

R E S U L T S

Different varieties of Brassica Seeds collected from the Punjab, Sind and North West Frontier Province regions during 1976-77 were analysed for their proximate composition. The results are given in Tables 5 to 7.

Brassica Juncea Seeds; Moisture contents of Brassica juncea seeds varied from 4.6 to 8.8%, the lowest was in poorbi rai and highest in RL-18, both from Punjab area. Protein contents varied from 27.2 to 32.7%, the minimum in Rai 4 and the maximum in Rai N.S. both from the Sind region. Percentage of allyl isothiocyanate varied from 0.70 to 1.41% the lowest in S-9(Gundial) and the highest in Rai-4 both from Sind area. Fibre contents varied from 4.1 to 7.9%, the minimum in local rai and maximum in S-9, both from Sind area. Ash contents ranged from 3.3 to 7.2%, the minimum was in E-16 and maximum was in S-9,(Gundial) both from Sind area (Table-5).

Brassica napus seeds ; Moisture contents varied from 3.8 to 6.5% , the lowest was in Brassica napus and the highest was in oro both from Sind area. Protein contents varied from 24.7 to 32.9%, the minimum in PR-7 from NWFP and maximum in Mus-13 from sind region.

Percentage of oil ranged from 36.0 to 46.1%, the lowest in Mus-13 from Sind area and the highest in PR-7 from NWFP. Allylis othiocyanate contents varied from 0.22 to 0.38%, the lowest was in Brassica napus and the highest was in Mus-15 both from Sind area. Crude fibre varied from 6.1 to 10.4%, the minimum was in PR-7 and maximum was in Brassica napus both from NWFP. Ash contents ranged from 3.5 to 5.2% minimum in Brassica napus from Sind area and maximum in PR-7 from NWFP (Table-6).

Brassica campestris seeds; Moisture contents ranged from 3.7 to 7.0%, the lowest in Toria selection from Sind area and the highest in Toria A from NWFP region. Protein contents varied from 23.9 to 31.6%, the highest in yellow rape from Punjab region and the lowest in Mus-80 from Sind area. Percentage of oil varied from 33.7 to 45.2%, the minimum in yellow rape and maximum in chinese rape both from sind area. Allylisothiocyanate varied from 0.26 to 0.71%, the minimum in Polish and maximum in Sarsoon-A both from sind region. Crude fibre ranged from 4.8 to 8.5%, the lowest in Toria-A, from NWFP region. Ash contents varied from 3.4 to 5.7% the minimum in Chinese rape seed from Sind area and maximum in Toria-A seed from NWFP area (Table-7).

Hull to Kernel Proportion of Brassica seeds; Different varieties of Brassica seeds collected from the Punjab, Sind, NWFP and

PROXIMATE ANALYSIS OF BRASSICA JUNCEA SEEDS

Local Name	Region	Crop	Moisture %	Protein %	Oil %	Allyliso- iocyanate %	Crude Fibre %	Ash %
Poorbi rai	Punjab	1976-77	4.6	28.3	32.9	0.92	5.9	4.1
RL-18	"	"	8.8	27.2	35.2	0.72	6.7	4.4
S-9	Sind	"	5.1	28.2	44.4	0.82	7.9	3.6
S-9 (Gundial)	"	"	6.4	27.7	36.7	0.70	5.8	7.2
E-16	"	"	6.4	28.1	42.6	0.83	7.2	3.3
Local rai	"	"	5.7	29.9	44.4	0.93	4.1	3.5
Mus -23	"	"	5.5	29.4	49.5	0.80	5.6	3.7
Rai-13	"	"	5.2	29.1	42.2	0.94	6.9	3.4
Poorbirai	"	"	5.5	26.9	38.0	0.90	7.4	3.8
Dacca rai	"	"	5.6	27.1	41.6	1.11	7.6	4.0
Proseny-62	"	"	5.8	30.7	38.0	0.77	5.6	3.9
Rai N.S.	"	"	5.9	32.7	37.9	1.20	6.7	3.9
Rai-4	"	"	5.9	27.2	48.3	1.41	4.7	4.2
RL-18	"	"	5.9	30.1	42.1	0.97	5.5	3.9

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PROXIMATE ANALYSIS OF BRASSICA NAPUS SEEDS

Local Name	Region	Crop	Moisture %	Protein %	Oil %	Allyliso- thiocyanate %	Crude Fibre %	Ash %
Mus-10	Sind	1976-77	6.5	30.9	36.7	0.37	7.2	4.4
Mus-15	"	"	5.7	30.0	41.7	0.38	7.8	4.1
Mus-13	"	"	6.4	32.9	36.0	0.22	7.1	4.5
Oro	"	"	6.5	27.0	38.3	0.25	9.3	4.4
Brassica napus	"	"	3.8	27.4	36.2	0.22	10.4	3.5
PR-7	WFP	"	5.9	24.7	46.1	0.25	6.1	5.2

T A B L E - 7

PROXIMATE ANALYSIS OF BRASSICA CAMPESTRIS SEEDS

Local Name	Region	Crop	Moisture %	Protein %	Oil %	Allylisothio- cyanate %	Crude Fibre %	Ash %
Toria 'A'	Punjab	1976-77	6.0	28.7	36.5	0.70	4.9	4.6
Toria 'A'	NWFP	"	7.0	25.4	43.5	0.38	8.5	5.7
<u>Toria Selection</u>	Sind	"	3.7	25.8	40.6	0.42	4.8	4.2
Sarson 'A'	"	"	5.9	25.1	44.5	0.71	5.5	3.6
Chinese rape	"	"	5.3	24.7	45.2	0.58	5.2	3.4
Mus 80	"	"	5.2	23.9	43.3	0.35	5.8	3.5
Toria 'A'	"	"	5.9	25.5	42.2	0.63	7.1	4.9
Polar	"	"	5.5	25.0	43.9	0.35	5.0	3.7
Polish	"	"	6.0	26.9	44.0	0.26	4.9	3.6
Yellow rape	"	"	5.8	31.6	33.7	0.48	7.7	4.3

Baluchistan regions during 1976-77 were analysed for hull to kernel ratio. The results are given in Table-8.

Brassica campestris seeds: Percentage of hull in Toria selection from Sind region was the highest while the percentage of Kernel in the same was lowest. Percentage of hull in Taramera from Baluchistan was minimum while the percentage of Kernel in the same was maximum.

Brassica juncea seeds:- Percentage of hulls in Dacca rai from Baluchistan region was the lowest while the percentage of Kernel in the same was the highest. Percentage of Hull in poorbi rai from Punjab region was maximum and the percentage of Kernel in the same was minimum.

Brassica napus seeds ; Percentage of hull was more in PR-7 from NWFP region while the percentage of kernel was more in Brassica napus from Sind region.

Seeds, Kernels and Hulls of Brassica Seeds for the crop 1976-77 from the Punjab, Sind, NWFP and Baluchistan Regions were analysed. The results are given in Tables 9 to 11.

Brassica campestris seeds; Protein content of seeds, kernels and hulls varied from 25.4 to 35.1, 27.1 to 38.7 and 14.4 to 22.5% respectively, the maximum was in the kernels and minimum in the hulls.

HULL TO KERNEL PROPORTION OF BRASSICA SEEDS

Local Name	Brassica Campestris SEEDS		Local Name	Brassica Juncea SEEDS		Local Name	Brassica Napus SEEDS	
	Hulls %	Kernels %		Hulls %	Kernels %		Hulls %	Kernels %
Toria 'A' 1976-77 (Punjab)	19.0	81.0	Poorbi rai (1975-77) (Punjab)	17.5	82.5	Brassica napus (1976-77) Sind PR-7 (NWFP)	25.0	75.0
Toria 'A' 1976-77 (NWFP)	17.0	83.0	RL-18 (1976-77) Punjab	16.5	83.5		17.8	82.2
Toria Sele-ction (1976-77) (Sind)	28.6	71.4	RL-18 (1976-77) NWFP	15.3	84.7			
Local sarson (1976-77) Sind	25.0	75.0	S-9 (1976-77) (Sind)	16.7	83.3			
Yellow rape (1976-77) (Sind)	18.9	81.1	Dacca rai (Baluchistan)	11.0	89.0			
Local Sarson (Baluchistan)	16.0	84.0	R-4 (Baluchistan)	13.0	87.0			
Taramera (Baluchistan)	13.0	87.0	R-5 (Baluchistan)	14.0	86.0			
			R-13 Baluchistan	14.0	86.0			

Allyl isothiocyanate content of seeds, kernels and hulls varied from 0.38 to 1.3, 0.43 to 1.59 and 0.12 to 0.15% respectively, the lowest was in hulls and the highest in kernels. Crude fibre contents of seeds, kernels and hulls varied from 4.8 to 9.0, 2.2 to 5.7 and 12.0 to 22.6% respectively, the lowest in kernels and the highest in hulls. Percentage of moisture of seeds, kernels and hulls of *Brassica Campestris* ranged from 3.7 to 7, 2.0 to 5.7 and 5.2 to 11.2 respectively, maximum was in hulls and minimum in kernels (Table-9).

Brassica juncea seeds; Protein content of seeds, kernels and hulls ranged from 23.5 to 35.4, 26.6 to 37.9 and 14.0 to 19.2% respectively the maximum was in kernels and minimum was in hulls. Oil contents of seeds, kernels and hulls ranged from 32.9 to 45.2, 36.4 to 50.0%, the highest was in kernels and the lowest in hulls. Percentage of allyl isothiocyanate in seeds, kernels and hulls varied from 0.59 to 1.24, 0.70 to 1.40 and 0.17 to 0.49 respectively, maximum was in kernels and the minimum in hulls. Crude fibre content of seeds, kernels and hulls ranged from 4.9 to 6.7, 2.9 to 5.2 and 14.9 to 21.2% respectively, the maximum was in hulls and minimum was in kernels. Percentage of moisture of seeds, kernels and hulls ranged from 3.5 to 5.4, 3.3 to 5.5 and 6.2 to 8.9 respectively maximum was in hulls and minimum in kernels (Table-10).

Brassica napus seeds: Protein content of seeds, kernel and

hulls of B.napus from sind and PK-7 from North West Frontier Province varied from 24.7 to 27.4, 27.8 to 29.5 and 16.5 to 23.3% respectively the highest was in kemels and the lowest in hulls. Oil contents of seeds, kemels and hulls ranged from 36.8 to 46.1 42.6 to 51.1 and 20.7 to 23.9 respectively, the maximum was in kemels and minimum in hulls. Allyl isothiocyanate content of seeds kemels and hulls varied from 0.22 to 0.26, 0.28 to 0.31 and 0.1 to 0.12% respectively minimum was in hulls and the maximum was in kemels. Fibre content of seeds, kemels and hulls ranged from 6.1 to 7.4, 3.8 to 4.4 and 17.1 to 17.6% respectively, the highest in hulls and the lowest in kemels. Percentage of moisture in seeds, kemels and hulls of Brassica napus seeds from Sind varied from 3.8 to 5.9, 2.3 to 5.1 and 4.7 to 9.3 respectively, maximum was in hulls and minimum in kemels (Table-11).

Six varieties of Brassica seeds (B. Juncea, B. Campestris and B. napus) were analysed to determine available and total amino acid for the crop 1976-77 (g/16 g Nitrogen). The results are given in Tables 12 and 13.

Total amino acids; Methionine content of Brassica seeds ranged from 1.84 to 2.82 gm, minimum was in poorbi rai (Brassica juncea) and maximum in white mustard (Sinapis alba). Isoleucine varied from 1.90 to 2.59 gm the lowest was in white mustard (Sinapis alba) and highest in Toria-A (Brassica campestris). Leucine

T A B L E -9

PROXIMATE COMPOSITION OF BRASSICA CAMPRESTRIS SEEDS
KERNELS AND HULL

Sample Name	Moisture (%)		Protein (%)		Oil (%)		Allyl isothiocyanate (%)		Crude fibre (%)					
	S	K	S	K	S	K	S	K	S	K				
'A' -77 (ab)	6.0	4.9	28.7	31.5	18.6	36.5	46.8	18.7	0.70	0.91	0.12	4.9	2.2	17.2
'A' -77 (FP)	7.0	5.7	25.4	27.1	18.5	43.5	48.4	21.8	0.38	0.43	0.32	8.1	5.0	21.4
Station -77	3.7	2.0	25.8	27.2	14.4	40.6	48.8	13.3	0.42	0.65	0.18	4.8	2.7	12.0
1 Sar-976 (ind)	4.5	3.2	27.4	30.2	22.5	32.2	39.5	19.3	0.62	0.71	0.28	9.0	5.7	18.7
new rape (S-77)	5.8	5.3	31.6	34.1	19.0	33.7	38.1	11.3	0.50	0.66	0.36	7.7	3.2	22.6
Sar-976 (alu-an)	5.1	4.8	31.7	38.7	18.6	35.1	40.0	18.4	1.16	1.19	0.51	6.9	4.9	20.0
nera chis-	5.7	4.1	35.1	37.1	17.2	35.1	38.2	18.4	1.30	1.59	0.13	6.0	4.0	20.7

S = Seeds

K = Kernels

H = Hulls

PROXIMATE COMPOSITION OF BRASSICA JUNCEA SEEDS

KERNELS AND HULLS

Local Name	Moisture (%)		Protein (%)		Oil (%)		Allyl isothiocyanate (%)		Crude fibre (%)				
	S	H	S	H	S	H	S	H	S	H			
bi rai 6-77)	4.6	4.4	28.3	31.4	17.9	32.9	36.4	17.5	0.92	1.03	0.22	5.2	18.6
jab) .8	5.4	5.1	27.2	28.9	16.6	35.2	39.5	16.3	0.72	0.83	0.17	4.0	17.8
6-77)	5.4	5.1	23.5	26.6	15.2	45.2	50.1	22.3	0.59	0.70	0.31	3.5	19.1
6-77)	3.5	3.3	28.8	31.0	19.2	40.6	45.2	18.4	0.74	0.88	0.19	2.9	14.9
de rai rchis-	5.2	4.1	35.4	37.8	17.5	34.9	38.3	19.1	1.03	1.08	0.49	4.0	29.4
rchis-	5.1	4.8	32.6	35.4	16.1	37.3	41.6	15.1	1.11	1.31	0.18	4.2	21.0
rchis-	5.3	5.5	32.9	35.4	18.2	35.2	38.2	11.5	1.24	1.49	0.43	4.2	21.0
rchis-	5.4	4.8	34.3	37.9	14.0	37.2	41.3	18.1	1.15	1.42	0.26	4.9	21.2

S = Seeds

K = Kernels

H = Hulls

PROXIMATE COMPOSITION OF BRASSICA NAPUS SEEDS

Sample Name	Moisture (%)		Protein (%)		Oil (%)			Allyl isothiocyanate (%)			Crude fibre (%)				
	S	K	H	S	K	H	S	K	H	S	K				
Brassica napus (6-77)	3.8	2.3	4.7	27.4	29.5	23.3	36.8	42.6	20.7	0.22	0.28	0.10	7.4	4.4	17.1
Brassica napus (FP)	5.9	5.1	9.3	24.7	27.8	16.5	46.1	51.1	23.9	0.26	0.31	0.12	6.1	3.8	18.6

S = Seeds

K = Kernels

H = Hulls

fell in the range of 6.88 to 8.88 gm, minimum was in RL-18 (Brassica juncea) and maximum in Toria-A(Brassica campestris). Phenylalanine contents were in between 3.41 and 4.15 gm, minimum was in S-9, (Brassica juncea) and maximum in white mustard (Sinapis alba). Brassica seeds contained Arginine from 6.10 to 8.06 gm, lowest was in Toria-A(Brassica campestris) and highest in local sarson(Brassica juncea). Histidine varied from 2.39 to 3.60 gm, minimum was in S-9(Brassica juncea) and maximum in white mustard(Sinapis alba). Tryptophan content were between 1.62 to 1.76 gm, minimum was in RL-18(Brassica juncea) and white mustard(Sinapis alba) and maximum in S-9 and local sarson(Brassica juncea). Valine content of Brassica seeds were from 3.46 to 5.76 gm, the lowest was in white mustard (Sinapis alba) and highest in Toria-A(Brassica campestris) (Table-12).

Available amino acids ; Brassica seeds contained methionine from 0.76 to 1.19 gm, minimum was in Toria-A(Brassica campestris) and maximum in RL-18 (Brassica juncea). Phenylalanine content of Brassica seeds fell in the range of 0.83 to 1.91 g, maximum was in local sarson (Brassica juncea) and minimum in Toria-A(Brassica campestris). Isoleucine content of Brassica seeds ranged from 0.79 to 1.78 gm, minimum was in Toria-A(Brassica campestris) and maximum in white mustard(Sinapis alba). Brassica seeds

TOTAL AMINO ACID CONTENT OF BRASSICA SEEDS (g/16 g NITROGEN)

VARIETY	Methionine	Isoleucine	Leucine	Phenyl Alanine	Arginine	Histidine	Tryptophan	Valine
S-9 (Brassica juncea)	1.87	2.55	7.73	3.41	7.01	2.39	1.76	4.08
RL-18 (B. Juncea)	1.89	2.47	6.88	3.6	6.32	2.60	1.62	3.72
Poorbi rai (B. Juncea)	1.84	2.55	7.93	3.88	6.87	2.78	1.74	4.52
Local Sarson (B. Juncea)	1.90	2.52	7.73	3.86	8.06	2.68	1.76	5.21
Toria "A" (B. Campestris)	2.03	2.59	8.88	3.42	6.10	2.68	1.64	5.72
White Mustard (Sinapis alba)	2.82	1.90	7.83	4.15	7.83	3.60	1.62	3.42

AVAILABLE AMINO ACID CONTENT OF BRASSICA SEEDS (g/16 NITROGEN)

VARIETY	METHIONINE	ISOLEUCINE	LEUCINE	PHENYL- ALANINE	ARGININE	HISTIDINE	TRYPTO- PHAN	VALINE
S-9 (B. Juncea)	0.85	1.02	3.06	1.08	1.91	1.02	0.42	1.72
RL-18 (B. Juncea)	1.19	1.03	4.46	1.48	2.00	1.08	0.39	1.85
Poorbi Rai (B. Juncea)	1.05	0.88	3.10	1.17	1.41	1.08	0.46	1.58
Local Sarson (B. Juncea)	0.907	1.008	3.36	1.91	2.48	1.008	0.55	3.35
Toria "A" (B. Campes)	0.76	0.79	3.33	0.832	1.60	0.814	0.40	1.24
White Mustard (Sinapisalba)	0.83	1.78	2.55	1.13	2.36	0.91	0.30	3.09

contained arginine from 1.41 to 2.48 gm, minimum was in poorbi rai and maximum in local sarson(Brassica juncea). Histidine ranged from 0.814 gm to 1.08 gm, minimum was in Toria-A (Brassica campestris) and maximum in RL-18 and poorbi rai (Brassica juncea). Tryptophan content of Brassica seeds varied from 0.30 to 0.55 gm minimum was in white mustard(Sinapis alba) and maximum in local sarson(Brassica juncea). Brassica seeds contained valine from 1.24 to 3.35 gm, minimum was in Toria-A (Brassica campestris) and maximum in local sarson(Brassica juncea) (Table-13).

Effect of Detoxification(Chemical and Biochemical) on Defatted Brassica seeds. The effect of various treatments on the composition of RL-18, S-9, local sarson & Poorbi rai defatted brassica seeds is given in Tables 14 to 17.

Single or double extraction with 80% acetone was not effective for complete detoxification. Allyl isothiocyanate contents were 0.64 & 0.56, 0.40 and 0.35, 0.50 and 0.47 and 0.70 and 0.72% in the case of RL-18, S-9, local sarson and poorbi rai(defatted seeds) cakes respectively.

Single extraction with 80% acetone resulted in up to 27.2, 34.4, 37.5, 27.2% decrease in allyl isothiocyanate content in the case of RL-18, S-9, local sarson and poorbi rai(defatted Brassica seed) cake

respectively. The maximum decrease in allyl isothiocyanate contents (37.5%) was observed with single extraction in the case of local sarson. Double extraction with 80% acetone resulted in up to 36.6, 40.9, 41.2, 23.4% allyl isothiocyanate content in the case of RL-18, S-9, local sarson and poorbi raj (defatted *Brassica* seed cake) respectively. The maximum detoxification (i.e. up to 41.2% decrease) as a result of double extraction of the seed cake with 80% acetone was observed in the case of local sarson.

Aqueous extraction, enzymic hydrolysis, Ferrous Sulphate treatment, Ferrous Sulphate treatment after extraction with acetone and Ferrous Sulphate enzymic treatment resulted in almost complete detoxification of RL-18, S-9, local sarson and poorbi raj (defatted *Brassica* seed cake).

Protein contents of RL-18 defatted seeds ranged from 31.2 to 48.1% the maximum was in case of aqueous treatment and minimum in the case of the sample which was treated with ferrous sulphate after extraction with acetone.

Recovery of protein varied from 74.0 to 83.4%, the maximum being when the sample was treated with single or double extraction with 80% acetone and minimum in the case of sample which was treated with ferrous sulphate after extraction with acetone (Table-14).

Protein contents of Soy cake varied from 34.6 to 46.7% the minimum was in case of the sample which was treated with ferrous sulphate after extraction with acetone and maximum in the case of enzymic hydrolysis.

Recovery of protein fell in the range of 76.3 to 85.2% the minimum was when treated with ferrous sulphate after extraction with acetone and maximum in case of single extraction with 80% acetone (Table-15).

Protein content of local sarsol(defatted **seeds**) cake ranged from 35.3 to 47.1% the minimum was in case of the sample which was treated with ferrous sulphate after extraction with acetone and maximum in case of enzymic hydrolysis.

Recovery of protein varied from 78.6 to 83.1% the minimum was in case of ferrous sulphate enzymic treatment and maximum in the case of single extraction with 80% acetone (Table-16).

Protein contents of Poorbi rai(defatted mustard seed) cake fell in the range of 36.3 to 47.5% the minimum was in the case of the sample which was treated with ferrous sulphate after extraction with acetone and maximum in case of enzymic hydrolysis.

Recovery of protein ranged from 75.8 to 87.3%, the minimum was in case of the sample which was treated with ferrous sulphate after extraction with acetone and maximum in the case of

TABLE - IV

EFFECT OF DETOXIFICATION ON RI-18 DEFATTED SEEDS

Treatment	Allylisothio- cyanate(%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	0.82	40.5	-	3.4
Aqueous extraction	Traces	48.1	75.0	3.8
Enzymic Hydrolysis	Traces	47.3	91.0	4.6
Single extraction with 80% acetone	0.64	40.1	83.4	5.1
Double extraction with 80% acetone	0.55	40.1	83.4	5.1
FeSO ₄ treatment	Traces	38.2	76.8	3.7
Single acetone extraction and then FeSO ₄ treatment	Traces	31.2	74.5	3.2
FeSO ₄ - Enzymic Treatment	Traces	39.2	77.0	3.2

EFFECT OF DETOXIFICATION ON S-9 DEFATTED SEEDS

Treatment	Allylisothio- cyanate (%)	Protein (%)	Recovery (%)	Moisture (%)
NH ₁	0.61	39.1	-	3.2
Aqueous extraction	Traces	45.3	79.0	4.2
Enzymic Hydrolysis	Traces	46.7	84.5	4.0
Single extraction with 80% acetone	0.40	43.2	85.2	4.0
Double extraction with 80% acetone	0.36	39.9	82.5	4.1
FeSO ₄ Treatment	Traces	40.3	80.2	2.5
Single acetone extraction and then FeSO ₄ treatment	Traces	34.6	75.3	1.5
FeSO ₄ - Enzymic Treatment	Traces	39.5	78.6	2.5

EFFECT OF DETOXIFICATION ON LOCAL SARSON DEFATTED SEEDS

Treatment	Allylisothio- cyanate (%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	0.80	41.0	-	2.5
Aqueous extraction	Traces	45.6	80.0	4.0
Enzymic Hydrolysis	Traces	47.1	83.0	4.1
Single extraction with 80% acetone	0.50	42.6	83.1	4.7
Double extraction with 80% acetone	0.47	38.9	81.6	4.1
FeSO ₄ treatment	Traces	43.4	81.3	4.1
Single acetone extraction and then FeSO ₄ treatment	Traces	35.3	79.4	4.1
FeSO ₄ - Enzymic Treatment	Traces	39.5	78.6	2.5

EFFECT OF DETOXIFICATION ON POORBI RAI DEFATTED SEEDS

Treatment	Allyl Isothio- cyanate (%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	0.94	41.3	-	3.6
Aqueous extraction	Traces	42.6	81.0	4.2
Enzymic Hydrolysis	Traces	47.5	85.0	4.5
Single extraction with 80% acetone	0.70	41.3	87.3	1.5
Double extraction with 80% acetone	0.72	39.6	85.6	2.5
FeSO ₄ treatment	Traces	39.1	79.3	2.4
Single acetone extraction and then FeSO ₄ treatment	Traces	30.3	75.8	2.1
FeSO ₄ - Enzymic Treatment	Traces	35.3	78.3	2.1

single extraction with 80% acetone (Table-17).

Recovery of protein ranged from 74.5 to 87.3% the maximum being when poorbi rai was given single extraction with 80% acetone and minimum when RL-18 was treated with ferrous sulphate after extraction with acetone.

EFFECT OF DETOXIFICATION (CHEMICAL AND BIOCHEMICAL) ON FULL FAT BRASSICA SEEDS

Tables 18 to 21 show the effect of various treatments on the composition of RL-18, S-9, local sarson and poorbi rai full fat Brassica seeds.

Single or double extraction with acetone was not effective for complete detoxification. Allyl isothiocyanate contents were 0.53 and 0.47, 0.34 and 0.31, 0.50 and 0.37, 0.61 and 0.60% in RL-18, S-9, local sarson and poorbi rai respectively.

Single extract with 80% Acetone resulted in upto 16.9, 37.03, 20.6 and 18.6% decrease in allyl isothiocyanate contents in the case of RL-18, S-9, local sarson and poorbi rai full fat mustard seed respectively. Maximum decrease in allyl isothiocyanate contents (i.e. 37.03%) with single extraction with acetone was observed in the case of S-9.

Double extraction with 80% acetone resulted in upto 26.9, 42.59, 41.2 and 20% decrease in allyl isothiocyanate content in the case of RL-18, S-9, local sarson and poorbi rai full fat

Mustard seed respectively. Maximum elimination of toxicity (i.e. 42.39%) as a result of soluble extraction with 80% acetone was observed in the case of S-9 full fat mustard seed. Aqueous extraction, Enzymic hydrolysis, Ferrous Sulphate treatment, single acetone extraction and then ferrous sulphate treatment or ferrous sulphate treatment after enzymic hydrolysis resulted in almost complete elimination of allyl isothiocyanate from KL-18, S-9, Local sarson and poorbi full fat mustard seed.

Full fat KL-18 Seeds: Protein contents in KL-18 full fat seeds varied from 24.6 to 30.6%, the minimum being in the case of Ferrous sulphate treatment and maximum in case of enzymic hydrolysis. Recovery of protein ranged from 73.0 to 84.2%, the minimum was in case of Ferrous sulphate treatment after enzymic hydrolysis and maximum in case enzymic treatment. (Table-18.)

Full fat S-9 Seeds: Protein contents fell in the range of 25.4 to 29.0% the minimum being in case of Ferrous Sulphate, Enzymic treatment and maximum in case of single extraction with 80% acetone. Recovery of protein varied from 73.0 to 88.0%, the lowest was in the case of the sample which was treated with ferrous sulphate after extraction with acetone and maximum in the case of enzymic hydrolysis. Table-19.

Full Fat Local Sarsoon Seed: Protein contents ranged from 24.2 to 31.3%, the minimum was in case of the sample which was treated with ferrous sulphate after extraction with acetone and maximum in case of double extraction with 80% acetone.

Recovery of protein varied from 74.8 to 89.0%, the lowest was in case of the sample which was treated with ferrous sulphate after extraction with acetone and the highest in the case of enzymic hydrolysis. (Table-20).

Full Fat Poorbi Rai: Protein content fell in the range of 25.9 to 31.4%, the minimum was in cases of ferrous sulphate and Ferrous sulphate enzymic treatment and maximum in case of double extraction with 80% acetone.

Recovery of protein varied from 71.1 to 85.0%, the maximum was in case of Ferrous sulphate enzymic treatment and maximum in case of aqueous extraction. (Table-21).

Recovery of protein in full fat samples ranged from 71.1 to 89.0%, the maximum recovery of protein was 89.0% in the case of local sarson seeds when subjected to enzymic detoxification and minimum in case of poorbi rai when treated with ferrous sulphate after enzymic detoxification or extraction with acetone.

Effect of pH on aqueous detoxification of Brassica defatted kernels is depicted in tables 22 to 25. Allyl isothiocyanate

EFFECT OF DETOXIFICATION ON RL-18 FULLFAT SEED

Treatment	Allyl isothio- cyanate (%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	0.65	27.6	-	5.2
Aqueous extraction	Traces	26.4	84.0	2.8
Enzymic Hydrolysis	Traces	30.6	84.0	2.7
Single extraction with with 80% acetone	0.53	27.5	79.2	1.0
Double extraction with 80% acetone	0.47	26.5	76.5	1.5
FeSO ₄ treatment	Traces	24.6	74.8	3.1
Single acetone extraction and then FeSO ₄ treatment	Traces	26.5	73.0	2.8
FeSO ₄ - Enzymic Treatment	Traces	25.1	73.0	2.5

EFFECT OF DETOXIFICATION ON S-9 FULLFAT SEED

Treatment	Allylisothio- cyanate(%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	.54	26.7	-	4.2
Aqueous extraction	Traces	27.1	8.0	2.9
Enzymic Hydrolysis	Traces	26.1	88.0	2.4
Single extraction with 80% acetone	0.33	29.0	76.8	1.0
Double extraction with 80% acetone	0.30	28.7	76.7	3.9
FeSO ₄ treatment	Traces	27.8	74.8	4.3
Single acetone extraction and then FeSO ₄ treatment	Traces	27.4	73.0	2.1
FeSO ₄ - Enzymic Treatment	Traces	25.4	73.3	4.8

EFFECT OF DETOXIFICATION ON LOCAL SARSON FULLIYA SEED

Treatment	Allylisothio- cyanate (%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	0.67	26.1	-	4.5
Aqueous extraction	Traces	25.3	80.0	3.1
Enzymic Hydrolysis	Traces	26.2	89.0	2.6
Single extraction with 80% acetone	0.48	30.1	78.2	2.6
Double extraction with 80% acetone	0.36	31.3	76.3	3.3
FeSO ₄ treatment	Traces	28.3	76.3	5.0
Single acetone extraction and then FeSO ₄ treatment	Traces	24.2	74.8	2.3
FeSO ₄ - Enzymic Treatment	Traces	24.7	75.3	6.6

EFFECT OF DETOXIFICATION ON POORBI RA1 FUJIFAT SEED

Treatment	Allylthio- cyanate (%)	Protein (%)	Recovery (%)	Moisture (%)
Nil	0.75	26.9	-	4.9
Aqueous extraction	Traces	28.4	82.0	2.8
Enzymic Hydrolysis	Traces	26.7	85.0	2.7
Single extraction with 80% acetone	0.61	30.6	75.6	1.0
Double extraction with 80% acetone	0.60	31.4	74.4	1.5
FeSO ₄ treatment	Traces	25.9	72.7	4.1
Single acetone extraction and then FeSO ₄ treatment	Traces	26.8	71.1	2.8
FeSO ₄ - Enzymic Treatment	Traces	25.9	71.1	4.3

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was completely removed when defatted kernels of poorbi rai local sarson, RL-18 and 5-9, were kept for 18 hours at pH-7 at ambient temperature.

Poorbi rai defatted kernels: An increase in pH above 7 also detoxified the kernels but at pH 8, 9 and 12 protein content decreased from 56.7% at pH 7 to 52.30, 51.5 and 51.1% respectively. Moisture fell in the range of 7 to 9.8% lowest was at pH-6 and highest at pH 3. Recovery on weight/weight basis varied from 65.8 to 75.3 % minimum was at pH 8 and maximum at pH 3 (Table-22).

Local Sarson defatted kernels: Allyl isothiocyanate contents of the kernels at pH 3, 6, and 12 were 0.15, 0.11 and 0.04% respectively. Protein ranged from 55.3 to 58.3% minimum was at pH 12 and maximum at pH 7. Recovery on weight/weight basis ranged from 59.6 to 77.1% minimum was at pH 7 and maximum at pH 3. (Table-23).

RL-18 defatted kernels: Allyl isothiocyanate contents at pH 3, 6 and 12 were 0.310, 0.150 and 0.040% respectively. Protein content fell in the range of 52.2 to 57.0% minimum was at pH 6 and maximum at pH 3. Recovery on weight/weight basis varied from 63.10 to 75.90% minimum was at pH 12 and maximum at pH 3 (Table-24).

S-9 defatted kernels: Allyl isothiocyanate content of the kernels at pH 3, 6 and 12 were 0.120, 0.80 and 0.40% respectively. Protein fell in the range of 55.6 to 60.3% minimum was at pH 12 and maximum at pH 3. Moisture content varied from 4.70 to 8.90% the lowest was at pH 12 and the highest at pH 3. Recovery on weight/weight basis ranged from 63.1 to 73.6% the minimum was at pH 6 and maximum at pH 3 (Table-25).

Effect of pH on enzymic detoxification of Brassica defatted kernels is given in tables 25 to 29. Allyl isothiocyanate was completely removed at pH ranging from 3 to 12 by incubating the defatted kernels of poorbi rai, local sarson, RL-18, and S-9 at 55.0°C for 45 minutes and steam stripping the hydrolysed allyl isothiocyanate.

Poorbi rai defatted kernels: Protein content fell in the range of 55.8 to 57.40% lowest was pH 3 and highest at pH 4. Moisture varied from 1.20 to 6.80% minimum was at pH 6 and maximum at pH 4. Recovery on weight/weight basis ranged from 65.6 to 76.3% lowest at pH 4 and highest at pH 12 (Table-26).

Local sarson defatted kernel: Protein varied from 55.6 to 59.0%

EFFECT OF p^H ON DETOXIFICATION & COMPOSITION OF

(POORBI RAI DEFATTED KERNEL)

Treatment	p^H	Moisture %	Allylisoithio- cyanate %	Protein %	Recovery Weight/Weight basis %
AQUEOUS TREATMENT	-	7.8	1.80	51.4	-
	3	9.8	0.04	55.8	75.3
	6	7.1	Traces	54.9	70.0
	7	9.3	Traces	56.7	70.6
	8	7.2	Traces	52.3	65.8
	9	7.7	Traces	51.5	69.3
	12	4.5	Traces	51.1	70.7

EFFECT OF pH ON DETOXIFICATION & COMPOSITION OF

LOCAL SARSON (DEFATTED KERNEL)

Treatment	pH	Moisture %	Allylisothiocyanate %	Protein %	Recovery Weight/Weight basis %
	-	5.9	1.76	50.6	-
	3	9.2	0.15	56.2	77.1
	6	7.3	0.11	55.4	68.4
	7	7.8	Traces	58.3	59.6
	8	7.8	Traces	58.2	59.7
	9	5.8	Traces	57.50	67.4
	12	2.8	0.04	55.3	63.6
AQUEOUS TREATMENT					

EFFECT OF p^H ON DETOXIFICATION AND COMPOSITION OF

RL-18 (DEFATTED KERNEL)

Treatment	p^H	Moisture %	Allyl isothio- cyanate(%)	Protein %	Recovery (%)	
					Weight	Weight basis
AQUEOUS TREATMENT	-	7.3	2.06	51.3	-	-
	3	9.1	0.31	57.0	75.9	75.9
	6	7.0	0.15	52.2	68.8	68.8
	7	8.0	Traces	53.2	69.5	69.5
	8	7.1	"	54.0	62.4	62.4
	9	5.9	"	56.2	65.9	65.9
	12	5.3	0.04	53.1	63.1	63.1
	.					

EFFECT OF p^H ON DETOXIFICATION AND COMPOSITION OF

S - 9 (DEFATTED KERNEL)

Treatment	p ^H	Moisture %	Allylthio- cyanate %	Protein %	Recovery Weight/Weight basis %
AQUEOUS TREATMENT	-	6.3	1.68	51.7	-
	3	8.9	0.12	60.3	73.6
	6	7.0	0.08	56.5	71.0
	7	8.0	Traces	60.0	65.0
	8	8.8	Traces	58.2	68.2
	9	6.6	Traces	56.5	70.0
	12	4.7	0.04	55.6	63.1

lowest was at pH 5 and highest at pH 3. Moisture fell in the range of 2.2 to 6.8% minimum was at pH 5 and maximum at pH 4. Recovery on weight/weight basis varied from 63.6 to 70.3% the lowest was at pH 5 and highest in pH 3 (Table-27).

RL-18 defatted kernels: Protein content fell in the range of 51.0 to 54.40% minimum was at pH 5 and maximum at pH 12. Moisture varied from 2.2 to 6.3% lowest was at pH 5 and highest at pH 4. Recovery on weight/weight basis ranged from 62.3 to 68.8% minimum was at pH 6 and maximum at pH 3 (Table-28).

S-9 defatted kernels: Protein content ranged from 1.6 to 6.7% lowest was at pH 9 and highest at pH 4. Moisture ranged from 1.60 to 6.70% lowest at pH 9 and highest at pH 4. Recovery on weight/weight basis varied from 61.30 to 68.10% minimum was at pH 5 and maximum at pH 3 (Table-29).

Effect of ethanolic sodium hydroxide, diffusion on proximate composition of Brassica seeds: is depicted in Table-30. The amount of allylisothiocyanate in S-9, RL-18 and poorbi rai seeds was 0.74, 0.87 and 0.93% respectively. Diffusion extraction with ethanolic sodium hydroxide removed all the allyli-

EFFECT OF p^H ON DETOXIFICATION & COMPOSITION

POORBI RAI (DEFATTED KERNEL)

Treatment	p^H	Moisture %	Allylisothio- cyanate %	Protein %	Recovery Weight/Weight basis %
ENZYMIC HYDROLYSIS	3.0	2.9	Traces	55.4	74.2
	4.0	6.8	Traces	57.7	65.6
	5.0	2.1	Traces	55.6	68.5
	6.0	1.2	Traces	54.8	71.1
	9.0	1.6	Traces	55.8	73.7
	12.0	1.8	Traces	56.8	76.3

EFFECT OF p^H ON DETOXIFICATION & COMPOSITION

LOCAL SARSON(DEFATTED KERNEL)

Treatment	p ^H	Moisture %	Allylisothio- cyanate %	Protein %	Recovery Weight/Weight basis %
ENZYMIC HYDROLYSIS	3.0	6.2	Traces	59.0	70.3
	4.0	6.8	Traces	56.7	64.4
	5.0	2.2	Traces	55.6	63.6
	6.0	4.9	Traces	56.0	68.9
	9.0	4.5	Traces	58.9	67.5
	12.0	4.5	Traces	58.0	66.6