriya, VL UGAL-7, PRB-1, Himgiri, Sangla B1, USDA-1 and Uday are the main varieties of buckwheat.



Buckwheat

1.2 Amaranthus

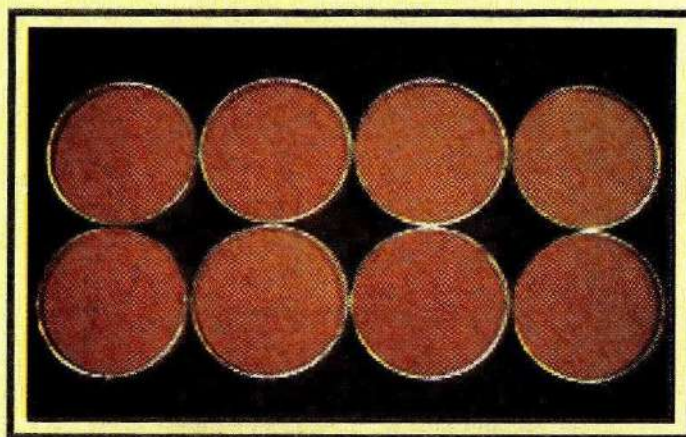
Two grain species *i.e.*, *Amaranthus hypochondriacus* and *Amaranthus caudatus* are mostly grown in the Himalayas and are often intercropped with maize, finger millet, Italian millet, barnyard millet, french bean, soyabean, black gram, horse gram and colocasia and sometime in pure stand. The species *Amaranthus caudatus* is of new occurrence. In India, the cultivation of amaranthus is most wide spread in the mountain regions above 1500 m and extends up to 3000 m elevation in the hills. The crop is also sporadically grown in the Northern plains, Central and Southern India. The exact information about the statistics on area and production in India is lacking. However as a grain crop it is estimated to be grown in 40-50 thousands/ha. Grain amaranthus contain 12-19% protein on dry basis with 5.5% essential amino acid specially lysine. It is an excellent source of iron, β -carotene and folic acid. It is endowed with C_4 metabolism with relatively low water and input requirements, suited to survive and thrive in an environment affected with climate change. AMA-1 gene for high quality protein has been isolated from grain amaranth and is being introduced into rice and potato. In potato the product with higher yield and protein content has been found to be safe and cleared the test related toxicity and other side effects.

Amaranths are widely distributed through the temperate and tropical region of the world before man domesticated them or converted some of them into cosmopolitan weeds. They are cultivated as minor crop in India, China, Manchuria, Nepal, Bhutan, Afghanistan, Indonesia, Japan, Thailand and Israel of Asia pacific region. In India, these are cultivated both in hills and plains covering the states of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Assam, Meghalaya, Arunachal Pradesh, Nagaland, Tripura, Jharkhand, Chhattisgarh, Maharashtra, Gujarat, Orissa, Karnataka, Kerala and Tamil Nadu. Various vernacular names used for grain amaranths are: *ramdana* (Bihar), *rajgira* (Deccan), *rajgaro* (Gujarat), *anardana* (Eastern. U. P.), *Chuko* (Bengal), *kalaghasa*, *chuamars*, and *ganher* (Central India) *kola bhazi* (Bombay) *rajagira* (Marathi) *bustanafroz* (Kashmir) *seol* and *sil* (Northern plains) *bathu* (Shimla, HP) *siriara* (Kullu, HP) *tulsi.dankar* and *kalzi* (Kinnaur, HP) *chua* (Kumaon) *marcha* (Garhwal) and *marcha*, *nana*, *pilum* and *latare* in Nepal.

In hills, the crop is generally sown in the months of May-June soon after onset of monsoon. However, in plains it can be sown either in *Rabi* or *Kharif* season. But, generally it is cultivated in *Rabi* Season and is sown in month of October- November. Grain amaranth requires well-drained sites and appears to prefer neutral or basic soil (pH values above 6). For seed to germinate and establish roots, amaranths require well-moistened soil, but once seedlings are established, grain amaranths do well with limited water; infact, they grow best under dry warm conditions. Vegetable amaranths, on the other hand require moisture throughout the growing season. The field must be well leveled and two to three ploughings are sufficient for sowing of amaranth seed. Before sowing, application of 50 quintals of farmyard manure per hectare has given very good result in yield. With proper soil moisture in the field, the seeds

should be shown about 2 cm deep in rows 45 cm apart with 10-15 cm distance plants. Seed rate of 1.5-2.0 kg/ha is enough for getting good yields. In case water is not available for irrigation in time or delayed then dry sowing can also be done. The seed will germinate when irrigation is given or rains occur. After one to two weeks of germination, thinning can be done to maintain the plant population at desired spacing. The crop gives a good response up to fertilizer application of 60:40:20 kg N: P: K/ha.

Varieties Annapurna (IC 42258-1), PRA-1 (PRA 8801), PRA-2 (PRA 9101), PRA-3 (PRA 9401) and Durga (IC-35407) are grown in hills where as, Gujarat Amaranthus-1 (G-1), Suvarna, Gujarat Amaranthus-2 (GA-2), Kapilasa (BGA-2), Gujarat Amaranthus-3 (GA-3) and RMA 4 are the varieties for plains.



Amaranth

1.3 Rice bean [*Vigna umbellata* (Thunb.) Ohwi & Ohasi]

Rice bean is one of such underutilized pulse crops, which could be utilized in future farming system especially covering neglected and poor soils in Himachal Pradesh and other parts of India. It has also attracted the attention of breeders and agronomist because of its high grain yielding ability, nutritional status, tolerance to diseases and pest associated with other pulses and for its multipurpose uses like green manure, fodder etc. Rice bean is a native of South East Asia. As cultigens, rice bean occurs in India, Burma, Malaysia, China, Korea, Indonesia and Philippines. It can be grown in varied climatic conditions of tropical, sub-tropical to sub-temperate up to an elevation of 1500 m amsl. Loam, sandy loam and slightly heavy soils with good drainage are suitable for its cultivation.

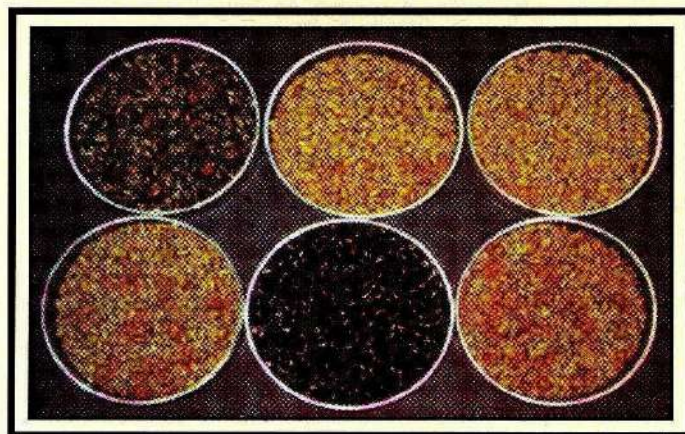
The acreage and production of rice bean is not available, however this occupies good acreage as mixed crop with maize and other pulses in various parts of the region. It is considered as a minor food and fodder crop and is grown during *kharif* as a mixed/intercrop and also as a sole crop in upland conditions. Regarding scientific classification the rice bean belongs to Kingdom- *Plantae*, Division-*Magnoliophyta*, Class-*Magnoliopsida*, Order-*Fabales*, Family- *Fabaceae*, Subfamily- *Faboideae*, Tribe- *Phaseoleae*, Genus- *Vigna*, Species- *V. umbellata*.

Presently, *Azuki* *umbellata* (Thunb.) Ohwi, *Phaseolus calcaratus* Roxb. and *Phaseolus pubescens*, are considered synonyms and this variability in nomenclature contributes towards making the rice bean less well known among people. A series of common names also increases the uncertainties about it. It has been variously referred to in English as rice bean, red bean, climbing mountain bean, Mambi bean and oriental bean. In Indian Hindi language it is named as 'Sutari', whereas, in the hills of Himachal Pradesh and Uttarakhand its popularly known as *Rajmoong*, *Naurangi*, *Satrangei*, *Haramah*, *Paharimah* and *Moth*.

Normally, farmers grows their own land races, however, preliminary studies indicated that varieties PRR-1, PRR-2, RBL-1, RBL-6 BRS-1 and BRS-2 are promising in Himachal region. PRR-1 and PRR-2 are the varieties for the hills whereas RBL-1, RBL-6, RBL-35 and RBL-50 are the varieties for the plains.

Sowing in the mid hill areas can be done in the second fortnight of June. However, in Sub mountain and low hills sub tropical zone, it can be sown up to first fortnight of July. Generally the crop is sown by broadcast, however to get better yield, line sowing by seed drill or behind the plough is best. If line sowing is done then row to row spacing of 35-40 cm and plant to plant spacing of 8-10 cm is optimum. A seeds rate of 20-25 Kg/ha is sufficient for sowing. Application of N, P and K in the ratio of 20:40:20 is recommended at the time of sowing. Rice bean is quite tolerant to various diseases of pulses. The crop is mainly infected by blister beetles at flowering stage. Attack of beetles can be checked by spraying Fenvalerate (315 ml Sumicidin/Fenval/Agrofen 20 EC) or Monocrotophos (625 ml Monocil 36 SL) in 625 litre of water per ha.

The crop usually takes about 120-150 days for maturity depending upon agroclimatic conditions. Since, it is asynchronous in maturity therefore, early maturing pods should be hand picked. The crop can be harvested when about 5-10 percent pods are immaturred. The harvested crop should be allowed to dry for 3-4 days on threshing floor. Crop can be threshed by trampling under the feet of bullocks or with tractor or by beating with sticks. Seeds can be separated by winnowing. The seed should be sun dried and stored in air tight containers.



Ricebean

Buckwheat based value added products

Biscuits

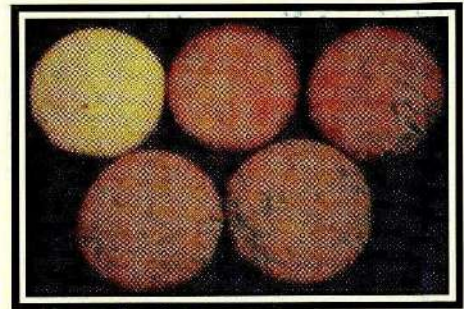
Ingredients

Refined wheat flour	:	720 g
Buckwheat flour	:	180 g
Sugar	:	520 g
Shortening	:	256 g
Sodium bi carbonate	:	10 g
Salt	:	8.4 g

Glucose solution (8.9 g of glucose dissolved in 150 ml water): 132.0 ml

Method of preparation:

- Sieve the composite flour, baking powder and salt.
- Cream the shortening till fluffy and add ground sugar and mix well.
- Add the above ingredients (composite flour, baking powder and salt) in it.
- Add glucose solution and make pliable dough with water.
- Roll the dough to ¼ inch thickness.
- Cut into desired shaped and place the biscuit 2.5 cm apart on a non greased tray.
- Bake in a preheated oven at 200° C for 15 to 20 minutes.



Khatai

Ingredients:

Refined wheat flour	:	750 g
Buckwheat flour	:	250 g
Shortening	:	500 g
Sugar	:	500 g
Curd	:	250 g
Sodium bicarbonate	:	2.5 g
Ammonium bicarbonate	:	5.0 g
Cardamom powder	:	5.0 g
Milk	:	Optional

Method of preparation:

- Sieve the refined wheat flour and buckwheat flour.
- Cream shortening and ground sugar till fluffy in texture.
- Add curd, sodium bicarbonate, ammonium bicarbonate and cardamom powder.
- Add flour and knead to pliable dough using milk if necessary.
- Make small round flat balls of this dough and keep in the greased tray leaving a distance of 5 cm between *khatai*.
- Bake in preheated oven at 150°C for 20 to 30 minutes.



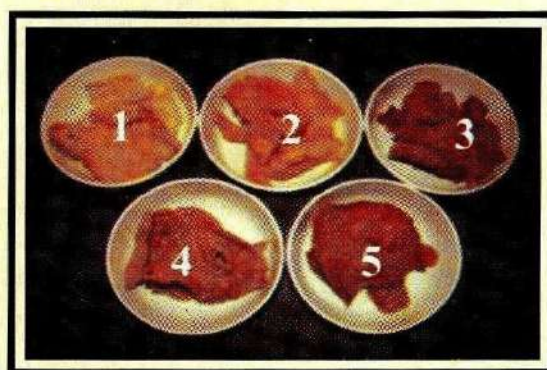
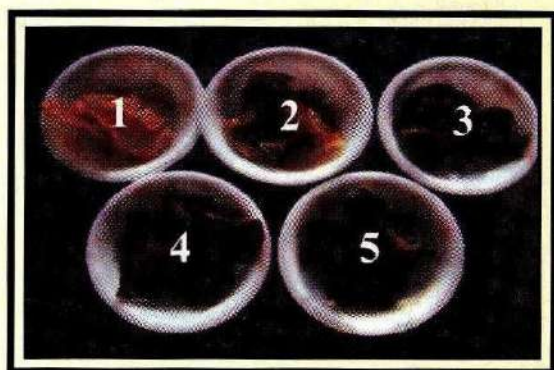
Papad

Ingredients:

Rice flour	:	1000 g
(Buckwheat flour: Replacing rice flour @ 25, 50, 75 and 100 per cent).		
Omum	:	50 g
Chilli powder	:	20 g
Salt	:	30 g
Water used	:	as required

Method of preparation:

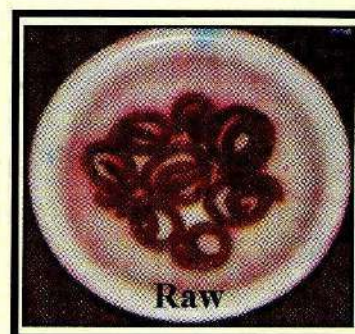
- Sieve rice flour and buckwheat flour and weigh the required amounts.
- Add required amounts of salt, chilli powder and omum seeds.
- Add water to this mixture and cook on medium flame to achieve a thick pouring consistency material.
- Spread the cooked material on a greased plate in circular shape with the help of ladle and dry in oven at 60⁰C till constant weight is achieved.
- Pack the dried samples of *papad* in polythene and deep fried before serving.



Curls (*Phulbadi*)

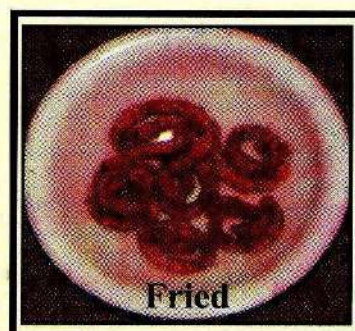
Ingredients:

Rice flour	:	500 g
Buckwheat flour	:	500 g
Omum	:	50 g
Chilli powder	:	10 g
Sa	:	30 g
Water	:	3000 ml



Method of preparation:

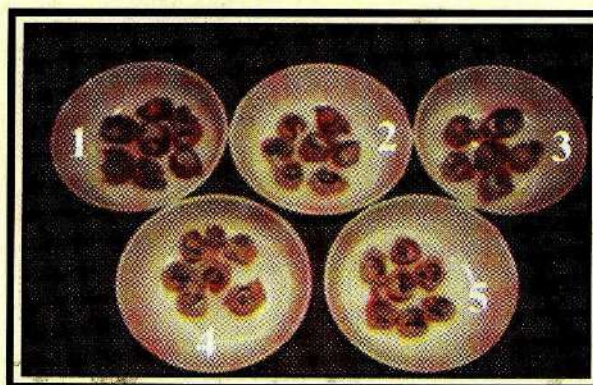
- Sieve rice flour and buckwheat flour in required amounts.
- Add omum seeds, red chilli powder and salt.
- Add required amount of water and mix thoroughly to prepare a batter of flowing consistency.
- Cook the batter at low flame to obtain a material of paste like consistency.
- Then extrude this batter with the help of hand extruder in the form of curls.



Colocasia Nuggets

Ingredients

Dehusked Black gram	:	750 g
Buckwheat flour	:	250 g
Cumin seed	:	50 g
Coriander powder	:	50 g
Big cardamom	:	25 g
Chilli powder	:	25 g



Method of preparation:

- Soak the dehusked Black gram overnight and wet grind in mixer and grinder.
- Add cumin seeds, coriander powder, big cardamom and chilli powder in measured quantities in the ground *dal*
- Don't whip the mixture.
- Wash and clean the colocasia stems.
- Roll the mixture of *dal* over colocasia stems and then dry partially.
- Cut the partially dried stems into pieces and dry at 60°C till constant weight is achieved

Vermicelli (Sewian)

Ingredients:

Refined wheat flour	:	500 g
Buckwheat flour	:	500 g
Refined oil	:	40 ml
Water used	:	as required



Method of preparation:

- Sieve refined wheat flour and buckwheat flour.
- Knead to pliable dough with the help of water.
- After giving a resting time of 10 to 15 minutes, divide the dough in to two balls and put in the greased hand extruder and extrude.
- Dry the vermicelli in a mechanical drier for 3-4 hours or till the constant weight is achieved.
- Pack in air tight containers for further use.

Vermicelli (Cooked)

Ingredients:

Vermicelli	:	500 g
Refined oil	:	300 ml
Sugar	:	300 g
Water	:	450 ml



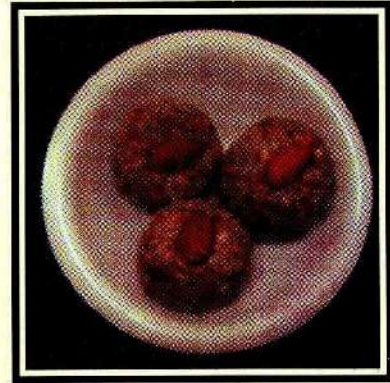
Method of preparation:

- Heat refined oil in a cauldron and put vermicelli in it.
- Roast the vermicelli over slow flame till golden brown in colour
- Then add water. Cook the mixture till soft.
- Finally add sugar and cook the whole mixture for 5-10 minutes on slow flame.

Buckwheat Pinni

Ingredients:

Buckwheat flour	: 1000 g
Sugar (powdered)	: 500 g
Popped lotus seeds	: 200 g
Desi ghee	: 800 g
Almonds	: 150 g
Cashew nuts	: 150 g
Edible gum	: 25 g
Coconut (grated)	: 200 g
Raisins`	: 200 g



Method of preparation:

- Heat small amount of ghee in cauldron and fry popped lotus seeds in it.
- In small amount of ghee fry edible gum and keep it aside.
- Crush fried popped lotus seeds and edible gum in a separate container.
- In rest of the ghee roast buckwheat flour over slow flame.
- Add crushed popped lotus seeds and edible gum in it and mix thoroughly.
- Add all dry fruits and add powdered sugar and stir continuously.
- Remove from fire, add cut raisins and let the mixture cool slightly.
- With hand mold the mixture in shape of pinnis and garnish with half cut almond on the top and store in air tight container.

Buckwheat Sewian (Sweet)

Ingredients:

Bengal gram flour	: 500 g
Buckwheat flour	: 500 g
Ghee	: 250 g
Baking powder	: 15 g
Sugar	: 1000 g (for syrup)



Method of preparation

- Sieve bengal gram flour, buckwheat flour and baking powder and add melted ghee in it. Prepare pliable dough with water and let it rest for 10 minutes.
- Put the dough in a hand extruder and then press the extruder in the heated oil for preparing *sewian*.
- Fry till light golden in colour.

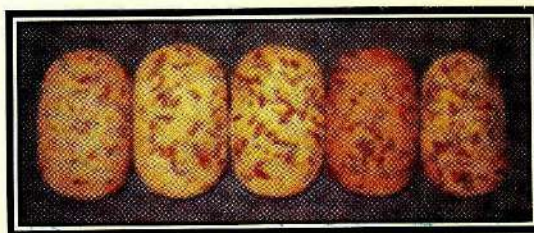
For making syrup

- Boil sugar in equal amount of water to get syrup of three thread consistency.
- Put the prepared *sewian* in the syrup for 20 minutes.
- On cooling the sugar gets coated around the *sewian*.

Salty Biscuits

Ingredients:

Refined wheat flour	:	325 g
Buckwheat flour	:	175 g
Baking powder	:	1.50 g
Salt	:	2 g
Sugar	:	100 g
Omum seeds	:	5 g
Cumin seeds	:	5 g
Shortening	:	275 g



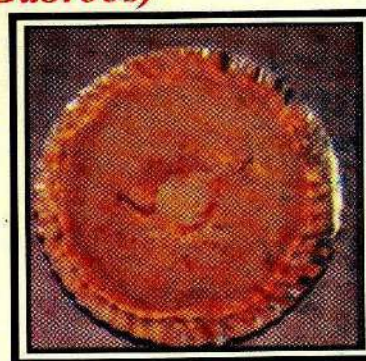
Method of preparation:

- Sieve the refined wheat flour, buckwheat flour and baking powder.
- Cream the fat and mix the above ingredients in it.
- Dissolve sugar and salt in water, add to the mixture and knead to pliable dough.
- Roll the dough to ¼ inch thickness.
- Spread omum and cumin seeds.
- Cut into desired shaped and place the biscuit 2.5 cm apart on a non-greased tray.
- Bake in a preheated oven at 350° F for 12 to 15 minutes.

Buck Wheat Pancakes (Babroos)

Ingredients

Whole wheat flour	:	480 g
Buckwheat flour	:	320 g
Sugar	:	300g
Water	:	as required
Ghee	:	for frying



Method of preparation:

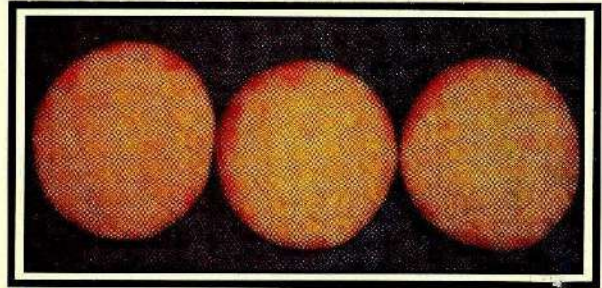
- Mix all the above ingredients except ghee to get batter of pouring consistency.
- Allow the batter to rest for 10 minutes.
- On a greased hot girdle pour 20ml of batter and flatten with the help of laddle.
- Cook the *babroo* by applying ghee and turning both the sides on girdle till done.

Amaranth based value added products

Biscuits

Ingredients:

Refined wheat flour	:	720 g
Amaranth flour	:	180g
Sugar	:	520 g
Shortening	:	256 g
Sodium bi carbonate	:	10 g
Salt	:	8.4 g



Glucose solution (8.9 g of glucose dissolved in 150 ml water): 132.0 ml

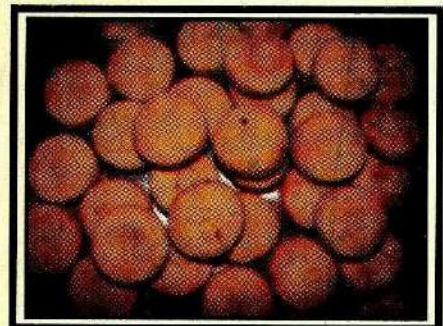
Method of preparation:

- Sieve the composite flour, baking powder, salt and ground sugar.
- Cream the shortening and mix the above ingredients in it.
- Add glucose solution and make pliable dough with water.
- Roll the dough to ¼ inch thickness.
- Cut into desired shaped and place the biscuit 2.5 cm apart on a non greased tray.
- Bake in a preheated oven at 200⁰ C for 15 to 20 minutes.

Salty Bites

Ingredients:

Refined wheat flour	:	650 g
Amaranth flour	:	350 g
Baking powder	:	3 g
Salt	:	4 g
Sugar	:	500 g
Shortening	:	550 g



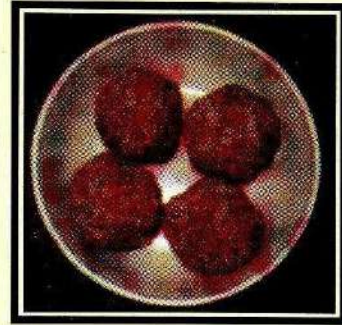
Method of preparation:

- Pop amaranth grains seeds in cauldron at a temperature of 210⁰C. Upon cooling, grind the popped seeds to powder.
- Sieve the refined wheat flour, popped amaranth flour and baking powder.
- Cream the fat and mix the above ingredients in it.
- Dissolve sugar and salt in water, add to the mixture and knead to pliable dough.
- Roll the dough to ¼ inch thickness.
- Cut into desired shaped and place the biscuit 2.5 cm apart on a non-greased tray.
- Bake in a preheated oven at 200⁰ C for 12 to 15 minutes.

Amaranth Coconut Ladoos

Ingredients:

Amaranth powder	: 1000 g
Sugar	: 1750 g
Desi ghee	: 250 g
Coconut powder	: 750 g



Method of preparation:

- For preparation of amaranth flour, pop the amaranth seeds in cauldron at a temperature of 210°C. Grind the popped seeds upon cooling.
- Heat clarified butter in a cauldron and add amaranth powder and coconut powder in it.
- Stir for half minute on slow fire and keep it aside.
- Prepare syrup of one thread consistency by dissolving sugar in equal amounts of water.
- Add the mixture of amaranth powder, coconut powder and ghee in it and mix thoroughly.
- Shape in to round balls with hand using water if necessary.
- Store in air tight containers on cooling.

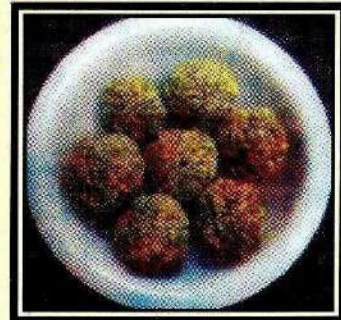
Ladoos

Ingredients:

Popped amaranth	: 1000 g
Jaggery	: 1000 g
Water	: 600 ml

Method of preparation:

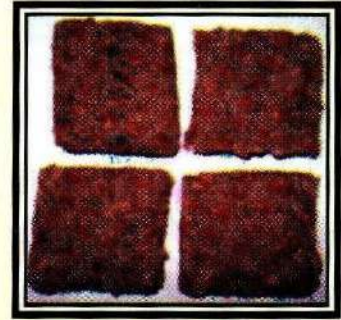
- Dissolve jaggery in hot water to prepare syrup of two thread consistency.
- Mix popped amaranth seeds thoroughly with jaggery syrup.
- Prepare small (10 g) sweet balls of this mixture when hot.
- Shape the balls into round shape by hand and store in air tight containers.



Amaranth Burfi

Ingredients:

Amaranth powder	: 1000 g
Sugar	: 500 g
Glucose solution	: 100 ml
Ghee	: 150 g



Method of preparation:

- Cook sugar and water together till the syrup reaches 118°C temperature and a syrup of multi string consistency is achieved
- Add liquid glucose and ghee and stir well
- Remove from heat and add amaranth powder stirring continuously. If necessary add one table spoon of water and keep stirring till the temperature comes down to 65°C.
- Knead lightly to make soft dough.
- Roll out on a flat greased surface to one centimeter thickness.
- Rub a butter paper over the surface to smoothen it evenly.
- Cut in square shape.

Rewari

Ingredients:

Popped amaranth	: 400 g
Jaggery	: 1600 g
Water	: 400 ml



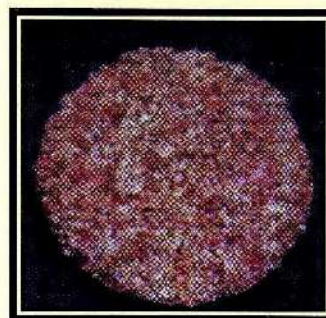
Method of preparation:

- Prepare syrup by dissolving jaggery in a cauldron by dissolving water in it.
- Boil the syrup till it reaches hard ball stage.
- Drop the resultant mixture over popped amaranth with the help of a spoon. For each *rewari* one teaspoon of syrup is required.
- The popped amaranth seeds stick with the syrup and result in round shaped *rewari*.
- Spread the *rewaries* over a clean tray, cool and store in air tight container.

Gajak

Ingredients:

Popped amaranth	: 800 g
Jaggery	: 1200 g
Water	: 400 ml



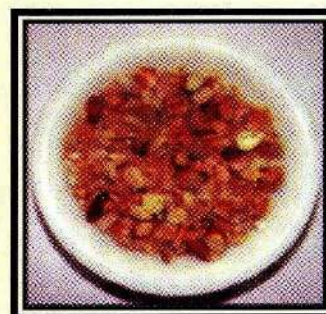
Method of preparation:

- Prepare thick syrup by dissolving jaggery in hot water.
- Add popped amaranth seeds to this syrup and mix thoroughly.
- Pour the mixture on to a greased tray. Spread the mixture evenly by rolling pin to obtain a *gajak* of uniform thickness.

Panjeeri

Ingredients:

Amaranth flour	: 800 g
Popped lotus seeds	: 200 g
Coconut (grated)	: 250 g
Almonds (crushed)	: 250 g
Raisins (cut)	: 200 g
Cashew nut (crushed)	: 200 g
Edible gum	: 25 g
Desi ghee	: 850 g
Jaggery power	: 600 g



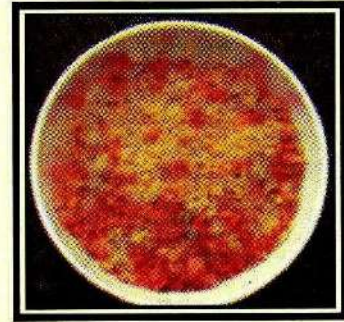
Method of preparation:

- Pop amaranth seeds and grind in mixer grinder to make flour of it.
- Heat small amount of ghee in a cauldron and fry popped lotus seeds and edible gum in it.
- Crush fried popped lotus seeds and edible gum and keep aside.
- Add crushed/ cut /grated dry fruits and crushed popped lotus seeds and edible gum in amaranths flour.
- Add jaggery powder and mix thoroughly.
- Put rest of ghee in this mixture and mix well.
- Store in air tight container.

Instant Energy Mix

Ingredients:

Amaranth flour	: 500 g
Almond powder	: 500 g
Desi ghee	: 1000 g
Mishri powder	: 1750 g



Method of preparation:

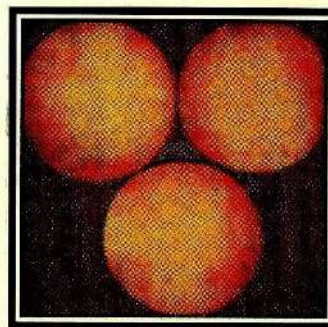
- Pop amaranth grains and grind in mixer and grinder to flour.
- Grind almonds and mishri to form powder.
- Mix amaranth flour, almond powder, mishri powder and ghee thoroughly.
- Keep in air tight container.
- Mix two to three tea spoons of the mixture in hot milk before serving.

Rice bean based value added products

Biscuits

Ingredients:

Refined wheat flour	: 630 g
Ricebean flour	: 270 g
Sugar	: 520 g
Shortening	: 256 g
Sodium bi carbonate	: 10 g
Salt	: 8.4 g



Glucose solution (8.9 g of glucose dissolved in 150 ml water): 132.0 ml

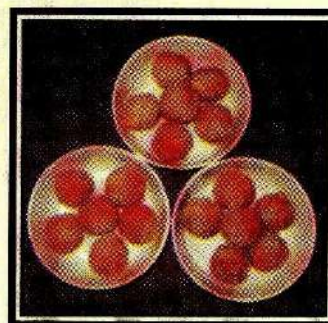
Method of preparation:

- Sieve the composite flour, baking powder, salt and ground sugar.
- Cream the shortening and mix the above ingredients in it.
- Add glucose solution and make pliable dough with water.
- Roll the dough to ¼ inch thickness.
- Cut into desired shaped and place the biscuit 2.5 cm apart on a non greased tray.
- Bake in a preheated oven at 200° C for 15 to 20 minutes.

Sweet Balls (*Ladoos*)

Ingredients:

Bengal gram flour	: 500g
Ricebean flour	: 500g
Ghee	: 350 g
Powdered sugar	: 500 g



Method of preparation:

- Sieve Bengal gram flour and ricebean flour. Melt ghee in a cauldron and add Bengal gram flour and rice bean flour.
- Cook on low heat with continuous stirring till the flour turns golden brown and gives a nice aroma and then remove from fire. This normally takes about fifteen to twenty minutes.
- Let it cool for a while and add powdered sugar and mix well.
- Shape in to walnut sized spherical shaped *ladoos*.

Sewian

Ingredients:

Bengal gram flour	: 700 g
Rice bean flour	: 300 g
Ghee	: 100 ml
Turmeric powder	: 15 g
Omum	: 15 g
Red chilli powder	: 15g
Salt	: 25 g
Water	: 450 ml
Oil for deep frying	



Method of preparation:

- Sieve Bengal gram flour and ricebean flour.
- Add oil and all the spices and rub well. Knead in to stiff dough.
- Heat oil in a cauldron. Put the dough in a hand extruder and extrude directly in to the hot oil.
- While extruding swiftly move your hand in a rotating motion so that the sewian do not fall in to one place.
- Fry till golden crisp. Remove drain and break them a bit cool and store in an air tight container.

Rice bean Namkeen

Ingredients:

Rice bean grains	: 1000 g
Salt	: 200 g
Chaat masala	: 50 g
Refined oil	: for frying



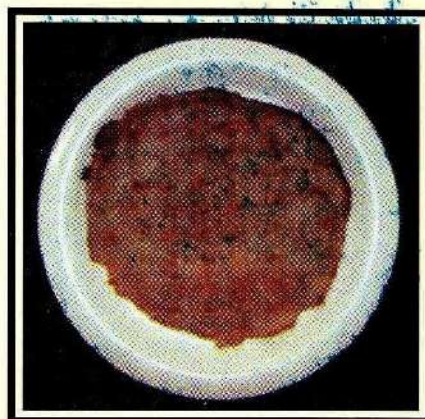
Method of preparation:

- Soak the rice bean grains overnight and drain the excess water next morning.
- Rub the soaked grains with hands to remove the husk of the grains.
- Put the soaked dehulled grains in one per cent boiling salt solution for 5 minutes followed by dipping the grains immediately in cold water.
- Spread the treated grains on a sheet of paper for drying of superficial water.
- Heat oil in a cauldron and deep fry the grains till golden brown in colour.
- Soak excess oil over a blotting paper sheet and store the *namkeen* in air tight containers.

Rice bean Pancake (*Babroo*)

Ingredients:

Wheat flour	: 800g
Rice bean flour	: 200 g
Sugar	: 400 g
Yeast	: 20 g
Grated coconut	: 50-100 g
Oil for frying	



Method of preparation:

- Dissolved yeast in luke warm water and add small amount of sugar and whole wheat flour and let it rest for 10 to 15 minutes to make ferment.
- Mix all the ingredients except oil in this ferment and prepare batter of desirable pouring consistency using water.
- Let the batter rest for 10 minutes.
- Pour a ladle full of batter on greased hot non-stick girdle and flatten with the help of ladle.
- Apply oil and cook the *babroo* by turning both the sides on girdle till done.

Matari

Ingredients:

Refined wheat flour	: 800 g
Rice bean flour	: 200 g
Shortening	: 300 g
Salt	: 20 g
Omum	: 10 g
Refined oil for frying	



Method of preparation:

- Sieve the refined wheat and rice bean flour and add salt and omum seeds.
- Put melted ghee in it and mix properly breaking all lumps.
- Make stiff dough using required amount of water.
- Roll the dough and cut diagonally into long shape pieces and deep fry till light brown.

Rice bean Pinni

Ingredients:

Rice bean flour	: 750 g
Whole wheat flour	: 250 g
Sugar (powdered)	: 500 g
Popped lotus seeds	: 150 g
Desi ghee	: 1000 g
Almonds	: 120 g
Cashew nuts	: 100 g
Edible gum	: 25 g
Coconut (grated)	: 150 g



Method of preparation:

- Heat small amount of ghee in cauldron and fry popped lotus seeds in it.
- In small amount of ghee fry edible gum and keep it aside.
- Crush fried popped lotus seeds and edible gum in a separate container.
- In rest of the ghee roast whole wheat and rice bean flour over slow flame.
- Add crushed popped lotus seeds and edible gum in it and mix thoroughly.
- Add all dry fruits after crushing except for raisins.
- Add powdered sugar and stir continuously.
- Remove from fire, add cut raisins and let the mixture cool slightly.
- With hand mold the mixture in shape of *pinnis*.
- Store in air tight container.

Rice bean *Shakarpara*

Ingredients:

Refined wheat flour	: 500 g
Rice bean flour	: 500 g
Baking powder	: 25 g
Ghee	: 300 g
Salt	: 10 g
Refined oil for frying	
Sugar	: 2000 g for making syrup
Water	: As required



Method of preparation:

- Sieve refined wheat and rice bean flour and mix baking powder and salt in it.
- Add melted ghee and rub the flour to break lumps and mix thoroughly ghee and flour.
- Knead to pliable dough using required amount of water.
- Roll the dough and cut square pieces and fry on slow flame till golden brown in colour.
- Prepare syrup of three thread consistency using sugar and water in equal amounts.
- Let the syrup cool slightly and put *shakarpara* in the syrup and keep stirring till the syrup sticks on the *shakarpara*.
- On cooling remove excess of sugar from the *shakarpara* and store in air tight container.

Rice bean *Bari*

Ingredients:

Black gram <i>dal</i>	: 500 g
Rice bean <i>dal</i>	: 500 g
Black pepper	: 50 g



Method of preparation:

- Soak black gram and rice bean *dals* separately in double amount of water.
- Drain excess water.
- Remove the husk of the *dal* manually by rubbing with hands.
- Grind both the *dals* in mixer and grinding using minimum amount of water.
- Whip the paste of *dal* after adding black pepper in one direction to make the mixture fluffy.
- On a greased tray drier tray put small amount of *dal* mixture in round shape to form *bari*.
- Dry in tray drier at 55-60°C till constant weight is achieved.
- Deep fry in refined oil and cook in onion and tomato gravy. Add sufficient water and pressure cook. Garnish with coriander leaves and serve with rice or *chappati*.

Promotion of underutilized crops

The underutilized plant has promising economic value and economically important for medicinal value and found in high altitude regions of Himachal Pradesh, Jammu and Kashmir and *Garwhal* and *Kumaon* regions of Uttarakhand. In Himachal the distribution of underutilized crops is mainly to the tribal regions of Lahaul and Spiti and Kinnaur districts and parts of Pangi and Bharmour Tehsils of Chamba district and some high hill areas of Kangra. Although Himachal Pradesh is the home for certain underutilized crops which are grown particularly in the tribal areas and have very good nutritional profile yet, in spite of high nutritional and medicinal properties these under-utilized crops are at the verge of extinction. These crops have not only nutraceutical properties but are also attractable to the farming community. Attempts have been made to evaluate the nutritional and product development potential of these crops. Among the different underutilized crops buckwheat, amaranth and rice bean have recently gained attention as supplementary food crops. These crops possess potential due to their nutritional quality, high grain yield and multipurpose usages.

Buckwheat is a multipurpose crop. It is rich in proteins, carbohydrates, fibre and essential amino acids. The percentage of essential amino acids of buckwheat is higher than cereals and almost equal to legumes. It also forms a rich source of micro nutrients with special reference to magnesium. Buckwheat is also reported to be useful in treatment of capillary fragility, retinitis, rheumatic fever of hemorrhagic conditions and helpful in management of diabetes and also in cardiovascular ailments. Utilization of buckwheat grains in form of flour with other flours viz. whole wheat flour, refined wheat flour, bengal gram flour, rice flour and many others up to 20 - 40 per cent for preparation of value added products like biscuits, pancakes (*babroos*), papads, phulbari, vermicelli, nuggets, pinni, sugar coated sewian and extruded products like pasta and noodles can be done at household as well as commercial level without compromising the sensory attributes. Incorporation of buckwheat flour enhances the nutritional profile of the supplemented products.

Amaranth has an attractive chemical composition when compared on an equal basis with other grains, whether cereals or food legumes and can be an

ideal nutritional supplement in cereal based diets. The dry matter of amaranth grain contains a substantial quantity of protein with adequate amounts of essential amino acids such as lysine and methionine. The grain contains 7-8 per cent lipids with high degree of un-saturation. Amaranth seeds are also good source of vitamins and minerals and contain a highly digestible starch. The amaranth possesses immense potential due to their nutritional quality, high grain yield and multipurpose usages. Amaranths after popping can be utilized for preparation of a variety of value added products viz. sweet balls (*ladoos*), burfi, panjeeri, biscuits and can also be supplemented with other flours to enrich them nutritionally.

Legumes are next to cereals as the source of protein in human diet. Legumes are a major source of dietary protein in developing countries. The rice bean is principally used for human consumption in the form of split bean (*dal*) and it is a useful source of dietary protein due to higher content of lysine. It can be used to supplement cereals for improving the protein quality. Nutritionally rice bean contains 25 per cent protein, 0.49 per cent fat and 5 per cent fiber. Based on 100 g edible portion it contains 300 mg calcium, 398 mg phosphorous and 6 mg iron. It is also rich in methionine and tryptophan as well as vitamins (thiamine, niacin and riboflavin). It is considered relatively free of anti-nutritional factors. Its seed is poor in phytin, a positive factor- as phytin inhibits mineral availability and digestibility. Low level oligosaccharides which cause flatulence are also low in rice bean. Rice bean is mainly consumed as '*dal*' (pulse). Many recipes like nuggets, *bhalla*, *bhaturu* (stuffed roti), biscuit, *ladoo*, *sewian*, *pinni*, *shakarpara*, *matari*, *namkeen* can be prepared from rice bean. In some products the acceptable level of ricebean flour incorporation was as high as 75 to 80 per cent.

Based on the studies conducted in the Department of Food Science and Nutrition, CSK HPKV, Palampur, the summary of the findings is as under:

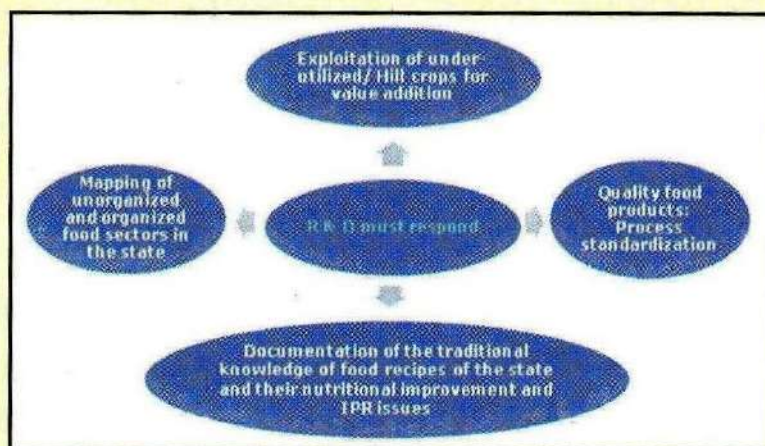
- Addition of these underutilized crops in diet which have high nutritional and medicinal benefits can not only relate to food security of the population but will also promote their cultivation and consumption.
- The treatments viz. roasting, popping, soaking and germination had beneficial effects on the nutritional quality of buckwheat and amaranths. The protein, ash and fibre contents increased with these treatments however roasting had slightly decreasing effect on the protein content.

- The utilization of buckwheat was tested in preparation of a variety of products viz. biscuits, *papad*, curls, vermicelli, nuggets, pasta, noodles, *pinni* and sugar coated sewian. The different types of *papad* are prepared mostly with rice flour. The efforts are made to replace rice flour with the buckwheat flour for the preparation of *papad* and the blends contained rice flour: buckwheat flour (75:25 and 50:50) produced best quality *papad*. However, the *papad* and *pinni* can be prepared from pure buckwheat flour and can be a good option for people who have fast for religious reason as buckwheat is usually recommended during fasts.
- Buckwheat is gluten free and the value added products prepared from pure buckwheat flour can be a good option for those who suffer from celiac disease and are gluten intolerant.
- The acceptability of buckwheat flour in preparation of extruded products viz. curls, vermicelli, pasta and noodles was studied. The products are prepared mainly from refined wheat flour. In case of curls and vermicelli the acceptable levels of buckwheat flour supplementation were 25 to 50 per cent but pasta, spaghetti and noodles require stiff type dough and the gluten plays an important role in such type of products. So the replacement of refined wheat flour up to 25 per cent level with buckwheat flour was acceptable for making pasta and noodles.
- The colocasia nuggets are usually prepared from black gram *dal* which has high protein content. These nuggets are liked by local people but consumption of these nuggets is to be restricted by the elderly people owing to its high protein content. Hence an attempt was made to develop an alternate product with almost same texture by replacing black gram with equal amounts of rice bean containing comparatively less protein but rich in other nutrients.
- Methodology was developed for utilization of amaranths in popped form in confectionery items at household and cottage levels.
- Rice bean was evaluated for preparation of value added products as such or as flour with in combination with other flour at different levels of supplementation. Acceptability of rice bean flour up to 75 per cent was observed in whole wheat flour *pinni* whereas; it was 50 per cent in *shakarpara*. Good quality biscuits were prepared using rice bean flour up to 40 per cent.

- The extruded product development not only have household uses but industrial application too. Utilization of these crops can add to a wide variety of products for those who are gluten intolerant and have to compromise because of less availability of such products.
- Keeping in view, the great significance of these under-utilized crops there is scope for technological interventions to promote entrepreneurs and other related units in the areas where the production is sufficient for empowerment of the target groups.
- For popularization and commercialization of amaranth and buckwheat products attempts are being made to establish linkages with local bakeries for the production of biscuits at mass scale. M/s Adrash Bakery, Palampur has already prepared buckwheat supplemented whole wheat flour biscuits and *khatai* and amaranth supplemented biscuits as per the standardized recipes.
- Based on the results of survey on “documentation of knowledge and traditional foods based on under- utilized crops and development of their value added products” conducted in Kinnaur District of Himachal Pradesh last year, attempts have been made to standardize and enrich the traditional food recipes of the local area.
- The storage stability of the value added products ranged from a few days to a few weeks depending upon the products prepared. The pancakes remained fresh for two to three days, confectionery products for two months whereas the nuggets were acceptable for 6 months
- The flavour of tradition is irresistible and so are the traditional foods. The intricacies of the recipe, the lack of opportunity to practice and master the art have tended to forego these delights to the gourmets and commons. Attempts are being made to popularize these traditions so that they can be made available with the added convenience.

Keeping in view the hardy nature of these crops, comparatively less input in cultivation, significant nutritional and medical importance and wide

acceptability in a number of value added products, the R&D must respond in following ways to make the cultivation and utilization of underutilized crops a sustainable process.



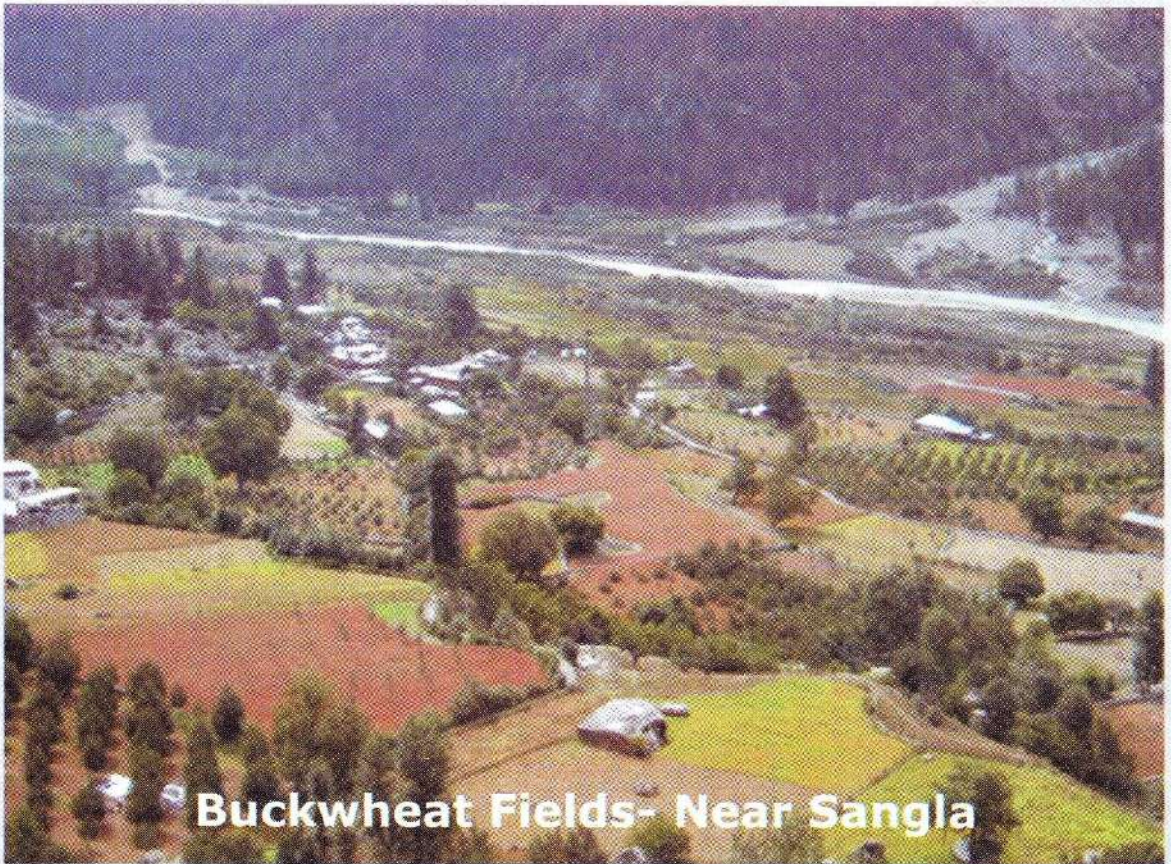
Increasing awareness of the consumer regarding the functional foods has increased the demand of several non conventional food resources. Promotion and popularization of the buckwheat, amaranths and rice bean and their value added products can be done by imparting trainings through SHGs, NGOs and *mahila mandals* or *krishik mahila smoohs* in the areas where such crops are cultivated. There is a great need for establishment and strengthening of market linkages for promotion of such products.

Common names of ingredients/ apparatus used

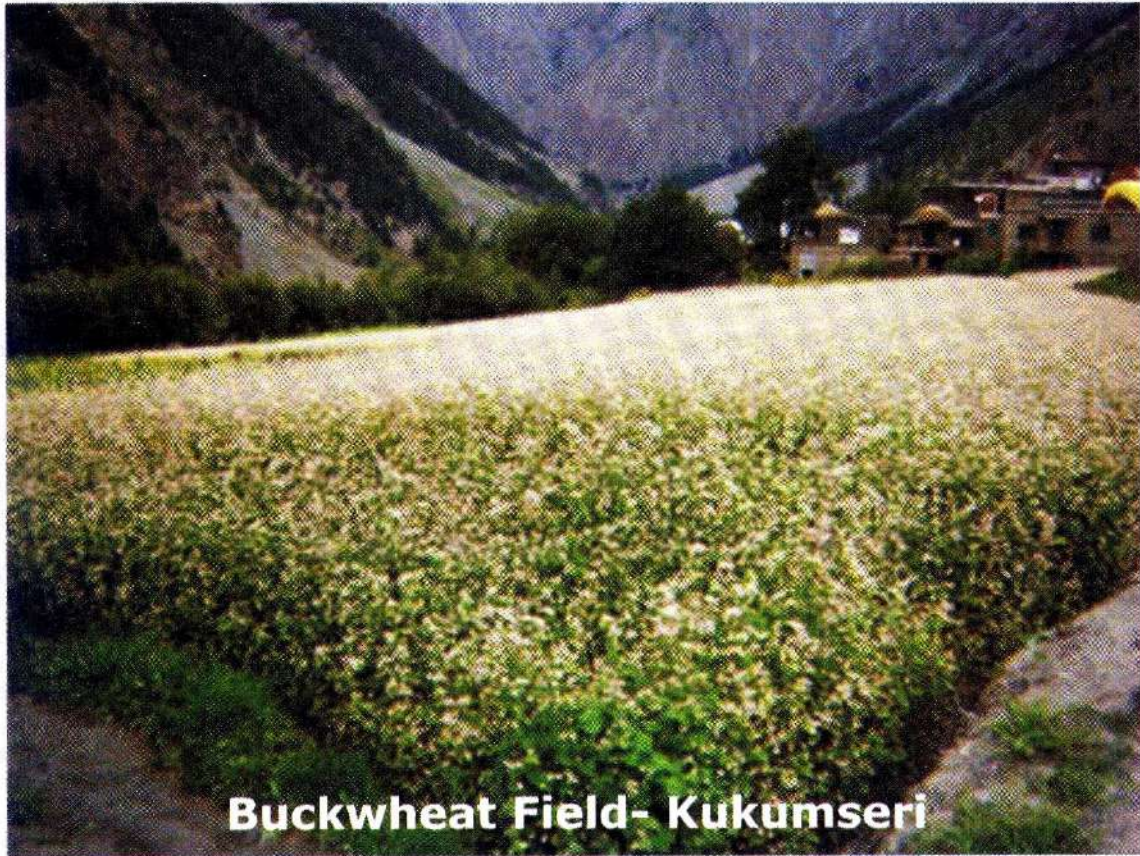
S.No.	English Name	Common Name
1	Whole wheat flour	<i>Atta</i>
2	Refined wheat flour	<i>Maida</i>
3	Bengal gram flour	<i>Besan</i>
4	Dehusked black gram dal	<i>Urad dal</i>
5	Turmeric powder	<i>Haldi</i>
6	Omum seeds	<i>Ajwain</i>
7	Cumin seeds	<i>Jeera</i>
8	Coriander powder	<i>Dhania</i>
9	Big cardamom	<i>Badi elachi</i>
10	Black pepper	<i>Kali mirch</i>
11	Red chilli powder	<i>Lal mirch</i>
12	Almond	<i>Badam</i>
13	Cashew nut	<i>Kaju</i>
14	Amaranth	<i>Cholie/Syul</i>
15	Buckwheat	<i>Ogla/bresh/fafra</i>
16	Rice flour	<i>Chawal ka atta</i>
17	Sodium bicarbonate	<i>Metha soda</i>
18	Popped lotus seeds	<i>Phool makhana</i>
19	Coconut	<i>Gari</i>
20	Edible gum	<i>Khaane wali gound</i>
21	Hull	<i>Chilka</i>
22	Jaggery	<i>Gur</i>
23	Jaggery powder	<i>Shakar</i>
24	Salt	<i>Namak</i>
25	Cauldron	<i>Kadai</i>
26	Griddle	<i>Tawa</i>
27	Rolling pin	<i>Belan</i>
28	Ladle	<i>Karchi</i>
29	Raisins	<i>Kishmis</i>



Buckwheat Fields- Near Spiti



Buckwheat Fields- Near Sangla



Buckwheat Field- Kukumseri



Buckwheat Crop in Apple Orchard- Sangla