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Biochemical Analysis of Different Wheat Varieties Grown under Various Zones of India

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ABSTRACT

Background: The study aimed to evaluate the flour quality of different wheat varieties (*Triticum durum* L.) for various end-use products such as chapati, bread, biscuits and pasta. The focus was on identifying varieties with superior nutritional and processing qualities by analyzing various qualitative parameters.

Methods: The study assessed multiple wheat varieties using a range of qualitative parameters, including moisture, ash, total soluble sugar, starch, protein, lysine, tryptophan, dry and wet gluten, gluten index, water binding capacity, β-carotene content, sedimentation value, thousand kernel weight and mineral content (Fe and Zn). The wheat varieties evaluated included A-206, GW-1, HI 8498 (Kota), PDW 291 (Hissar) and NIDW 295 (Pune).

Result: The study identified A-206 and GW-1 as wheat varieties with superior protein content, gluten quality and water binding capacity, making them ideal for various end-use products. A-206 also had the highest lysine and tryptophan levels, while GW-1 and HI 8498 (Kota) had elevated ash content. PDW 291 (Hissar) was notable for its higher total soluble sugar and NIDW 295 (Pune) excelled in starch content, β-carotene and thousand kernel weight. Overall, NIDW 295 showed the most promise for pasta production due to its comprehensive quality traits.

Key words: Gluten index, Nutritional parameter, *Triticum durum,* Wheat quality.

INTRODUCTION

Wheat is one of the most globally important cereal crops worldwide, in terms of production, utilization and a major contributor to food self-sufficiency in India. More than 35% of the world's population subsists on wheat (Sajida *et al.,* 2009). Wheat is an important cereal crop as being consumed for staple food in the world (Abebe *et al.,* 2022). There is a continuous need of obtaining higher yield to feed a growing population of the world It has been estimated that about 65% of wheat grain is directly used as food for humans, indicating its acceptance as main staple food and 21% as a feed for livestock, 8% as seed material and the remaining 6% for the other uses like industrial raw material (Faqir *et al.,* 2007). Wheat belongs to the sub-tribe *Triticinae* of tribe *Triticeae* in the grass family *Poaceae.* The sub-tribe *Triticinae* is of recent origin and contains about 35 genera including *Triticum*, *Aegilops*, *Thinopyrum etc*., (Sakamura, 1918). In India three types of wheat are grown *Triticum aestivum* L. (Bread/common wheat, 2n=6x=42), *Triticum durum* L. (Durum wheat, 2n=4x=28) and *Triticum dicoccum* L. (Dicoccum wheat, 2n=2x=28). Wheat is the main source of world's food energy and nutrition. Large numbers of end-use products such as chapati, bread, biscuit, pasta, noodles, macroni, spaghetti, cakes, pizzas and doughnuts *etc*., products are made from wheat, which shows its importance in food and baking industries (Sewa and Mishra, 2007). In view of its industrial importance, a special emphasis is given to wheat crop. Quality differences among wheat varieties have gained even more importance in trading due to important global economic and social trends. Durum wheat widely cultivated in the Mediterranean Basin and also in Canada, U.S.A., Argentina and India. With about 21 million ha under cultivation (about 8% of the total wheat cultivated area), durum wheat ranks eighth among all cereals (Blanco, 1998). Wheat is one of the most important cereal crops of the world on account of its wide adaptability to different agroclimatic conditions and different soil. Among major cereals, wheat ranks first in area and production at the global level and it contributes more calories and proteins to the world's human diet than any other cereals. It is the main staple food of nearly 35 per cent of the world population (Afzal and Ramesh, 2015).

Similarly, durum wheat which nearly occupies about 2 million ha area in India has a good potential for export. Increasing global demand, value addition potential, better price in market due to good nutritional quality and resistance to kernel bunt are the factors, which make durum an export commodity. Durum is mainly used for production of pasta

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products as well as its quality characteristics like yellow color and resist to over cooking *i.e.* cooked pasta should maintain good texture, resists surface disintegration and has firm structure consistency. Most of these characteristics are determined by the quantity and quality of gluten proteins (Anonymous, 2007).

The nutritional value of wheat is extremely important as it takes an important place among thefew crop species being extensively grown as staple food sources. The importance of wheat ismainly due to the fact that its seed can be ground into flour, which forms the basic ingredients of bread and other bakery products, as well as pastas and thus it presents themain source of nutrients to the most of the world population.

MATERIALS AND METHODS

Nine durum wheat varieties were studied for biochemical analysis (North western zone: PDW 291 Hissar, PDW 291 Durgapur; Central zone: HI 8498 Indore, HI 8498 Kota, HI 8498 Vijapur; Peninsular zone: NIDW 295 Niphad, NIDW 295 Pune; Western zone: GW-1 Arnej, A-206 Arnej). Seven varieties were obtained from Directorate of Wheat Research, Kernel, India and two varieties were selected from Regional Research Station, Arnej, Gujarat. Analysis of various biochemical constituents were carried out in B. A. College of Agriculture, Anand Agricultural University and College of Agriculture, Parul University in 2021-22. Moisture (AOAC, 1995), Ash (AOAC, 1965), Total soluble sugars (Dubois *et al.,* 1956), starch content (Maccready *et al.,* 1950), Total protein (AOAC, 1965), Lysine(Sadasivam and Manickam, 1992), Tryptophan (Nurit *et al.,* 2009), Wet gluten and dry gluten (AACC, 2000), β-Carotene (Misra and Gupta, 1995), Sedimentation test (Misra and Gupta, 1995), Thousands kernel weight (Misra and Gupta, 1995) were determined from wheat flour.

Statistical analysis

The research was conducted using completely randomized design with 3 replications.

RESULTS AND DISCUSSION

Wheat as a grain is grown on more land area than any other commercial food. Its world trade in is greater than all other crops combined. Globally, wheat is the leading source of vegetable protein in human food, having higher protein content than other major cereals (Dutta *et al.,* 2018). Various quality measurements affecting dough quality of wheat flour has been studied for all nine varieties in three replications. Mean data are presented in Table 1, 2, 3. The moisture percentage of all studied wheat varieties was from 8.36% to 11.04%. The flour of PDW 291 (Hissar), PDW 291 (Durgapur), HI 8498 (Indore), HI 8498 (Kota), HI 8498 (Vijapur), NIDW 295 (Niphad), GW-1 (Arnej) and A-206 (Arnej) is suitable for storage stability and longer shelf life, whereas variety NIDW 295 (Pune) showed slightly higher range of moisture of 11.04%. Moisture content of 9 and 10% is suitable for storage stability and longer shelf life of wheat flour (Nasir *et al.,* 2003). Ash is primarily concentrated in the bran and is an indicator of flour yield (Prabhasankar *et al.,* 2002). Ash content of studied wheat varieties was found from 1.47% to 1.71%. Varieties HI 8498 (Kota) and GW-1 (Arnej) showed highest ash 1.71%, whereas HI 8498 (Vijapur) has lowest 1.47% of ash. TSS content in flour where found to be varies from 2.56 to 2.66%. Variety PDW 291 (Hissar) showed higher total soluble sugar content, whereas variety PDW 291 (Durgapur) showed lower total soluble sugar content. Percentage of starch ranges from 64.02 to 66.40% among nine wheat varieties. Total soluble sugar and starch content ranges from 1.5 to 2% and 65 to 70% respectively (Gooding and Davis, 1997). Protein content of studied varieties varies from 9.52% to 13.29%. Variety A-206 (Arnej) had the highest protein content of 13.29% and PDW 291 (Hissar) showed lowest as 9.52%. For making good quality pasta products from durum wheat, more than 12 % protein is required. In present study Varieties GW-1 (Arnej) and A-206 (Arnej) showed higher protein content which can be suitable for making pasta as compared to other durum varieties of different zones of India. The lysine content in studied varieties varies from

Table 1: Quality parameters of different *Triticum durum* wheat varieties.

Varieties	Moisture (%)	Ash (%)	TSS (%)	Total protein (%)	Starch (%)	Lysine/ Protein(%)	Tryptophan/ Protein (%)
PDW 291 (Hissar)	10.62	1.61	2.66	9.52	64.02	2.68	1.80
PDW 291 (Durgapur)	8.72	1.65	2.56	11.66	66.21	4.05	1.36
HI 8498 (Indore)	8.36	1.54	2.63	10.62	64.99	2.85	1.48
HI 8498 (Kota)	9.50	1.71	2.62	12.21	64.63	2.44	1.09
HI 8498 (Vijapur)	10.37	1.47	2.61	12.39	65.10	3.53	1.16
NIDW 295 (Pune)	11.04	1.57	2.64	11.47	66.40	3.50	1.83
NIDW 295 (Niphad)	9.57	1.65	2.58	11.48	65.66	3.65	1.60
GW-1 (Arnej)	10.10	1.71	2.62	13.12	65.38	3.81	1.74
A-206 (Arnej)	9.98	1.63	2.59	13.29	65.77	4.88	2.14
S.Em.	0.197	0.037	0.017	0.134	0.422	0.057	0.043
C.D.	0.585	0.111	0.050	0.398	1.255	0.170	0.128
C.V. (%)	3.51	4.01	1.11	2.11	1.12	2.83	4.72

Table 2: Quality parameters of different *Triticum durum* wheat varieties.

Varieties	Dry gluten (%)	Wet gluten (%)	Gluten index	Water binding capacity
PDW 291 (Hissar)	8.15	27.35	45.93	19.55
PDW 291 (Durgapur)	8.39	29.70	27.02	21.63
HI 8498 (Indore)	7.65	24.14	54.74	17.54
HI 8498 (Kota)	8.17	26.46	55.08	19.24
HI 8498 (Vijapur)	10.23	33.35	43.04	24.27
NIDW 295 (Pune)	8.13	24.59	52.35	17.34
NIDW 295 (Niphad)	6.00	18.60	78.07	13.76
GW-1 (Arnej)	11.8	38.7	84.11	28.45
A-206 (Arnej)	11.8	39.3	83.53	28.76
Mean	8.92	29.14	58.21	21.17
S.Em.	0.157	0.338	0.492	0.599
C.D.	0.466	1.005	1.463	1.778
C.V. (%)	3.35	2.25	1.47	4.90

Table 3: Quality parameters of different *Triticum durum* wheat varieties.

Varieties	β-Carotene (ppm)	Sedimentation test (ml)	Thousand kernel weight (gm)	Fe (ppm)	Zn (ppm)
PDW 291 (Hissar)	3.72	34.00	78.51	40.76	36.72
PDW 291 (Durgapur)	4.71	28.00	80.59	36.64	44.70
HI 8498 (Indore)	4.70	30.00	83.81	40.47	41.25
HI 8498 (Kota)	2.89	33.00	82.85	42.86	33.32
HI 8498 (Vijapur)	3.40	32.00	82.40	39.88	45.96
NIDW 295 (Pune)	3.69	32.00	81.50	36.00	36.01
NIDW 295 (Niphad)	6.95	29.00	84.30	37.72	32.56
GW-1 (Arnej)	4.44	38.00	74.4	36.00	34.00
A-206 (Arnej)	4.25	42.00	77.2	43.90	33.90
S.Em.	0.081	1.048	0.736	0.505	0.555
C.D.	0.241	3.115	2.186	1.501	1.648
C.V. (%)	3.53	5.72	1.58	2.17	2.24

2.44% to 4.88%, whereas tryptophan content varies from 1.09 % to 2.14%. Lysine and tryptophan content per protein in the wheat were 2% and 1.1%, respectively (Shewry, 2004). The WHO recommended level for lysine and tryptophan per protein is 5.5% and 1%, respectively.

Wet gluten and gluten index are directly proportional to end use quality (Mioc, 2000). Wet gluten, dry gluten, gluten index and water binding capacity of flour are shown in Table 2. Average gluten index of all durum varieties were 58.21%. GW-1 (Arnej) has highest gluten index value 84.11%, followed by A-206 (Arnej) having 83.53%. Mean wet gluten, dry gluten and water binding capacity of all durum varieties were 29.14, 8.92 and 21.17% respectively. Results indicated that varieties GW-1 (Arnej) and A-206 (Arnej) showed superior quality for pasta making.

β-carotene content, sedimentation test, thousand kernel weight and minerals (Fe, Zn) of flour are show β-carotene content of all durum varieties ranges from 2.89 ppm to 6.95 ppm. Variety NIDW 295 (Niphad) showed maximum (6.95 ppm) β-carotene content whereas variety HI 8498 (Kota) showed minimum (2.89 ppm) β-Carotene content. Durum wheat with more than 7.00 ppm β-carotene content is preferred in the international market (Gupta *et al.,* 2002). Sedimentation value varies from 28 ml to 42 ml in all durum wheat varieties. This quality parameter gives an idea about the gluten strength. 35 ml and more values are required for good quality pasta making from durum wheat (20). Thousand kernel weight (TKW) of all durum wheat varieties ranges from 74.4 g to 84.3 g. Variety NIDW 295 (Niphad) had the highest (84.30 g) thousand kernel weight where as variety GW-1 (Arnej) had the lowest (74.40 g) thousand kernel weight. Different mineral constituent are directly or indirectly related with the quality parameters. The total amount of Fe and Zn present in all durum varieties ranged from 36.00 ppm to 43.90 ppm, 32.56 ppm to 45.96, respectively.

CONCLUSION

From the above results it can be concluded that A-206 and GW-1 had significantly higher protein content, sedimentation value, dry gluten, wet gluten, gluten index and water binding capacity as compared to other varieties. Significantly higher

amount of lysine and tryptophan content was also recorded in A-206 (Arnej). Results of all these parameters shows that GW-1 (Arnej) and A-206 (Arnej) varieties are suitable for superior quality for pasta making as compared to all other durum wheat varieties.

Conflict of interest

The authors declare that they have no conflict of interest regarding the publication of this research. There are no financial or personal relationships with other people or organizations that could inappropriately influence or bias the content of this study.

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