Himachal Journal of Agricultural Research 35 (1): 112-116 , 2009

Biochemical composition of some promising buckwheat genotypes of Himachal Pradesh

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Abstract

Dry mature grains of 13 genotypes of buckwheat procured from MAREC, Sangla during the year 2005 were analyzed for various physical and biochemical attributes of dietary significance by following standard procedures. Wide variations were observed in 100-seed weight (2.10-2.67g), moisture content (10.33 - 12.44 %), protein (9.35 - 10.97%), essential limiting amino acid(s) *viz.*, methionine (0.15 - 0.31 g/100g grains) and tryptophan (0.19 - 0.35 g/100g grains), total carbohydrates (64.46 - 69.76%), total sugars (9.92 -11.86%) and total phenols (56.23 - 133.19 mg/100g). The study indicated that among various genotypes Sangla-B-1, Sangla-B-212 and EC-323729 in seed protein; Hassoska, Kalpa and VHC-27 in carbohydrates; USDA-1, Sangla-B-212 and Hassoska in methionine; Kalpa, PRB-9001 and Hassoska in tryptophan and VHC-27, Sangla-B-1 and Kamru in total phenols emerged promising genotypes for individual quality attribute(s). Moreover, cumulative varietal grading based on overall performance of varieties / genotypes with regard to various desirable nutritional characteristics taken together showed that Hassoska, Chini, PRG-9001, Kalpa and USDA-1 were adjudged as versatile genotypes in order of excellence.

Key words: Buckwheat, essential limiting amino acid, total phenols protein, carbohydrates.

Introduction

Buckwheat (*Fagopyrum esculentum* Moench) commonly known *kathu, fafra, ogle or bharesh* is herbaceous erect annual plant belonging to family Polygonaceae. It is an important pseudocereal crop in higher hills and mountains grown especially above 1500 msl upto 4500 msl in the Himalayas. Originally from China buckwheat has been well known cultivated plant in Europe since the middle ages. It is widely grown in Japan, Yugoslavia, Germany, Hungary, China and other countries. In India, it is grown almost entirely as food crop in the temperate parts of the Himalayan ranges and hilly areas of Tamil Nadu (Singh, 1961). Moreover, it is becoming popular crop owing to its tolerance to stress conditions in Uttrakhand, Himachal Pradesh and Jammu and Kashmir. Buckwheat is a rich source of dietary protein, carbohydrates, fibre and essential amino acids excluding leucine. It is reported to be useful in treatment of capillary fragility, retinitis, rheumatic fever of hemorrhagic conditions and helpful against cardiovascular ailments (Friederich *et al.*, 2000).

Literature revealed still inadequate information on variability in biochemical constituents of quality significance of buckwheat genotypes grown particularly in Himachal Pradesh conditions. Therefore, the present study was planned to evaluate biochemical constituents of dry mature grains of promising buckwheat genotypes to be useful for further crop improvement purpose.

Material and Methods

Dry mature grains of thirteen promising buckwheat varieties/ genotypes grown in the randomized block design with three replications by following the recommended cultural practices at Mountain Agriculture Research and Extension Centre, Sangla of the university during the year 2005, were procured and analysed for various physical and biochemical attributes. Prior to analysis the grains of various buckwheat genotypes were cleaned and freed from extraneous substances and dried in an electric oven at $60^0 \pm 5^0$C. The oven dried samples were ground in a Willey mill to pass through 40 mesh sieve and stored in polythene bags. The samples were labelled and kept at room temperature for further analysis. Moisture, ash and crude fibre contents were determined as mentioned in AOAC (1990), whereas total soluble protein was estimated by following the Bradford method (1976). Total sugars were extracted by following procedure of AOAC (1970) and estimated the same in the test extract by adopting the phenol sulphuric acid method of Dubois *et al.* (1956). The determination of oil content was done by following the Soxhlet method as described in AOAC (1965). Carbohydrate content was computed by subtracting from 100 the sum of the values for moisture, protein, fat, ash and crude fibre content.

Methionine and tryptophan contents were estimated by the procedures given by Horn *et al.* (1946) and Spies and Chambers (1949), respectively. The status of total phenols was found out by adopting the method of Bray and Thorpe (1954). Out of different, buckwheat varieties / genotypes evaluated promising genotypes superior in individual quality parameter(s) were identified that might be useful for further crop improvement through breeding / biotechnological approaches. Besides, an attempt was also made to carry out overall genotypic ranking in respect of various quality attributes *viz.*, protein, carbohydrates limiting amino acid(s) viz. methionine and tryptophan content in order to identify nutritionally superior multipurpose genotypes by following the procedure adopted by Sanjula (2006).

The data pertaining to various biochemical attributes of selected genotypes of buckwheat were subjected to statistical analysis by using analysis of variance for precise conclusions (Panse and Sukhatme, 1984).

Results and Discussion

The data on physical and biochemical characteristics of dry mature grains of various buckwheat genotypes are presented in Table 1. It was observed that 100-grain weight ranged significantly from 2.10 (Sangla-B-212) to 2.67 g (VL-27). The grain moisture content, which roughly indicates the degree of maturity, varied from 10.33 (VHC-27) to 12.44 (Sangla-B-212) per cent.

The highest protein content was found in the genotype Sangla-B-1 (10.97%) followed by Sangla-B-212 (10.83%) and EC-323729 (10.63%). However, the lowest value for protein content was noticed in the genotype OC_2. The protein content in the grains of common and tartary buckwheat has been reported as $11.7 \pm 0.04\%$ and $11.01 \pm 0.01\%$, respectively on dry weight basis by Bonafaccia *et al.*, (2003). The results of the present study are very close to those reported by other investigators on this aspect earlier who have observed variation in protein content from 8.7 to 13.9 and 8.1 to 13.4 per cent in buckwheat genotypes grown at Hissar and Sangla centers, respectively (Lal *et al.*, 2003).

The status of essential limiting amino acid(s) of pulses *viz.*, methionine and tryptophan was evaluated in buckwheat genotypes and the data revealed wide variation among different genotypes with respect to methionine and tryptophan content. The methionine content in different genotypes varied form 0.15 to 0.31 g/100g grains with its highest value exhibited by USDA-1 and Sangla-B-212, and the lowest in case of Emka. Since methionine is actively involved in several trans-methylation reactions in the plants and animals, the genotypes USDA-1 and Sangla-B-212 might have an advantage over other genotypes on this aspect. The maximum and minimum values with regard to tryptophan content was found in Kalpa (0.35 g/100g grains), PRB-9001 (0.33 g/100g grains) and Sangla-B-1 (0.19 g/100g grains), respectively. The genotypes Kalpa and PRB-9001 emerged out as superior ones over other genotypes with respect to tryptophan content. The status of methioine (g/100g protein) in common and tartary buckwheat flour has been reported as 1.41 and 1.42, which is equivalent to 0.149 and 0.145 g/100g grains, respectively (Bonafaccia *et al.* 2003).The overall performance in respect of methionine and tryptophan contents was more or less in accordance with the findings of Robinson (1980) and Thacker *et al.*(1984), who have observed variation in these parameters from 0.15 to 0.21 per cent and 0.14 to 0.19 per cent, accordingly. Moreover, marginally higher values observed in the accompanying work on this aspect might be attributed to the cumulative genotypic and environmental effects on these crop quality attributes as well.

Significant variations in carbohydrates were noticed to range from 64.46 (Sangla-B-212) to 69.76 (Hassoska). The highest value was exhibited by Hassoska, Kalpa and VHC-27, while the lowest value was showed by Sangla-B-212 for this parameter. Total sugars also varied significantly from 9.92 (EC-323729) to 11.86 (Hassoska) per cent. Almost similar pattern of variability for these parameters have also been reported by Robinson (1980); Gopalan *et al.* (2004) and Sharma (2006) indicating over all variation in carbohydrate content from 64.0 to 73.3 per cent. Keeping in view the beneficial effects of phenolics / flavonoids as anti-oxidants, when present in foods substantially amount and consumed with in permissible limits from nutritional quality stand point, the status of total phenols content in dry mature grains of buckwheat genotypes was evaluated. Significant variation with regard to total phenol content was noticed from 56.23 to 133.19 mg /100g. The genotypes Hassoska, Emka, Sangla-B-212 and OC_2 exhibited lowest value for total phenols in that order, whereas genotypes VHC-27, Sangla-B-1, Kamru and Chini with significantly high total phenol content were adjudged to be superior in

able 1. Variation in physical and biochemical attributes of dry mature grains of buck wheat genotypes

Parameters	PRB-9001	Emka	Kalpa	Hassoska	VHC-27	EC-323729	Chini	OC-2	Sangla-B-212	VL-7	Kamru	USDA-1*	Sangla-B-1*	SE (±m)	CD (5%)
100-seed weight (g)	2.32	2.57	2.39	2.47	2.35	2.57	2.37	2.48	2.10	2.67	2.37	2.32	2.31	0.03	0.09
Moisture (%)	11.75	12.22	10.43	10.62	10.33	12.19	10.49	12.21	12.44	11.39	12.14	11.39	11.50	0.006	0.01
Protein (%)	10.52	10.36	9.56	9.54	9.74	10.63	10.35	9.35	10.83	10.55	10.17	9.96	10.97	0.02	0.06
Fat (%)	2.65	2.79	1.70	2.52	1.71	1.80	2.65	2.50	2.74	2.28	2.32	2.70	2.60	0.09	0.27
Crude fibre (%)	6.74	6.80	6.69	5.23	7.26	7.20	6.40	5.50	7.45	6.40	6.87	6.80	6.88	0.12	0.36
Ash (%)	2.17	2.39	2.39	2.33	2.25	2.12	2.39	2.60	2.08	3.16	2.30	2.08	2.15	0.04	0.11
Carbohydrates (%)	66.22	65.54	69.23	69.76	68.71	66.06	67.72	67.00	64.46	66.75	66.20	67.07	64.78	0.02	0.08
Total sugars (%)	11.45	10.45	10.66	11.86	11.41	9.92	11.79	9.98	11.75	11.27	10.56	10.97	11.57	0.04	0.14
Methionine (g/100g grains)	0.23	0.15	0.20	0.29	0.19	0.28	0.26	0.24	0.30	0.21	0.29	0.31	0.25	0.004	0.01
Tryptophan (g/100g grains)	0.33	0.26	0.35	0.31	0.29	0.24	0.25	0.25	0.23	0.22	0.25	0.24	0.19	0.004	0.01
Total phenols (mg/100g)	87.17	56.24	69.96	56.23	133.19	89.95	122.15	77.10	57.23	86.81	130.55	98.28	132.29	0.69	2.03

*Released varieties of the State of Himachal Pradesh

this parameter over others. The range of variation in total phenols content of this study is in agreement with the observations of other investigators [Eggum *et al.* (1981); Dietrych-Szostak and Oleszek (1999) and Ikeda *et al.* (2001) who, have reported range of variation on this aspect from 18.8 to 154 mg/100g in this crop.

The study thus revealed that genotypes Sangla-B-1, Sangla-B-212 and EC-323729 in grain protein; Hassoska, Kalpa and VHC-27 in carbohydrates; USDA-1 Sangla-B-212 and Hassoska in methionine; Kalpa, PRB-9001 and Hassoska in tryptophan and VHC-27, Sangla-B-1 and Kamru in total phenols emerged promising genotypes for individual quality traits to be useful for further crop improvement purpose.

Besides, cumulative genotypic rating based on over all performance of genotypes in respect of grain protein, carbohydrate, essential limiting amino acids viz. methionine and tryptophan showed that Hassoska, Chini, PRG-9001, Kalpa and USDA-1 genotypes of buckwheat were adjudged as overall superior versatile genotypes in order of excellence (Table 2). Moreover, further studies are warranted to evaluate buckwheat germplasm for the status of flavonoid constituents (exhibiting anti-oxidant properties), dietary fibre components and also conducting biological (feeding trial) studies before recommending the versatile genotypes for direct human consumption purposes.

Table 2. Varietal grading of buckwheat varieties/genotypes in search of versatile multipurpose genotypes

Parameters/ Genotypes	PRB-9001	Emka	Kalpa	Hassoska	VHC-27	EC-323729	Chini	OC-2	Sangla-B-212	VL-7	Kamru	USDA-1	Sangla-B-1
Protein	4	5	9	9	8	3	5	10	2	4	6	7	1
Carbohydrates	7	9	2	1	3	8	4	5	11	6	7	5	10
Methionine	6	9	7	2	8	3	4	5	1	7	2	1	4
Tryptophan	2	5	1	3	4	6	5	5	7	7	5	6	8
Total*	19	28	19	15	23	20	18	25	21	24	20	19	23
Cumulative grading	3	9	3	1	6	4	2	8	5	7	4	3	6

* Genotypes graded in the descending order for nutritionally desirable characters

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