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Quality evaluation of nutritional and anti-nutritional characteristic of some varieties/genotypes in various *Brassica* species

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Abstract
The present study was conducted in the laboratories of the Department of Agricultural Biochemistry to evaluate thirty nine varieties/genotypes of *Brassica* Species for nutritional and anti-nutritional characteristics such as Tryptophan content in meal, Acid value, Iodin value, Saponification value, Phytic acid and Glucosinolates content in meal. The samples was collected from University farm as well after grading of the sample the quality analysis in the laboratory was conducted as per standard procedures. Tryptophan content in different genotypes of yellow sarson varied from 1.89 to 0.91 g/100 g, while toria entries varied from 1.86 to 1.12 g/100 g. In case of rai the range of variation was 1.86 to 1.10 g/100 g. Acid value in different genotypes of yellow sarson varied from 1.34 to 0.62 mg, while toria entries varied from 1.32 to 0.63 mg. In case of rai the range of variation was 1.36 to 0.64 mg. Iodine value in different genotypes of yellow sarson varied from 108.15 to 96.32 gm, while toria entries varied from 108.22 to 96.58 gm. In case of rai the range of variation was 106.32 to 96.74 gm. Saponification value in different genotypes of yellow sarson varied from 176.32 to 168.58 mg, while toria entries varied from 176.60 to 169.55 mg. In case of rai the range of variation was 176.85 to 168.30 mg. Phytic acid in different genotypes of yellow sarson varied from 3.03 to 2.21%, while toria entries varied from 3.00 to 2.31%. In case of rai the range of variation was 3.02 to 2.26%. Phytic acid in different genotypes of yellow sarson varied from 3.03 to 2.21%, while toria entries varied from 3.00 to 2.31%. In case of rai the range of variation was 3.02 to 2.26%.

Keywords: Tryptophan content in meal, acid value, iodin value, saponification value, phytic acid and glucosinolates content in meal

Introduction
Rapeseed- Mustard is one of the major oilseed crops of India belonging to family Brassicaceae. Itis mostly grown in India especially in northern region. Rapeseed-mustard paly important role in the country among the oilseeds being cultivated. It includes generally Indian mustard (*Brassica juncea*) brown sarson (*Brassica campestris* var. *brown sarson*), yellow sarson (*Brassica campestris* var. *yellow sarson*), toria (*Brassica rapa* var. *toria*), and raya crops. Indian mustard (*B. juncea*) is the predominant crop (about 90%) of rapeseed mustard group of crops in India. Among the oilseed Brassica crops, Indian mustard [*Brassica juncea* (L.) Czern and Coss.] Is an important source of oil from a nutritional point of view (Singh *et al*., 2014) [4]. Rapeseed meals contain less essential amino acids than yellow seeded rapeseed meal Phenylalanine, lysine, threonine, isoleucine, asparagine, glutamic acid, methionine, cysteine, tyrosine, glycine alanine, were significantly higher in yellow seeded meal than in black seeded rapeseed meal (Jiang *et al*., 2015) [2]. Mustard seed contain special compound like Glucosinolates which are responsible for the characteristic flavor Enzyme myrosinase breaks Glucosinolates into isothiocyanates, thiocyanates and cyanides. The main bioactive compound responsible for various pharmacological effects such as antifungal, antibacterial, bioherbicidal, antioxidant, antimutagenic etc. the Glucosinolates found in mustard is sinigrin it also several other Glucosinolates compound such as sinalb in and Glucobrassicin as well. (Tsao *et al*., 2000) [13]. Phytic acid and erucic acid are another anti-nutritional compounds found in mustard oil and seed meal (Sharafi *et al*., 2015) [10].

Materials and Methods
The present research work was carried out during summer season of year thirty nine varieties/genotypes of *Brassica* Species.

Some variety of varieties/genotypes of *Brassica* Specie grown at Students Instructional Farm of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) Some varieties/genotypes of *Brassica* Specie in CRD design with three replications and after harvesting the grains were processed for different quality parameters. Estimation of tryptophan content was done by Spies JR and Chambers DG (1949) [11]. Estimation of Acid value was done by Cox HE and Pearson D (1962) [15]. Estimation of Iodine value and Saponification Value was done by William Horourtz (1975) [14]. Estimation of phytic acid in given sample was done by using freshly ground sample by the method described by Haug and Lantzsch (1983) [19]. Total glucosinolate were estimated by spectrophotometer method described by Maw Long *et al* (2017) [20].

Statistical analysis

All sample extracts were prepared and analysis done using a complete randomized design at 5% level of critical difference. Analysis of variance (ANOVA) for the design was carried out to determine the significance of differences among different treatments.

Results and Discussion

Tryptophan content in different genotypes of yellow sarson varied from 1.89 to 0.91 g/100 g, while toria entries varied from 1.86 to 1.12 g/100 g. In case of rai the range of variation was 1.86 to 1.10 g/100 g. Among yellow sarson the entry YSKM 18-107 recorded highest tryptophan content 1.89 g/100 g followed by YSKM 18-106 (1.82 g/100 g) while in toria the entry KMR (E) 18-102 recorded maximum tryptophan content 1.86 g/100 g followed by KMR (E) 18-107 (1.81 g/100 g). The entry TKM 18-105 showed highest tryptophan content of rai cultivars 1.86 g/100 g followed by TKM 18-104 (1.73 g/100 g). It was observed that the three groups of brassica cultivar (yellow sarson, toria and rai) in sampled variants varied from 1.89 to 0.91 g/100 g. The yellow sarson variety YSKM 18-107 showed the maximum tryptophan content (1.89 g/100 g) followed by yellow sarson variety- YSKM 18-106 (1.82 g/100 g). The minimum tryptophan content was noted in yellow sarson variety- YSKM 18-110 (0.91 g/100 g). The *Brassica rapa* var. yellow sarson variety YSKM 18-107 were significantly superior to other *Brassica* species. This result was supported by Singh *et al*., (2013) [6], Singh *et al*., (2017) [5] and Kumari *et al*., (2018) [18]. Acid value in different genotypes of yellow sarson varied from 1.34 to 0.62, while toria entries varied from 1.32 to 0.63 mg. In case of rai the range of variation was 1.36 to 0.64 mg. Among yellow sarson the entry YSKM 18-107 recorded highest acid value 1.34 mg followed by YSKM 18-108 (1.25 mg) while in toria the entry KMR (E) 18-103 recorded maximum acid value 1.32 mg followed by KMR (E) 18-105 (1.31 mg). The entry TKM 18-106 showed highest acid value of rai cultivars 1.36 mg followed by TKM 18-105 (1.27 mg). It was observed that the three groups of brassica cultivar (yellow sarson, toria and rai) in sampled variants varied from 1.36 to 0.64 mg. The rai variety TKM 18-106 showed the maximum acid value (1.36 mg) followed by yellow sarson variety- YSKM 18-107 (1.34 mg). The minimum acid value was noted in yellow sarson variety- PITAMBARI (0.62 mg). The *Brassica juncea* var. rai variety TKM 18-106 were significantly superior to other *Brassica* species. These results are in close agreement with the reports of Singh *et al*., (2013) [6], Choudhury *et al*., (2014) [1] and Sultana *et al*., (2018) [12]. Iodine value in different genotypes of yellow sarson varied from 108.15 to 96.32 gm, while toria entries varied from 108.22 to 96.58 gm. In case of rai the range of variation was 106.32 to 96.74 gm. Among yellow sarson the entry PITAMBARI recorded highest iodine value 108.15 gm followed by YSKM 18-112 (107.34 gm) while in toria the entry TAPESHWARI recorded maximum iodine value 108.22 gm followed by BHAWANI (106.65 gm). The entry KANTI showed highest iodine value of rai cultivars 106.32 gm followed by NDRE-4 (105.65 gm). It was observed that the three groups of brassica cultivar (yellow sarson, toria and rai) in sampled variants varied from 108.22 to 96.32 gm. The toria variety TAPESHWARI showed the maximum iodine value (108.22 gm) followed by yellow sarson variety- PITAMBARI (108.15 gm). The minimum iodine value was noted in yellow sarson variety- YSKM 18-103 (96.32 gm). The *Brassica rapa* var. Toria variety TAPESHWARI were significantly superior than other *Brassica* species. These results are in close agreement with the reports of Chowdhury *et al*., (2014) [1], Sultana *et al*., (2018) [12] and Hossain *et al*., (2018) [16]. Saponification value in different genotypes of yellow sarson varied from 176.32 to 168.58 mg, while toria entries varied from 176.60 to 169.55 mg. In case of rai the range of variation was 176.85 to 168.30 mg. Among yellow sarson the entry YSKM 18-112 recorded highest saponification value 176.32 mg followed by PITAMBARI (175.54 mg) while in toria the entry KMR (E) 18-106 recorded maximum saponification value 176.60 mg followed by KMR (E) 18-106 (175.87 mg). The entry TKM 18-107 showed highest saponification iodine value of rai cultivars 176.85 mg followed by TKM 18-109 (175.60 mg). It was observed that the three groups of brassica cultivar (yellow sarson, toria and rai) in sampled variants varied from 176.85 to 168.30 mg.The rai variety TKM 18-107 showed the maximum saponification value (176.85 mg) followed by toria variety- KMR (E) 18-103 (175.87 mg). The minimum saponification value was noted in rai variety- TKM 18-103 (168.30 mg). The *Brassica juncea* var. variety TKM 18-107 were significantly superior to other *Brassica* species. These results are in close agreement with the reports of Singh *et al*., (2013) [6], Sharif *et al*., (2017) [3] and Sultana *et al*., (2018) [12].

Table 1: Variability in acid value, iodine value, saponification and tryptophan content value of varieties/genotypes of some *Brassica* Species

S. No	*Brassica* species	Acid value (mg)	iodine value (gm)	Saponification value (mg)	Tryptophan content (g/100 g protein)
***Brassica rapa* var. yellow sarson (G1)**					
1	YSKM 18-101	0.78	98.20	172.50	1.76
2	YSKM 18-102	0.82	100.60	169.60	1.78
3	YSKM 18-103	0.65	96.32	173.40	1.22
4	YSKM 18-104	0.96	99.45	174.65	1.46
5	YSKM 18-105	1.05	97.12	175.22	1.19
6	YSKM 18-106	1.12	102.08	168.58	1.82
7	YSKM 18-107	1.34	104.32	171.56	1.89
8	YSKM 18-108	1.25	107.23	169.72	1.02
9	YSKM 18-109	0.72	103.61	174.15	1.08
10	YSKM 18-110	0.98	101.25	175.20	0.91
11	YSKM 18-111	0.92	105.23	172.35	1.63
12	YSKM 18-112	0.77	107.34	176.32	1.61
13	YSKM 18-113	0.84	101.47	171.38	1.01
14	PITAMBARI	0.62	108.15	175.54	1.71
15	YST-151	0.68	106.75	174.86	1.39
Mean		0.90	102.60	173.00	1.43
***Brassica rapa* var. toria (G2)**					
1	KMR(E) 18-101	1.03	98.54	169.55	1.62
2	KMR(E) 18-102	1.23	101.23	173.45	1.86
3	KMR(E) 18-103	1.32	100.11	175.87	1.12
4	KMR(E) 18-104	1.24	97.45	171.30	1.36
5	KMR(E) 18-105	1.31	96.58	174.40	1.29
6	KMR(E) 18-106	1.09	98.65	176.60	1.71
7	KMR(E) 18-107	0.83	99.87	172.50	1.81
8	KMR(E) 18-108	0.91	102.41	169.65	1.14
9	KMR(E) 18-109	0.75	103.91	173.28	1.18
10	KMR(E) 18-110	0.69	102.63	174.70	1.28
11	BHAWANI	0.67	106.65	175.80	1.41
12	TAPESHWARI	0.63	108.22	173.40	1.55
Mean		0.97	101.35	173.37	1.44
***Brassica juncea* var. rai (G3)**					
1	TKM 18-101	0.79	103.12	170.35	1.13
2	TKM 18-102	0.81	102.98	173.50	1.62
3	TKM 18-103	0.93	99.43	168.30	1.33
4	TKM 18-104	1.18	101.23	172.60	1.73
5	TKM 18-105	1.27	97.31	173.20	1.86
6	TKM 18-106	1.36	96.74	174.45	1.52
7	TKM 18-107	1.02	102.41	176.85	1.45
8	TKM 18-108	1.11	100.05	169.25	1.66
9	TKM 18-109	0.87	103.56	175.60	1.10
10	TKM 18-110	0.92	104.78	172.85	1.34
11	KANTI	0.64	106.32	173.45	1.70
12	NDRE-4	0.71	105.65	174.55	1.65
Mean		0.96	101.96	172.91	1.50
S.E (diff) Within group		0.021	0.029	0.028	0.019
C.D. at 5%		0.042	0.058	0.057	0.038
S.E.(diff.) between G1XG2		0.023	0.032	0.024	0.018
C.D. at 5%		0.046	0.064	0.047	0.035
S.E.(diff.) between G1XG3		0.021	0.029	0.030	0.019
C.D. at 5%		0.042	0.059	0.060	0.038
S.E.(diff.) between G2XG3		0.019	0.026	0.032	0.020
C.D. at 5%		0.039	0.052	0.064	0.041

Phytic acid in different genotypes of yellow sarson varied from 3.03 to 2.21%, while toria entries varied from 3.00 to 2.31%. In case of rai the range of variation was 3.02 to 2.26%. Among yellow sarson the entry YST-151 recorded highest phytic acid3.03% followed by YSKM-18 109 (3.00%) while in toria the entry BHAWANI recorded maximum phytic acid 3.00% followed by TAPESHWARI (2.91%). The entry NDRE-4 showed highest phytic acid phytic acid of rai cultivars 3.02% followed by KANTI (2.98%). It was observed that the three groups of brassica cultivar (yellow sarson, toria and rai) in sampled variants varied from 3.03 to 2.21%. The yellow sarson variety YST-151 showed the maximum phytic acid (3.03%) followed by rai variety- NDRE-4 (3.02). The minimum phytic acid was noted in yellow sarson variety-YSKM 18-101 (2.21%). The *Brassica rapa* var. yellow sarson variety YST-151 were significantly superior than other *Brassica* species. Similar observations have been also recorded by Khattab *et al*., (2010) [17]. Glucosinolate content in different genotypes of yellow sarson varied from 108.50 to 74.64 um/g meal, while toria entries varied from 113.65 to

78.23 um/g meal. In case of rai the range of variation was 116.25 to 75.80 um/g meal. Among yellow sarson the entry YSKM-18-108 recorded highest glucosinolate content108.50 um/g meal followed by YSKM-18-107 (105.00 um/g meal) while in toria the entry KMR (E)-18-104 recorded maximum glucosinolate content 113.65 um/g meal followed by KMR (E)-18-102 (110.00 um/g meal). The entry TKM 18-107 showed highest glucosinolate content of rai cultivars 116.25 um/g meal followed by TKM 18-106 (112.50 um/g meal). It was observed that the three groups of brassica cultivar (yellow sarson, toria and rai) in sampled variants varied from 116.25 to 74.64 um/g meal. The rai variety TKM 18-107 showed the maximum glucosinolate content (116.25 um/g meal) followed by toria variety- KMR (E)-18-104 (113.65 um/g meal). The minimum glucosinolate content was noted in yellow sarson variety- YST-151 (74.64 um/g meal). The *Brassica juncea* var. rai variety TKM 18-107 were significantly superior to over the rest of the varieties of *Brassica* species. Similar observations have been also recorded by Rahman *et al*., (2009) [7], Saikia *et al*., (2018) [8], Sharma *et al*., (2018) [9].

Table 2: Variability in Phytic acid and glucosinolate content of varieties/genotypes of some *Brassica sp*ecies

S. No.	*Brassica* species	Phytic acid (%)	Glucosinolate content (um/g meal)
***Brassica rapa* var. yellow sarson (G1)**			
1	YSKM 18-101	2.21	80.20
2	YSKM 18-102	2.24	78.50
3	YSKM 18-103	2.25	88.30
4	YSKM 18-104	2.26	81.25
5	YSKM 18-105	2.27	87.65
6	YSKM 18-106	2.29	92.60
7	YSKM 18-107	2.28	105.00
8	YSKM 18-108	2.46	108.50
9	YSKM 18-109	3.00	103.40
10	YSKM 18-110	2.81	102.50
11	YSKM 18-111	2.26	95.60
12	YSKM 18-112	2.52	100.25
13	YSKM 18-113	2.25	87.65
14	PITAMBARI	2.79	76.55
15	YST-151	3.03	74.64
Mean		2.46	90.83
***Brassica rapa* var. toria (G2)**			
1	KMR(E) 18-101	2.34	105.30
2	KMR(E) 18-102	2.57	110.00
3	KMR(E) 18-103	2.31	108.60
4	KMR(E) 18-104	2.58	113.65
5	KMR(E) 18-105	2.35	106.25
6	KMR(E) 18-106	2.33	102.35
7	KMR(E) 18-107	2.32	98.25
8	KMR(E) 18-108	2.39	97.50
9	KMR(E) 18-109	2.48	102.25
10	KMR(E) 18-110	2.56	86.30
11	BHAWANI	3.00	82.15
12	TAPESHWARI	2.91	78.23
Mean		2.51	99.23
***Brassica juncea* var. rai (G3)**			
1	TKM 18-101	2.26	95.32
2	TKM 18-102	2.80	94.60
3	TKM 18-103	2.37	95.25
4	TKM 18-104	2.39	102.50
5	TKM 18-105	2.41	108.75
6	TKM 18-106	2.44	112.50
7	TKM 18-107	2.36	116.25
8	TKM 18-108	2.48	106.50
9	TKM 18-109	2.65	101.25
10	TKM 18-110	2.68	96.25
11	KANTI	2.98	75.80
12	NDRE-4	3.02	79.22
Mean		2.57	98.68
S.E (diff) Within group		0.018	0.036
C.D. at 5%		0.036	0.073
S.E.(diff.) between G1XG2		0.018	0.037
C.D. at 5%		0.035	0.075
S.E.(diff.) between G1XG3		0.019	0.036
C.D. at 5%		0.038	0.072
S.E.(diff.) between G2XG3		0.018	0.036
C.D. at 5%		0.036	0.073

Conclusion

On the basis of results recorded during investigation of grain quality characteristics of 39 recommended varieties/genotypes brassica species. Tryptophan content were obtained in Yellow sarson (*Brassica rapa*) varieties/genotypes *Brassica* Species, YSKM 18-107, YSKM 18-106 and YSKM 18-102, range from 1.89 gm, 1.82 gm and 1.78 gm. The minimum Tryptophan content was found in variety-YSKM 18-110, 0.91 gm. Tryptophan content were obtained in toria (*Brassica rapa*) varieties/genotypes *Brassica* Species, KMR(E) 18-102, KMR(E) 18-107 and KMR(E) 18-106, range from 1.86 gm, 1.81 gm and 1.71 gm. The minimum Tryptophan content was found in variety- KMR(E) 18-103, 1.12 gm. Tryptophan content were obtained in rai (*Brassica juncea*) varieties/ genotypes *Brassica* Species, TKM 18-105, TKM 18-104 and KANTI, range from 1.86 gm, 1.73 gm and 1.70 gm. The minimum Moisture content was found in variety- TKM 18-109,1.10 gm. Acid value were obtained in Yellow sarson (*Brassica rapa*) varieties/genotypes *Brassica* Species, YSKM 18-107,YSKM 18-108 and YSKM 18-106, range from 1.34 mg, 1.25 mg, 1.12 mg. The minimum Acid value was found in variety- PITAMBARI, 0.62 mg. Acid value were obtained in toria (*Brassica rapa*) varieties/genotypes *Brassica* Species, KMR(E) 18-103, KMR(E) 18-105 and KMR(E) 18-104, range from 1.32 mg, 1.31 mg, 1.24 mg. The minimum Acid value was found in variety- TAPESHWARI, 0.63 mg. Acid value were obtained in rai (*Brassica juncea*) varieties/ genotypes *Brassica* Species, TKM 18-106, TKM 18-105 and TKM 18-104, range from 1.36 mg, 1.27 mg, 1.18 mg. The minimum Acid value was found in variety- KANTI,0.64 mg. Iodine value were obtained in Yellow sarson (*Brassica rapa*) varieties/genotypes *Brassica* Species, Pitambari, YSKM 18-112 and YSKM 18-108, range from 108.22 gm, 106.65 gm and 103.91 gm. The minimum Iodine value was found in variety- YSKM 18-103, 96.32 gm. Iodine value were obtained in toria (*Brassica rapa*) varieties/genotypes *Brassica* Species, TAPESHWARI, BHAWANI and KMR(E) 18-109, range from 108.15 gm, 107.34 gm and 107.23 gm. The minimum Iodine value was found in variety- KMR(E) 18-105, 96.58 gm. Iodine value were obtained in rai (*Brassica juncea*) varieties/genotypes *Brassica* Species, KANTI, NDRE-4 and TKM 18-110, range from 106.32 gm, 105.65 gm and 104.78 gm. The minimum Iodine value was found in variety-KANTI, 96.74 gm. Saponification value were obtained in Yellow sarson (*Brassica rapa*) varieties/ genotypes *Brassica* Species, YSKM 18-112, PITAMBARI, and YSKM 18-105, range from 176.32 mg, 175.54 mg and 175.22 mg. The minimum Saponification value was found in variety- YSKM 18-106, 168.58 mg. Saponification value were obtained in toria (*Brassica rapa*) varieties/genotypes *Brassica* Species, KMR (E) 18-106, KMR (E) 18-103 and BHAWANI, range from 176.60 mg, 175.87 mg and 175.80 mg. The minimum Saponification value was found in variety- KMR (E) 18-101, 169.55 mg. Saponification value were obtained in rai (*Brassica juncea*) varieties/genotypes *Brassica* Species, TKM 18-107, TKM 18-109 and NDRE-4, range from 176.85 mg, 175.60 mg and 175.55 mg. The minimum Saponification value was found in variety- TKM 18-103, 168.30 mg. Phytic acid were obtained in Yellow sarson (*Brassica rapa*) varieties/genotypes *Brassica* Species, YST-151, YSKM 18-109, and PITAMBARI, range from 3.03%, 3.00% and 2.79%. The minimum Phytic acid was found in variety- YSKM 18-101, 2.21%. Phytic acid were obtained in toria (*Brassica rapa*) varieties/genotypes *Brassica* Species, BHAWANI, TAPESHWARI and KMR(E) 18-102, range from 3.00%, 2.91% and 2.57%. The minimum Phytic acid was found in variety- KMR (E) 18-103, 2.31%. Phytic acid were obtained in rai (*Brassica juncea*) varieties/genotypes *Brassica* Species, NDRE-4, KANTI and TKM 18-102, range from 3.02%, 2.98% and 2.80%. The minimum Phytic acid was found in variety- TKM 18-101, 2.26%. Glucosinolate content were obtained in Yellow sarson (*Brassica rapa*) varieties/ genotypes *Brassica* Species, YSKM 18-108, YSKM 18-107 and YSKM 18-109, range from 108.50 um/gm, 105.00 um/gm and 103.40 um/gm. The minimum Glucosinolate content was found in variety- YST 151, 74.64 um/gm. Glucosinolate content were obtained in toria (*Brassica rapa*) varieties/ genotypes *Brassica* Species, KMR(E) 18-104, KMR(E) 18-102 and KMR(E) 18-103, range from 113.65 um/gm, 110.00 um/gm and 108.60 um/gm. The minimum Glucosinolate content was found in variety- TAPESHWARI, 78.23 um/gm. Glucosinolate content were obtained in rai (*Brassica juncea*) varieties/genotypes *Brassica* Species, TKM 18-107, TKM 18-106 and TKM 18-105, range from 116.25 um/gm, 112.50 um/gm and 108.75 um/gm. The minimum Glucosinolate content was found in variety- KANTI, 75.80 um/gm.

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