IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
Volume 7 | Issue 1 | January, 2012 | 168-172

RESEARCH ARTICLE

Malting potential of fifteen genotypes of husked barley

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SUMMARY

The variation might be under the influence of genetic make up of cultivars and abiotic factors. But the differences observed in the present study appeared to be mainly genetic ones as the malting quality of fifteen husked barley varieties were grown under Rajasthan agro climatic conditions were explored. TKW, Kernel plumpness and germination energy and capacity ranged from 28.6 to 49.2 per cent, 18.29 to 96.36 per cent, 91to 100 per cent and 64 to 98 per cent. The concentration of moisture, protein and starch in malt and grain varied from 3.70 to 4.49 per cent and 6.23 to 10.13 per cent, 9.31 to 13.26 per cent and 8.20 to 11.81 per cent, 41.32 to 56.88 per cent and 53.10 to 65.70 per cent and husk content ranged from 10.70 to 20.15 per cent. Malt yield, malt friability, malt homogeneity, hot water extract and saccharification time varied from 84.10 to 90.51 per cent, 92.78 to 98.62, 86.20 to 99.98, 61.80 to76.08 per cent and 5 min.Wort colour, wort appearance, filtration rate, soluble nitrogen and Kolbach index ranged from 2.5 to 4.5 ^{0}EBC, bright wort colour, 0.67 to 0.99 per cent and 0.38 to 0.64, respectively. Considering all the quality traits, superior for malting and brewing purposes.

Key Words **:** Barley, *Hordeum vulgare* L., Husked barley, Malting quality, Germination capacity, Wort

How to cite this article **:** Sexena, N., Kulshreshtha, S., Sood, D.R. and Sexena, V. (2012). Malting potential of fifteen genotypes of husked barley. *Internat. J. Plant Sci.*, **7** (1) : 168-172.

Article chronicle **: Received :** *18.10.2011;* **Sent for revision :** *05.11.2011;* **Accepted :** *28.12.2011*

Barley (*Hordeum vulgare* L.) is one of the major cereal crops ranking fourth in world acreage and production after wheat, rice and maize. About ten per centage of the world's barley production is utilized in malting and brewing industries and the rest for feeding to humans and animals. The health and medicinal benefits of barley foods have been stressed in ancient Egyptian, Greek and Romans (Chughatai *et al.,* 2002) . Barley husk has been utilized for the production of furfural and active carbon (Malcolmson *et al.,* 2005). Due to the liberalized economic policy of government of India, Also, there is the malt production in India is likely to increase in future and scope of exporting good quality barley malt at competitive prices in south-east Asian and far-east countries, is likely to be widened. European Union countries barley is the most nutritious food supplying a balance of minerals, amino acids, fibers and enzymes to that support the body's own self healing mechanisms. Barley has been used in the treatments of arthritis, digestive disease, diabetes, skin abnormalities, weight loss, detoxification mechanisms and cancer (Khorasani *et al.,* 1997).

Huskless barley varieties are ideally suitable for the alcohol industry in comparison to hulled ones (Ingledew *et al.,* 1995). Husked barleys are superior to dehusked for malting on the basis of higher thousand kernel weight, starch content and true extract and low crude fibre and fat contents (Anonymous *et al*., 1996). The national core groups of "Malt barley development" have laid down certain specifications for grain and malt quality characteristics that the two row and six row barleys must have in order to provide good raw materials for malt production (Sood *et al.,* 1987). Understanding the overall nutrients build up, their action,

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interaction and overall utilization by the human system may help in greater acceptability and usage and in indentifying barley cultivars with better storage quality, industrial application and in development of value added products. The present study investigation deals with malting quality of husked barleys under agro climatic conditions in Rajasthan state.

MATERIALS AND METHODS

Fifteen barley husked genotypes of fifteen varieties namely RD-2052, RD-2503, RD-2624, RD-2035, RD-2683, RD-2660, RD-2670, RD-2715, RD-2706, RD-2696, RD-2685, RD-2552, RD-2592, RD-2508, RD-2668 were procured from senior barley breeder Rajasthan Agriculture Station, Durgapura, Jaipur. The recommended doses of fertilizers and other agronomical practices were adopted to raise the crop under Rajasthan conditions during *Rabi* season of 2008-2009. Grains were cleaned, air dried and stored in tight plastic containers for analysis. One tablet of parad (Zandu pharmaceuticals) was added to each container to avoid infestation during storage. Grain samples of each variety were ground through Cyclotec sample mill (Tecator, AB; Hoganas, Sweden) fitted with 0.5 mm screen to deliver particle size of 0.45 mm and subsequently stored in airtight plastic containers at room temperature. One hundred plumped grains of each variety were malted in an automatic micro-malting machine (Seeger Maschinenfabrik, Feilback, Gemany). The dried malt was crused lightly to remove rootlets and the malt yield was calculated by ASBC (1992).Thousand kernel weight (TKW), kernel plumpness, malt friability, homogeneity, hot water extract (wort), wort colour and moisture contents were determined as per ASBC (1992). Kernels retained on sieves having a size of <2.2 mm and >2.5 mm were considered as thin and plump, respectively. Germination energy and germination capacity were worked out by the method of Kent-Jones and Amos (1967). Sodium hypochlorite reagent was used for the determination of husk content of grain (ASBC, 1992). Protein was calculated from nitrogen content determined by conventional micro-Kjeldahl method using a conversion factor of 6.25(AOAC). Soluble wort nitrogen was estimated according to the method of Vickery *et al.* (1935). Kolbach index was calculated by dividing the soluble wort nitrogen by total nitrogen. Starch content was estimated after removing the soluble sugars by dissolution in 80 per cent ethanol, followed by centrifugation and digesting the residue with 52 per cent perchloric acid to its glucose residue (McCready *et al.,* 1950) and subsequent reaction of glucose with phenol sulphuric acid (Dubois *et al.,* 1956).

RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed under following sub heads:

Malt quality parameters:

Data presented in Table 1 indicate the TKW of husked barley renged 28.6 to 49.2 g. Similarly, kernel plumpness of

Table 1: Malt quality parameters in barley grains of husked varieties

Sr.No.	Varieties	TKW(g)	Kernel Plumpness		Germination energy (%)	Germination capacity (%)
			Bold (%)	Thin (%)		
1.	RD-2052	39.6	73.33	3.64	99	98
2.	RD-2503	35.1	53.67	16.07	99	96
3.	RD-2624	30.0	41.38	20.18	99	93
4.	RD-2035	28.6	18.29	42.03	97	92
5.	RD-2683	43.5	83.83	5.45	92	92
6.	RD-2660	35.1	75.74	4.90	98	91
7.	RD-2670	40.6	66.07	9.86	100	97
8.	RD-2715	37.3	73.06	5.37	92	64
9.	RD-2706	32.5	49.75	17.61	91	80
10.	RD-2696	49.2	96.36	0.47	98	90
11.	RD-2685	32.7	49.75	20.05	92	86
12.	RD-2552	37.3	57.23	12.04	99	94
13.	RD-2592	35.7	76.39	5.18	91	69
14.	RD-2508	34.7	65.26	7.16	98	85
15.	RD-2668	40.4	74.69	3.34	98	96
Max		49.2	96.36	42.03	100	98
Min		28.6	18.29	0.47	91	64
Mean		37.06	62.90	12.69	96.11	87.35
S.D.		6.011	22.09	12.36	3.49	11.10
C.V.		16.21	35.11	97.35	3.63	12.71

Bold > 2.5mm; Thin < 2.2mm

husked barley ranged widely from 18.29 to 96.36 per cent. Barley varieties having higher TKW and plumpy kernels may be desirable for malting because of their greater malt extract (Mather *et al*., 1997).

However, malt of husked barley renged 84.10 to 90.51 per cent.Germination energy and capacity varied from 91 to100 per cent and from 64 to 98 per cent in barley husked varieties, respectively. All the varieties under study possessed good germination capacity and germination energy. However, germination energy was slightly higher than germination capacity, indicating that the varieties were water sensitive. Similar observation was made by Sood *et al.* (1987).

Chemical composition of barley malt :

Table 2 reveal that Moisture contents of the barley grain varieties ranged from 6.23 to 10.13 per cent, whereas those of malt varied from 3.70 to 4.49 per cent.Compared to barley grain protein content slightly lower values than malt protein varied from 8.20 to 11.81 per cent and from 9.31 to 13.26 per cent (Yadav *et al.,* 2000). Husk contents varied from 10.70 to 20.15 per cent with maximum and minimum in 'RD-2624' and 'RD-2696', respectively. More or less similar values have been reported by (Gupta, 1997). Starch is major constitutent of barley endosperm, which produces sugars at the time of malting and later forms a part of the wort. The high value of starch in barley grains consequently results in better wort. The starch contents in barley grains vary from 55.10 to 65.70 per cent and decreased during malting, the values from 41.36 to 56.88 per cent. The observed decrease in starch content during malting is in agreement with the findings of (Subramanian *et al.,* 1992).

Malt and wort quality characteristics :

Table 3 and 4 show hot water extract is a key malting quality indicator because it reflects the amount of beer that can be produced from a given quantity of malt and it varied over a narrow range of 61.81(RD-2685) to 76.08(RD-2035) per cent (Table 3). Malt friability ranged from 92.78 to 98.62 per cent, while malt homogeneity varied from 86.20 to 99.98 per

Table 2 : Chemical composition of barley grain and malt of husked varieties

Sr. No.	Varieties	Moisture (%)		Protein (%)		Starch (%)		Husk content (%)
		Malt	Grain	Malt	Grain	Malt	Grain	Grain
1.	RD-2052	4.42	10.13	10.69	9.33	47.91	57.68	15.45
2.	RD-2503	4.02	9.28	11.47	9.46	53.64	65.70	16.30
3.	RD-2624	4.26	9.37	10.81	10.85	50.18	64.58	20.15
4.	RD-2035	3.72	9.17	11.1	9.67	50.26	60.18	16.65
5.	RD-2683	4.41	7.54	9.31	8.20	49.38	58.20	13.0
6.	RD-2660	3.74	6.23	12.77	11.81	51.61	63.38	15.50
7.	RD-2670	4.26	7.70	9.57	8.23	54.08	62.20	14.10
8.	RD-2715	3.70	7.62	10.62	9.40	52.61	60.29	16.35
9.	RD-2706	3.94	9.21	10.33	9.36	46.11	57.89	18.30
10.	RD-2696	4.09	8.40	9.76	8.83	49.01	58.00	10.70
11.	RD-2685	4.10	8.83	12.23	11.04	54.11	61.39	19.85
12.	RD-2552	4.22	8.95	10.61	9.95	42.46	54.68	15.95
13.	RD-2592	4.49	8.60	9.93	8.87	41.32	53.10	14.65
14.	RD-2508	4.09	9.02	13.26	11.64	42.12	56.25	14.90
15.	RD-2668	4.20	9.23	11.56	10.59	56.88	63.30	12.45
Max		4.49	10.13	13.26	11.81	56.88	65.70	20.15
Min		3.70	6.23	9.31	8.20	41.32	53.10	10.70
Mean		4.10	8.56	10.97	9.83	49.40	59.74	15.59
S.D.		0.26	1.12	1.25	1.20	5.06	59.86	2.84
C.V.		6.47	13.07	11.42	12.28	11.62	59.52	18.59

Table 3 : Malt quality characteristics of husked barley varieties

Sr. No.	Varieties	Malt yield	Malt friability	Malt homogeneity	Hot water extract	Saccharification time
1.	RD-2052	88.6	95.92	99.72	74.62	5 min
2.	RD-2503	87.78	96.54	99.82	70.92	5min
3.	RD-2624	85.6	94.32	99.8	67.79	5min
4.	RD-2035	86.9	98.26	99.98	76.08	5min
5.	RD-2683	87.1	92.78	99.04	75.91	5min
6.	RD-2660	90.0	93.92	99.74	68.64	5min
7.	RD-2670	84.1	93.72	99.58	73.17	5min
8.	RD-2715	86.29	95.24	99.66	70.91	5min
9.	RD-2706	89.1	97.24	86.2	69.06	5min
10.	RD-2696	90.51	98.62	99.94	74.85	5min
11.	RD-2685	88.21	94.08	99.44	61.80	5min
12.	RD-2552	87.11	97.22	99.44	70.32	5min
13.	RD-2592	85.21	97.92	99.82	71.06	5min
14.	RD-2508	85.94	97.3	99.88	70.47	5min
15.	RD-2668	88.11	98.08	99.9	72.87	5min
Max		90.51	98.62	99.98	76.08	-
Min		84.1	92.78	86.2	61.80	-
Mean		87.36	96.03	98.12	70.96	-
S.D.		1.96	2.01	4.36	4.21	-
C.V.		2.24	2.10	4.44	5.93	-

S =Satisfactory (5min)

Table 4 : Wort quality characteristics of husked barley varieties

Sr. No.	Varieties	Wort colour (^{0}EBC)	Wort appearance	Filtration/h(ml)	Soluble-N (%)	Kolbach index
1.	RD-2052	3.5	BR	170	0.85	0.50
2.	RD-2503	3.0	BR	185	0.86	0.47
3.	RD-2624	3.5	BR	100	0.86	0.50
4.	RD-2035	4.5	BR	145	0.89	0.50
5.	RD-2683	4.0	BR	155	0.89	0.60
6.	RD-2660	4.0	BR	145	0.77	0.38
7.	RD-2670	3.0	BR	240	0.97	0.64
8.	RD-2715	4.5	BR	50	0.99	0.58
9.	RD-2706	3.5	BR	90	0.92	0.56
10.	RD-2696	2.5	BR	115	0.85	0.54
11.	RD-2685	4.0	BR	210	0.80	0.41
12.	RD-2552	3.0	BR	220	0.67	0.40
13.	RD-2592	3.5	BR	60	0.94	0.59
14.	RD-2508	4.0	BR	175	0.99	0.47
15.	RD-2668	3.0	BR	160	0.96	0.52
Ma.x		4.5		240	0.99	0.64
Min		2.5		50	0.67	0.38
Mean		3.55		147.64	0.87	0.51
S.D.		0.63		60.61	0.09	0.08
C.V.		17.95		41.05	11.23	16.18

E.B.C=Europen brewing convension, BR= Bright wort colour

cent, respectively. Wort colour were observed in husked barley ranged from 2.5 (RD-2696) to 4.5 (RD-2035, RD-2715) and all the varieties had bright appearance. The lowest filtration rate in 50ml (RD-2715) and highest 240ml (RD-2670). Similar views were also shared by Yadav *et al.*(2001). Soluble wort nitrogen ranged from 0.676 per cent (RD-2552) to 0.999 per cent (RD-2508) with mean content of 0.879 per cent. Kolbach index represents the percentage of malt nitrogen that is soluble and indicates total protcolytic activity during malting and mashing. These values varied widely and significantly from 0.67 (RD-2552) to 0.99 (RD-2508). Przvlj *et al*.(1998)· also observed genotypic differences in kolbach index in winter barley.

Acknowledgement :

Help rendered by Dr. R.P.S. Verma, Scientist, Directorate of Wheat Research, Karnal is duly acknowledged.

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