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Quality Evaluation Of Under-Utilized Crops Of Himachal Pradesh

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ABSTRACT

Most of traditional crops have often been used for centuries, but have become increasingly neglected in times as more productive and profitable crops replaced them in farming systems. Almost about half of the humanity's need regarding calories and proteins is met by three crops, wheat, maize, and rice, but there is an urgent need to promote crop diversification to avoid the vulnerable situations in future.. Under-utilized crops are often rich in nutrients when compared to more popular staple crops. They often contain high levels of protein, vitamins, phytochemicals and they can have a good macronutrient profile of fat, protein and carbohydrates. With regard to health superiority, national under-utilized crops for example pulses can be included as a promising food group. Thence, developing varietalhuman dietary sources e.g., amaranth, buckwheat, ricebean, adzuki bean, chenopodium and many more can play a important role to ensure nutritional security.

Keywords: Traditional crops, phytochemicals, flavanoids, amaranth, ricebean, chenopodium and nutritional security.

1. INTRODUCTION

Underutilized crops which are domesticated plant species used for centuries for food, but over time they have reduced their importance as well as cultivation. These crops have multiple usage and untapped potentials for nutritional improvement of populationand contribute to fight malnutrition. Underutilized food crops are domesticated plant species that are grown for food but have been neglected due to various reasons; for example, adaptation to diverse growing conditions, ease of cultivation, storage of the crop, its nutritional characteristics and taste, and social taboos (Padulosi et al., 2002, Gupta, S.et al 2019).). Despite of being the potential food crops underultilized, such crops play a vital role in increasing essential micronutrient nutritional food insecurity(Vuong, 2000, Khamparia, A., et al.2020)). Worse still, their view as 'food of the poor' often stigmatize them, creating a financial disadvantage for their production and consumption.The underutilized crops also 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 Uttar Pradesh. In Himachal the distribution of underutilized crops is mainly to the Lahaul and spiti and Kinnaur districts and parts of Pangi and Bharmour Tehsils of Chamba district.

Even in north east India various lesser known crops are used by tribal people such as leaves of chenopodium and amaranth.

Among different underutilized crops, some crops grown in different regions are amaranth, buckwheat, horsegram, ricebean black cumin and finger millet have recently gained the attention as supplementary food crops. These posses immense potential due their nutritional quality, high grain yield and multipurpose usages.(Chopra, M., et al.2020)So these crops have great potential to play number of roles in improvement of food security and to utilize these species having comparative advantages in providing better food affordable by poor. Buckwheat, amaranth, rice bean and adzuki bean are amongst potential crops which have high nutritional and medicinal value and have potential for adding in weaning foods for improving nutritional, functional and sensory acceptability of the formulated weaning food mixes for the product development.(Jozinović et al., 2012, Kumar, V., et al 2020)

Among these crops amaranth grain has high level of protein, as well as a appreciable amount of fat content and has the potential to use it as an energy giving food. The balance of carbohydrates, fats, and protein, allow amaranth the chance to achieve a balanced nutrient uptake level with decreased amounts of consumption than with other cereals.(Sukul, P., et al.2020)The amaranth grain is also high in minerals such as calcium, magnesium, phosphorus, as well as dietary fibre.Rice bean [*Vignaumbellata*] is also called by the namemambi bean, climbing mountain bean, red bean and oriental bean. Rice bean is one of best legume, rich in protein (21-25%) and amino acid, especially the limiting amino acids namely, methionine and tryptophan and considerably increased quality of vitamins as well as minerals.Buckwheat (*Fagopyrum esculentum)* is a potential source of proteins, fibers, vitamins and minerals, such as iron, , phosphorus, selenium and manganese. Some buckwheat components, such as proteins has valuable cholesterol lowering properties and remarkable outstanding health enhanced properties(Lamichhane, Ojha, & Paudyal, 2013).On addition of buckwheatphysical properties, texture, colour and sensory characteristics of extruded products get improved (Wójtowicz, Kolasa, & Mościcki, 2013). Adzuki bean (*Vigna angularis)* is grown throughout East Asia and the Himalyas. The name adzuki comes from Japanese language, which are red in colour and found in certain areas. These are high in dietary fiber, and rich in folate, potassium and magnesium. Dry adzuki bean are high in protein but still it is considered as an under-utilized crop.

2. MATERIALS AND METHODS

The present investigation entitled "Quality evaluation of under-utilized crops of Himachal Pradesh" was conducted in the Department of Food Science, Nutrition and Technology, College of Home Science, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur.

Five under-utilized crops Ricebean, Adzuki bean, Buckwheat, Chenopodium and Amaranth were obtained from Department of Organic Agriculture, CSKHPKV, Palampur and Regional Research Station, Sangla.

Sample preparation

The seeds obtained were cleaned to remove adhered dirt, dust and foreign particle, if present, by hand. The clean seeds so obtained, were converted into a very fine grounded powder with stainless steel mixer. The grounded sample was stored till further analysis in an airtight containers to prevent any change. Four treatments given to them are as follows:

The seeds of chenopodium and buckwheat was dropped in a preheated cauldron and were moved with the help of moulded muslin or cotton cloth resulting the roasted

seeds.Ricebean and adzuki bean seeds for 12h were soaked in tap water and grain to water ratio (1:3). The seeds of amaranth were popped by keeping them in a pre heated cauldron and movedwith help of moulded muslin cloth until white colour for seeds obtained. The white seeds obtained were converted into grounded powder with the help of stainless steel mixer and in order to minimize changes till further analysis, sample were stored in airtight containers.

Adzuki bean **Buckwheat** **Ricebean** **Amaranth**

Plate 1 Under-utilized crops of Himachal Pradesh

3. RESULTS AND DISCUSSION

Physical Characteristics of under-utilized crops of Himachal Pradesh

1000 Kernel weight

Table 4.1 indicates the results for 1000 kernel weight of Amaranth, Buckwheat, Rice bean, Adzuki bean and Chenopodium. The highest seed weight was recorded in adzuki bean i.e. 72.48 gm followed by ricebean i.e. 67.30 gm. Same results were there by (Awasthi, Thakur, Dua, & Dhaliwal, 2011) who observed and report 1000 kernel weight of ricebean varieties ranged between 68.00 to 74.00 gm. The results of buckwheat, amaranth and chenopodium were 17.69 gm, 0.981 gm and 0.61 gm respectively and(Jain & Hauptli, 1980)also reported mean weight of 1000 seeds in range of 1.99 to 5.08 gm. The results were found to be significant with each other. In current study difference might have been due to the different cultivars and agro-climatic conditions.

Shape

Chenopodium and amaranth were roundin shape as presented in table 4.1. Similar results were shown by (Partap & Kapoor, 1985) in chenopodium and by (Jain & Hauptli, 1980)in amaranth who reported the shape of seeds were round. Further ricebean and adzuki bean was longitudinal (table 1). It was also reported that the shape of the rice bean was longitudinal. The buckwheat was observed to be triangular in shape.

Colour

The colour of amaranth was ceramic as indicated in table 1 and similar results were reported that amaranth seeds colour varies from white, gold and brown respectively while colour of buckwheat, ricebean, adzuki bean and chenopodium was brown, green, reddish and

earthen black respectively. (Verma & Mehta, 1988)reported greenish yellow colour of RBL 1 variety of ricebean seed and reported polymorphic colour of chenopodium seeds representing 7 colours in different ratio viz.. black, pale yellow, red and earthen. The variation in colour would be due to varietal difference.

Table 1

Physical Characteristics of under-utilized crops of Himachal Pradesh

Parameters	**Amaranth**	**Buckwheat**	**Ricebean**	**Adzuki bean**	**Chenopodium**	**CD (P≤0.05)**
1000 Kernel weight(gm)	0.981	17.69	67.30	72.48	0.61	2.30
Shape	Round	Triangular	Longitudinal	Longitudinal	Round	-
Colour	Ceramic	Brown	Greenish yellow	Reddish	Earthen Black	-
Length (mm)	1.45	2.42	5.35	4.87	1.24	0.04
Diameter (mm)	1.18	2.79	2.91	3.08	1.17	0.04

Length

As it is evident from the data in table 1 that seed length of ricebean was significantly higher (5.35 mm) as compared to other seeds i.e. adzuki bean(4.87mm), buckwheat(2.42mm), amaranth(1.45mm) and chenopodium(1.24mm) respectively. The results ofpresent study are in agreement with finding of (Joshi, Bhandari, Gautam, Bajracharya, & Hollington, 2007)while studying ricebean reported that average length of ricebean seed was 6.1 mm. Same results were shown by for amaranth who observed that the average length seeds were 1.42 mm respectively and (Partap & Kapoor, 1985) reported mean length of black, brown, red and earthen varieties of Himalyan hilly chenopods ranged between 1.32-1.52 mm. The slight differenceof present investigation may be due to cultivars or varietal differences.

Diameter

The diameter value of adzuki bean was 3.08 mm, ricebean was 2.91 mm followed by buckwheat, amaranth and chenopodium which was 2.79 mm, 1.18 mm and 1.17 mm respectively as presented in table 1. Similar results were shown by(Joshi et al., 2007)who while studying “Ricebean: a multipurpose underutilized legume” reported that average width of seed was 3.3 mm. (Akubugwo, Obasi, Chinyere, & Ugbogu, 2007) studied that the seeds of amaranth are little and lenticellular in their shape with average 1-1.5 mmdiameter, whose results were found to be similar and (Partap & Kapoor, 1985) who reported the mean diameter is from 1.28-1.72 mm for black, brown, red and earthen varieties of Himalayan chenopods. The results were found to be significant with each other.

Nutritional characteristics of under-utilized crops of Himachal Pradesh

The data in table 2 pertains to the nutritional characteristics of raw ingredients used for weaning food mixes.

Moisture

The values of moisture content of different crops varied significantly. The highest moisture content was found to be in ricebean (13.71%) and(Bajaj, 2014) reported that, the values of moisture content of ricebean as 10.53 per cent whose values are in close agreement with present results.It was followed by adzuki bean (10.58%), chenopodium (10.51%) and amaranth which contained lowest moisture content (8.76%) respectively. Similar results were found by (Emire & Arega, 2012) who analysed moisture content in amaranth and it was found to be 9.60 per cent respectively. And (Valencia-Chamorro, 2003) gave results for moisture content in chenopodium as 10.78 per cent. However 'chenopodium' and 'adzuki bean' were varied critically non-significant. These results are in similar with present investigation and thus provide credence to it.

Crude Protein

As presented in table 2 the maximum crude protein was reported in ricebean (23.26%) followed by adzuki bean (23.1%), amaranth (17.66%), chenopodium (15.22%) and buckwheat (10.6%) and similar results in buckwheat were reported by (Milovanović, Demin, Vucelić-Radović, Žarković, & Stikić, 2014) who reported protein content as 10.66 per cent. The results of ricebean are obtained close in agreement with who reported the values of protein content ranged from 17.26 to 21.42 per cent. (BAIK, Klamczynska, & Czuchajowska, 1998) reported protein amount in adzuki bean as 24.2% which was close in agreement with present investigation.(Valencia-Chamorro, 2003)revealed results for protein content of chenopodium as 15.17 %. The results varied significantly with each other. The slight variation in the protein content of different seeds may be due to genetic variation.

Crude Fat

The values of crude fat varied significantly and was found to be highest in amaranth (9.89%) and(Emire & Arega, 2012) found similar results for amaranth and fat content was found to be 7.49 per cent in amaranth respectively. It was followed by chenopodium (3.59%) whose results were in accordance with(Valencia-Chamorro, 2003) gave similar results for chenopodium in fat content as 5.57 per cent, buckwheat (3.54%) which were close in agreement with(Milovanović et al., 2014) who reported fat content as 3.06 per cent and adzuki bean has lowest crude fat i.e. 1.02 per cent.

Table 2

Nutritional characteristics of under-utilized crops of Himachal Pradesh

Parameters	**Amaranth**	**Buckwheat**	**Ricebean**	**Adzuki bean**	**Chenopodium**	**CD (P≤0.05)**
Moisture (%)	8.76	9.18	13.71	10.58	10.51	0.25
Crude Protein (%)	17.66	10.6	23.26	23.1	15.22	0.04
Crude Fat (%)	9.89	3.54	2.3	1.02	3.59	0.04

Crude Fibre (%)	11.05	7.14	6.96	0.96	2.7	0.04
Total Ash (%)	2.6	3.7	4.31	4.29	4.21	0.94
Total Sugars (g/100gm)	3.28	3.02	6.12	3.69	4.16	0.05
Vitamin-C (mg/100gm)	4.09	3.32	4.26	2.76	3.7	0.02
B-carotene (µg/100gm)	1.37	0	23.89	28.33	3.17	2.32
Methionine (g/100gm)	1.07	1.39	0.90	0.025	0.039	0.03
Tryptophan (g/100gm)	0.89	0.29	0.79	0.029	0.075	0.02

Crude Fibre

The results of crude fibre were found to be significant among all five crops and it was highest in amaranth (11.05%) followed by buckwheat (7.14%), ricebean (6.96%), chenopodium (2.7%) and adzuki bean (0.96%). Similar results of amaranth was given by(De Ruiz & Bressani, 1990) who while studying chemical composition and nutritive value of 14 selections of amaranth grain reported fibre content was in range 5.6-10.6 per cent respectively and (Valencia-Chamorro, 2003) gave similar range of crude fibre of chenopodium as 2.0 per cent.

Total Ash

The values of total ash varied significantly. It was found to be highest in ricebean (4.31%) and similar results were given by Ren et al. (2012) who reported ash content of ricebean was 3.26 per cent followed by adzuki bean (4.29%), chenopodium (4.21%), buckwheat (3.7%) and amaranth (2.6%). (Vilche, Gely, & Santalla, 2003) reported reported ash in amaranth is from 2.4-3.65 per cent. (BAIK et al., 1998) who results matched the results of present investigation for adzuki bean i.e. 4.24 per cent. (Valencia-Chamorro, 2003) gave similar results for total ash content in chenopodium as 3.52 per cent and for buckwheat results were observed by(Mishra, 2009)who reported ash content in buckwheat as 2.09 per cent. However the values of total ash of 'Chenopodium', 'Buckwheat and 'Adzuki bean' and 'Ricebean' were varied critically non significant.

Total sugars

Data in table 2 tells the values of total sugars present in under-utilized crops. The value was found to be significantly higher in ricebean (6.12 g/100gm) whose results were similar with (SAHARAN, KHETARPAUL, & BISHNOI, 2002) who reported total sugar of ricebean seeds was 5.60 g/100gm followed by chenopodium (4.16 g/100gm). observed quinoa flour and showed quinoa flour have yielded free sugars like glucose (4.55%), fructose (2.41%) and sucrose (2.39%). It was lowest in buckwheat (3.02g/100gm). All values varied significantly with each other.

Vitamin-C

The values of ascorbic acid content of all under-utilized crops were varied significantly and highest value were recorded in ricebean (4.26 mg/100gm) whose values were in agreement with(Thakur, 2013) who reported that the ascorbic acid content of ricebean seeds was 5.49 mg/100gm. It was followed by amaranth (4.09 mg/100 gm), chenopodium (3.7 mg/100 gm), buckwheat (3.32 mg/100 gm) and adzuki bean (2.76mg/100 gm). Similar results of chenopodium were reported by(Milovanovic et al. 2014) who observed Vitamin-C content in the quinoa seeds as 4.0mg/100g.

β-Carotene

The values present in β-Carotene of under-utilized crops varied significantly. It was found to be highest in adzuki bean (28.33 µg/100gm), followed by ricebean (23.89 µg/100gm), chenopodium (3.17 µg/100gm) and similar results were found by (Gupta 2013)reported β-carotene 0.39 µg/100gm and it was lowest in buckwheat. However the values of 'Amaranth', 'Buckwheat' and 'Chenopodium' varied critically non-significant.

Methionine

The values of methonine varied significantly. It was found to be highest in buckwheat (1.39 g/100gm), followed by amaranth (1.07 g/100gm) and was lowest in chenopodium (0.039 g/100gm). Similar results for amaranth were revealed by (Venskutonis & Kraujalis, 2013) who reported methionine content as 2.2 g/100 gm and (Kaur & Kawatra, 2000) gave results for methionine in ricebean as 0.98 g/100gm.

Tryptophan

The values of tryptophan content varied significantly. It was found maximum in amaranth (0.89 g/100gm) followed by ricebean (0.79 g/100 gm) and lowest in adzuki bean (0.029 g/100gm). Similar results for amaranth were revealed by (Venskutonis & Kraujalis, 2013)) who reported tryptophan content in amaranth as 1.1 g/100 gm and(Kaur & Kawatra, 2000) gave results for tryptophan in ricebean as 1.15 g/100gm.The values of 'Adzuki bean' and 'Chenopodium' varied critically non-significant.

Anti-nutritional factors present in under-utilized crops of Himachal Pradesh

Phytic Acid

Table 3 illustrates the results related to the phytic acid content of different under-utilized crops. The values of phytic acid of amaranth, buckwheat, ricebean, adzuki bean and chenopodium were492, 349, 516, 442, 135 mg/100gm respectively. Similar results for phytic acid were observed by(Navale, Swami, & Thakor, 2015) in ricebean who reported phytic acid as 407.90 mg/100gm. However the values varied significant with each other.

Table 3

Anti-nutritional factors present in under-utilized crops of Himachal Pradesh

Parameters	**Amaranth**	**Buckwheat**	**Ricebean**	**Adzuki bean**	**Chenopodium**	**CD (P≤0.05)**
Phytic acid	492	349	516	442	135	10.71

(mg/100gm)						
Saponins (g/100gm)	2.08	2.07	6.01	2.1	0.41	0.07

Saponins

Table 3 indicates values of saponin content varied significantly and higher values were recorded in ricebean (6.01 g/100 g) followed by amaranth (2.08 g/100g) and lowest in chenopodium (0.47 g/100 g) and similar results in chenopodium were reported(Jain 2015) who reported saponin content in different varities in chenopodium is between 0.01-4.65 per cent. However, the values of 'Buckwheat', 'Amaranth' and 'Chenopodium' were varied critically non-significant

Mineral content present in under-utilized crops of Himachal Pradesh

Data in Table 4 indicates mineral content in copper was found to be maximum in ricebean (2.926 mg/100gm) and lowest in amaranth (1.09 mg/100gm). Calcium content was observed to be highest in Chenopodium (344.5 mg/100gm) followed by ricebean (331.4 mg/100gm) and results were similar with (Hira, Kanwar, Gupta, & Kochhar, 1988), who reported the values of Ca in ricebean ranged between 200-470 mg/100gm. Iron content was highly significant in amaranth which was 16.12 mg/100 gm, followed by chenopodium (7.14 mg/100 g) whose values matched with the results of (Deosthale, 1981)observed iron content in various *Chenopodium album* cultivars values varied from 4.0-6.6 mg/100g. The values of manganese, phosphorus and magnesium are presented in table 5 and minerals content varied significantly. However 'Buckwheat' and 'Ricebean' varied critically non significant in iron, 'Amaranth' and 'Buckwheat' in copper and 'Amaranth' and 'Ricebean' in manganese.

Table 4

Mineral content in under-utilized crops used for preparation of Weaning Food Mixes

Parameters	**Amaranth**	**Buckwheat**	**Ricebean**	**Adzuki bean**	**Chenopodium**	**CD (P≤0.05)**
Calcium (mg/100gm)	205.2	110.4	331.4	212.6	344.5	0.40
Phosphorus (mg/100gm)	388.4	398.4	431.5	269.7	624.4	0.49
Magnesium (mg/100gm)	281.4	108.5	110.6	101.4	307.3	0.45
Iron (mg/100hm)	16.12	4.0	3.87	2.14	7.14	0.16
Copper (mg/100gm)	1.09	1.08	2.92	1.23	2.42	0.14
Manganese (mg/100gm)	2.42	2.89	2.42	2.14	5.12	0.04
Zinc (mg/100gm)	3.53	0.88	0.62	2.51	5.41	0.04

4. CONCLUSION

From the results it can be concluded that the acceptable quality of value added products can be prepared from amaranth, buckwheat, ricebean and adzuki bean. The addition of under-utilized crops in food products will improve their nutritional and functional properties. The addition of ricebean and adzuki bean improved protein content along with other nutrients. Utilization of the under-utilized crops in value added poducts will not only help the consumer to harness the nutritional and medicinal benefits of the under-utilized crops but will also suggest ways for their utilization.

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