Asian Journal of Bio Science, **Vol. 3 No. 2 : 355-360 (October, 2008)**

Nutritional profile of millet tempeh

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(Accepted : September, 2008)

Millet tempeh was prepared by supplementation of soybean and horse gram with millets (little, foxtail and finger millet) at different proportions by using *Rhizopus microsporus* var *oligosporus* incubated at 30 and 35^{0}C. Nutritional analysis of millet tempeh indicated that protein content was decreased in millet tempeh with increased proportion of millets. T_1 (100 per cent soybean) recorded highest protein content (43.05 g) followed by the treatments supplemented with 25 per cent of millets (little, foxtail and finger millet) recorded higher protein content. At 35^{0}C, the crude protein content was higher. Carbohydrate content of millet tempeh did not differ significantly for their effect of incubation temperature. Antinutritional factors like trypsin inhibitor was absent in millet tempeh and less tannin content (0.80 g) was recorded in T_{13} (100 per cent finger millet).

Key words : Millet tempch, Nutritional profile, *Rhizopus microsporus* var *oligosporus*.

INTRODUCTION

India is densely populated, however, with respect to nutritional study the availability of protein is below the WHO standards. India is mainly vegetarian country where main protein intake is through pulses. Per-capita availability of pulses has sharply declined from 75 g in 1959 to 40 g in 1991 as against 80 g by FAO/WHO recommendations (Anon., 1992). In order to solve the problem of malnutrition (protein hunger), possible sources of protein production shall have to be exploited to meet the challenge. Exploitation of traditional food resources can make substantial break through to meet protein deficiency. Small millets as a group include several coarse cereals namely finger millet, little millet, foxtail millet, kodo millet, proso millet and barnyard millet grown throughout the length and breadth of the country in diverse soils and climatic conditions. Grains are rich in minerals and fibre content. Recent studies indicate that minor millets are nutritionally superior to conventional food grains and exhibit hypoglycemic effect due to presence of higher proportion of unfavorable complex carbohydrate, resistant starch and release sugars slowly (Malleshi, 1993 and Mani *et al*., 1993). The flavour and difficulty in processing of millets are the limitations for their use in the routine diets. Hence combination of millets and pulses with suitable processing protocol emerged to overcome the problem of aroma with improvement in nutritional quality. Soybean and horse gram are not edible in raw state, but are processed in number of ways before consumption which may have effect on nutritional quality and digestibility of nutrients (Kalmesh *et al*., 2002). If soy tempeh is prepared with any minor millets it increases energy value and the cost gets decreased.

MATERIALS AND METHODS

Soybean (*Glycine max*) and horse gram (*Dolichos biflorus*) were obtained from Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Minor millets like foxtail millet (*Setaria italica* var HMT-100-1), little millet (*Panicum milearum* var. TNAU-63) and finger millet (*Eleucine coracana* var GPU-34) were obtained from the A.R.S, Hanumanamatti. Culture organism (*Rhizopus microsporus* var. oligosporus MTCC-556) obtained from the culture collection center, IMTECH, Chandigarh. Chemicals used for the research were of analytical grade. Soybean and horse gram were dehulled by soaking in the water for over night and rubbing with hand and hulls removed by flotation method. The fungal culture, *Rhizopus microsporus* var *oligosporus* was maintained on slants of potato dextrose agar at 4^{0}C. Before each experiment, the fungus was transferred to fresh PDA slants and incubated at 25^{0}C for 7 days. Millet tempeh was prepared by using soybean and horse gram at different proportions with millets. The treatments are T1(100% pulses), T2 (75% pulses+25% millets), T3(50% pulses + 0% millets), T4(25% pulses+75% millets),T5 (100% millets). Nutrient analysis was done by slicing fermented product into pieces and dried at 60^{o}C in the oven for one day and then powdered. The protein content of tempeh sample was estimated as the percentage of total nitrogen by Microkjeldhal method (AOAC, 1980). Moisture content, fat, crude fibre, total ash, total minerals

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(calcium, phosphorous) and carbohydrates are estimated by AOAC methods (1980). Total phenols were determined by extracting with 80 per cent alcohol and are estimated by Bray and Thorpe, (1954) method. Total amino acids were estimated by extracting the sample with 80 per cent alcohol Calorimetric method (Moore and Stein, 1948). Trypsin inhibitor was analyzed using casein as substrate.

RESULTS AND DISCUSSION

The data recorded on moisture content (%), cruide protein, carbohydrate, crude fibre, fat, total minerals, ash, calcium, phosphorus, total phenols and amino acids as influenced by temperature is given in Table 1. Treatment receiving 100 per cent horse gram (T_{14}) recorded lowest moisture content of 59.24%. The treatments incubated at 35°C recorded lowest moisture content of 66.46% as compared to 30°C (66.56%). This might be due to fast growth of *Rhizopus microsporus* var *oligosporus* and by evaporation of moisture due to increase in temperature by respiration (Hesseltine, 1983). The protein content of tempeh was found to be significantly higher (43.05g) when supplemented with 100 per cent soybean (T_1) as compared to the rest of the treatment combinations. However, the crude protein content was significantly highest at 35°C. The variation in protein content of millet tempeh due to different proportion of millets (little, foxtail and finger millet) with soybean and horse gram and also due to strong proteolytic activity of *Rhizopus microsporus* var *oligosporus* during fermentation (Steinkraus *et al.*, 1960). Carbohydrate content of millet tempeh did not differ significantly for their effect of incubation temperature on the fermentation. T_{13} (100 per cent finger millet) recorded highest carbohydrate content of 71.83g. Increasing trend was observed in the carbohydrate content of treatments with the decreased proportion of soybean and horse gram supplementation. Sorenson and Hesseltine (1966) reported that during the fermentation,

Table 1 : Nutritional profile of soybean and horsegram supplemented with millets at different proportions incubated at different temperature ranges

Substrates	Moisture content (%)			Crude protein (g/100 g)			Carbohydrate (g/100 g)		
	30°C	35°C	Mean	30°C	35°C	Mean	30°C	35°C	Mean
T_1 : 100% soybean	63.12	62.12	62.62	41.19	44.91	43.05	25.17	24.26	24.71
T_2 : 75% soybean + 25% foxtail millet	66.15	64.52	65.33	32.48	35.84	34.16	32.35	33.27	32.81
T_3 : 50% soybean + 50% foxtail millet	64.86	62.68	64.21	24.26	27.26	25.76	41.73	41.68	41.70
T_4 : 25% soybean + 75% foxtail millet	65.53	64.37	65.03	18.12	19.48	18.80	49.63	61.39	50.51
T_5 : 100% foxtail millet	66.73	65.56	66.14	12.65	13.64	13.14	59.98	61.89	60.93
T_6 : 75% soybean + 25% little millet	65.13	64.31	64.72	33.61	35.16	34.61	32.14	32.93	32.53
T_7 : 50% soybean + 50% little millet	67.24	66.36	66.80	22.91	25.70	24.30	44.13	46.25	45.19
T_8 : 25% soybean + 75% little millet	68.70	67.30	68.00	17.12	18.53	17.82	55.18	57.48	56.33
T_9 : 100% little millet	69.33	68.73	69.03	6.98	8.73	7.85	65.39	67.75	66.57
T_{10} : 75% soybean + 25% finger millet	67.43	66.33	66.88	30.28	32.17	31.22	35.84	35.60	35.72
T_{11} : 50% soybean + 50% finger millet	68.81	67.15	67.98	25.73	26.71	26.22	45.92	47.92	46.92
T_{12} : 25% soybean + 75% finger millet	72.67	72.36	72.51	16.91	18.20	17.55	60.98	60.14	60.56
T_{13} : 100% finger millet	73.12	71.02	73.07	6.28	7.51	6.89	71.31	72.35	71.83
T_{14} : 100% horsegram	59.14	59.00	59.24	22.45	24.54	23.49	62.48	64.30	63.39
T_{15} : 75% horsegram + 25% foxtail millet	62.86	63.06	62.46	16.50	18.20	17.35	61.47	53.54	62.50
T_{16} : 50% horsegram + 50% foxtail millet	63.92	62.29	63.10	16.84	18.78	17.81	61.78	62.58	62.15
T_{17} : 25% horsegram + 75% foxtail millet	64.29	63.55	64.25	13.61	14.50	15.65	60.98	60.92	60.95
T_{18} : 75% horsegram + 25% little millet	62.96	62.11	62.53	21.14	23.41	22.21	63.32	64.23	63.77
T_{19} : 50% horsegram + 50% little millet	66.30	65.03	65.66	12.98	14.29	14.13	66.79	65.79	66.29
T_{20} : 25% horsegram + 75% little millet	67.94	66.49	67.21	8.21	9.30	8.80	68.24	67.23	67.73
T_{21} : 75% horsegram + 25% finger millet	64.17	63.91	64.04	16.12	17.40	17.26	64.12	64.14	64.13
T_{22} : 50% horsegram + 50% finger millet	66.97	65.79	66.38	12.90	14.97	13.93	68.69	68.73	68.71
T_{23} : 25% horsegram + 75% finger millet	72.12	72.46	72.29	10.50	13.05	11.77	71.53	71.43	71.48
Mean	66.59	66.46		19.21	21.17		55.18	55.90	
	S.E.±	C.D.(P=0.01)		S.E.±	C.D.(P=0.01)		S.E.±	C.D.(P=0.01)	
Substrates (A)	0.4073	1.10		0.389	1.07		0.680	1.880	
Temperature (B)	0.1201	0.33		0.114	0.31		0.200	0.550	
A × B	0.5760	1.57		0.5504	1.52		0.970	2.688	

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Substrates	Crude fibre (g/100 g)			Fat content (g/100 g)		
	30^0C	35^0C	Mean	30^0C	35^0C	Mean
T_1 : 100% soybean	3.80	3.75	3.77	18.12	19.89	19.00
T_2 : 75% soybean + 25% foxtail millet	4.85	4.84	4.84	15.98	16.21	16.09
T_3 : 50% soybean + 50% foxtail millet	6.01	6.12	6.06	11.34	12.09	11.71
T_4 : 25% soybean + 75% foxtail millet	7.10	7.12	7.11	7.61	8.16	7.86
T_5 : 100% foxtail millet	8.11	8.12	8.11	4.12	4.32	4.22
T_6 : 75% soybean + 25% little millet	4.73	4.75	4.74	16.22	16.31	16.26
T_7 : 50% soybean + 50% little millet	5.71	5.73	5.72	11.91	12.29	12.10
T_8 : 25% soybean + 75% little millet	6.47	6.49	6.48	7.98	8.49	8.23
T_9 : 100% little millet	7.71	7.73	7.72	4.51	4.76	14.63
T_{10} : 75% soybean + 25% finger millet	3.70	3.72	3.71	14.24	15.48	1.86
T_{11} : 50% soybean + 50% finger millet	3.66	3.68	3.67	9.91	10.66	10.32
T_{12} : 25% soybean + 75% finger millet	3.63	3.65	3.64	5.34	5.94	3.64
T_{13} : 100% finger millet	3.63	3.64	3.64	1.12	1.36	1.24
T_{14} : 100% horsegram	4.90	4.92	4.90	1.52	1.68	1.60
T_{15} : 75% horsegram + 25% foxtail millet	6.22	5.92	6.07	2.13	2.12	2.12
T_{16} : 50% horsegram + 50% foxtail millet	6.61	6.65	6.63	2.61	2.92	2.76
T_{17} : 25% horsegram + 75% foxtail millet	7.42	7.50	7.46	3.24	3.61	3.42
T_{18} : 75% horsegram + 25% little millet	6.71	6.75	6.73	2.31	2.11	2.21
T_{19} : 50% horsegram + 50% little millet	6.31	6.34	6.33	2.98	3.13	3.05
T_{20} : 25% horsegram + 75% little millet	6.79	6.81	6.80	3.35	3.94	3.64
T_{21} : 75% horsegram + 25% finger millet	4.58	4.60	4.59	1.17	1.28	1.22
T_{22} : 50% horsegram + 50% finger millet	4.27	4.28	4.27	1.36	1.4	1.40
T_{23} : 25% horsegram + 75% finger millet	4.86	4.88	4.87	1.18	1.39	1.28
Mean	5.55	5.56		6.53	6.93	
	S.E.±	C.D.(P=0.01)		S.E.±	C.D.(P=0.01)	
Substrates (A)	0.03	0.083		0.400	1.100	
Temperature (B)	0.01	0.027		0.120	0.330	
A × B	0.05	0.138		0.57	1.570	

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Substrates	Total minerals (g/100 g)			Ash content (g/100 g)			Calcium content (mg/100 g)		
	30^0C	35^0C	Mean	30^0C	35^0C	Mean	30^0C	35^0C	Mean
T_1 : 100% soybean	1.61	1.62	1.62	2.29	2.30	2.29	241.0	243.00	242.00
T_2 : 75% soybean + 25% foxtail millet	3.24	3.25	3.24	2.00	2.02	2.01	190.04	242.00	191.06
T_3 : 50% soybean + 50% foxtail millet	2.42	2.43	2.42	1.77	1.79	1.78	136.13	191.06	137.13
T_4 : 25% soybean + 75% foxtail millet	2.81	2.82	2.81	1.69	1.71	1.70	85.29	131.13	86.29
T_5 : 100% foxtail millet	3.22	3.23	3.22	1.26	1.28	1.27	29.23	86.29	30.23
T_6 : 75% soybean + 25% little millet	1.60	1.61	1.60	2.10	2.12	2.11	185.10	30.23	186.10
T_7 : 50% soybean + 50% little millet	1.55	1.56	1.55	1.35	1.37	1.36	128.07	186.10	12.07
T_8 : 25% soybean + 75% little millet	1.85	1.86	1.85	1.82	1.83	1.83	71.14	129.07	72.32
T_9 : 100% little millet	1.45	1.46	1.45	1.25	1.27	1.26	15.03	17.36	16.19
T_{10} : 75% soybean + 25% finger millet	1.9	1.92	1.91	2.10	2.12	2.11	267.00	16.19	268.00
T_{11} : 50% soybean + 50% finger millet	2.17	2.18	2.17	1.72	1.74	1.73	291.00	268.00	292.00
T_{12} : 25% soybean + 75% finger millet	2.42	2.44	2.43	1.44	1.46	1.45	316.23	318.23	317.23
T_{13} : 100% finger millet	2.72	2.73	2.72	1.16	1.18	1.17	348.00	317.23	343.00
T_{14} : 100% horsegram	3.21	3.20	3.20	2.95	2.96	2.96	285.00	343.00	286.00
T_{15} : 75% horsegram + 25% foxtail millet	3.25	3.25	3.25	2.50	2.52	2.51	222.00	224.00	223.60
T_{16} : 50% horsegram + 50% foxtail millet	3.23	3.24	3.23	2.11	2.13	2.12	158.00	160.00	159.60
T_{17} : 25% horsegram + 75% foxtail millet	3.15	3.16	3.15	1.71	1.73	1.72	96.29	98.46	97.38
T_{18} : 75% horsegram + 25% little millet	2.8	2.81	2.80	2.49	2.51	2.50	217.17	219.16	218.16
T_{19} : 50% horsegram + 50% little millet	2.36	2.37	2.36	2.06	2.08	2.07	150.02	152.02	151.02
T_{20} : 25% horsegram + 75% little millet	1.91	1.92	1.91	1.70	1.72	1.71	82.16	84.16	83.16
T_{21} : 75% horsegram + 25% finger millet	3.12	3.13	3.12	2.50	2.52	2.51	332.64	301.06	316.85
T_{22} : 50% horsegram + 50% finger millet	2.98	2.99	2.98	2.07	2.10	2.08	313.16	315.17	314.16
T_{23} : 25% horsegram + 75% finger millet	2.74	2.85	2.79	1.62	1.64	1.63	326.23	328.23	327.23
Mean	2.51	2.52		1.89	1.91		194.78	195.36	
	S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)	
Substrates (A)	0.0115	0.030		0.0042	0.011		0.353	0.970	
Temperature (B)	0.0034	0.0094		0.0012	0.0036		0.104	0.288	
A × B	0.0162	0.044		0.0060	0.0166		0.499	1.380	

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Substrates	Phosphorus (mg/100 g)			Total phenols (mg/100 g)			Total amino acids (g/100 g of protein)		
	30^0C	35^0C	Mean	30^0C	35^0C	Mean	30^0C	35^0C	Mean
T_1 : 100% soybean	690.95	691.66	691.30	164.93	164.94	164.93	74.42	75.41	74.92
T_2 : 75% soybean + 25% foxtail millet	594.53	596.17	595.00	132.34	133.72	133.03	68.23	71.24	69.23
T_3 : 50% soybean + 50% foxtail millet	490.93	492.13	491.53	99.73	101.08	100.41	63.44	64.91	64.17
T_4 : 25% soybean + 75% foxtail millet	388.50	390.53	389.51	67.13	68.37	67.75	57.60	59.21	58.40
T_5 : 100% foxtail millet	288.13	290.25	269.19	34.53	35.64	35.08	52.55	53.45	53.00
T_6 : 75% soybean + 25% little millet	573.15	575.25	574.21	141.64	42.39	142.01	60.21	63.27	61.74
T_7 : 50% soybean + 50% little millet	454.64	456.30	455.47	118.22	119.37	118.79	47.03	46.54	46.78
T_8 : 25% soybean + 75% little millet	340.69	341.63	341.16	94.95	95.46	95.20	31.57	32.91	32.24
T_9 : 100% little millet	259.77	219.83	239.80	71.61	72.59	72.10	17.31	18.91	18.11
T_{10} : 75% soybean + 25% finger millet	587.95	590.37	589.16	154.14	155.02	154.58	67.17	69.41	68.29
T_{11} : 50% soybean + 50% finger millet	485.57	487.74	486.65	144.35	145.13	144.74	59.75	61.52	60.63
T_{12} : 25% soybean + 75% finger millet	383.12	385.21	384.18	132.54	133.58	133.06	52.42	53.41	52.91
T_{13} : 100% finger millet	282.72	283.57	383.14	120.13	121.73	120.93	104.79	48.12	46.45
T_{14} : 100% horsegram	317.69	319.26	318.47	180.23	181.02	180.62	62.31	63.31	62.81
T_{15} : 75% horsegram + 25% foxtail millet	306.46	307.22	306.84	143.89	146.81	145.35	59.84	60.41	60.12
T_{16} : 50% horsegram + 50% foxtail millet	302.92	304.62	303.77	99.75	99.99	99.87	59.61	57.41	58.51
T_{17} : 25% horsegram + 75% foxtail millet	294.00	295.88	295.12	71.98	72.90	72.44	55.42	54.93	55.17
T_{18} : 75% horsegram + 25% little millet	286.26	288.07	287.16	153.19	155.03	154.11	52.14	51.04	51.59
T_{19} : 50% horsegram + 50% little millet	265.72	268.42	267.07	125.92	126.79	126.35	40.18	39.80	39.99
T_{20} : 25% horsegram + 75% little millet	244.62	246.27	245.42	98.87	99.61	99.24	33.78	32.86	33.32
T_{21} : 75% horsegram + 25% finger millet	301.54	303.49	302.51	165.69	166.35	166.02	59.91	67.99	63.95
T_{22} : 50% horsegram + 50% finger millet	294.73	296.49	295.61	150.29	152.78	151.54	54.10	53.70	53.90
T_{23} : 25% horsegram + 75% finger millet	287.71	289.89	288.80	136.37	137.46	136.91	50.47	40.39	49.93
Mean	379.24	379.14		121.84	122.97		52.23	54.26	
	S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)	
Substrates (A)	0.4297	1.188		0.0499	0.135		0.1054	0.291	
Temperature (B)	0.1267	0.330		0.0147	0.407		0.3110	0.861	
A × B	0.6077	1.660		0.0706	0.194		0.14916	0.412	

the principal changes in carbohydrates are the rapid removal of hexoses and the slow hydrolysis stachyose, but does not utilize sucrose or raffinose under the same conditions. The treatment receiving 100 per cent soybean (T_1) recorded highest fat content (19.00g). At 35°C fat content was more (6.93g) as compared to 30°C (6.53). With respect to fibre, T_5 (100per cent foxtail millet) recorded maximum fibre content of 8.11g, but no temperature effect was observed. Rathnamani (1987) recorded highest fat content in soy sunflower seed combination. The mold possesses a strong lipolytic activity, hydrolyzing over one third of the neutral fat during 72 hr fermentation at 37°C (Wagenknecht *et al.*, 1961). The treatments T_2 (75 % soybean+25% foxtail millet) and T_{15} (75% horse gram+25% foxtail millet) recorded highest mineral content of 3.25 g, whereas T_{14} (100% horse gram) recorded highest ash content of 2.96 g. T_{13} (100% finger millet) recorded maximum calcium of 343.00 mg and T_1 (100% soybean) recorded highest phosphorus content of 691.30 mg. The effect of incubation temperature on total mineral content, ash, calcium and phosphorus did not differ significantly. Total phenol content in T_{14} (100% horse gram was found to be significantly higher (180.62 mg) as compared to rest of the treatment combinations. The treatment T_1 (100% soybean) recorded highest amino acid content of 74.92 g/100 g of protein. Murata *et al.* (1967) reported quantity of free amino acids increased as fermentation progressed. Raw soybean and horse gram recorded trypsin inhibitor of 64.92 and 31.17 µg/g, respectively. But, trypsin inhibitor was not found in millets. The millet tempeh after fermentation did not show any trypsin inhibitor. Least tannin content (0.80 g) was recorded in T_{13} (100% finger millet) (Table 2). Camacho *et al.* (1981) reported that the concentration of trypsin

Table 2: Effect of fermentation on antinutritional factors of soybean and horsegram supplemented millet tempeh at different temperatures

Substrates	Tannin content (g/100 g of sample)			Trypsin inhibitor (µg/g of sample)		
	30^0C	35^0C	Mean	30^0C	35^0C	Mean
T_1 : 100% soybean	0.89	0.89	0.89	0.00	0.00	0.00
T_2 : 75% soybean + 25% foxtail millet	1.01	1.01	1.01	0.00	0.00	0.00
T_3 : 50% soybean + 50% foxtail millet	1.04	1.02	1.02	0.00	0.00	0.00
T_4 : 25% soybean + 75% foxtail millet	1.13	1.11	1.12	0.00	0.00	0.00
T_5 : 100% foxtail millet	1.14	1.14	1.14	0.00	0.00	0.00
T_6 : 75% soybean + 25% little millet	1.02	1.00	1.01	0.00	0.00	0.00
T_7 : 50% soybean + 50% little millet	1.09	1.11	1.10	0.00	0.00	0.00
T_8 : 25% soybean + 75% little millet	1.10	1.12	1.11	0.00	0.00	0.00
T_9 : 100% little millet	1.10	1.09	1.09	0.00	0.00	0.00
T_{10} : 75% soybean + 25% finger millet	0.90	0.91	0.90	0.00	0.00	0.00
T_{11} : 50% soybean + 50% finger millet	0.91	0.93	0.92	0.00	0.00	0.00
T_{12} : 25% soybean + 75% finger millet	0.93	0.94	0.93	0.00	0.00	0.00
T_{13} : 100% finger millet	0.80	0.80	0.80	0.00	0.00	0.00
T_{14} : 100% horsegram	1.57	1.59	1.58	0.00	0.00	0.00
T_{15} : 75% horsegram + 25% foxtail millet	1.17	1.18	1.17	0.00	0.00	0.00
T_{16} : 50% horsegram + 50% foxtail millet	1.15	1.16	1.15	0.00	0.00	0.00
T_{17} : 25% horsegram + 75% foxtail millet	1.11	1.12	1.11	0.00	0.00	0.00
T_{18} : 75% horsegram + 25% little millet	1.26	1.30	1.28	0.00	0.00	0.00
T_{19} : 50% horsegram + 50% little millet	1.21	1.22	1.21	0.00	0.00	0.00
T_{20} : 25% horsegram + 75% little millet	1.17	1.19	1.18	0.00	0.00	0.00
T_{21} : 75% horsegram + 25% finger millet	1.10	1.11	1.10	0.00	0.00	0.00
T_{22} : 50% horsegram + 50% finger millet	1.07	1.08	1.07	0.00	0.00	0.00
T_{23} : 25% horsegram + 75% finger millet	0.95	0.98	0.96	0.00	0.00	0.00
Mean	1.66	1.67				
	S.E.±	C.D. (P=0.01)		S.E.±	C.D. (P=0.01)	
Substrates (A)	0.0068	0.0188		0.00	0.00	
Temperature (B)	0.0020	0.0055		0.00	0.00	
Interaction (A x B)	0.0096	0.0266		0.00	0.00	

inhibitor varies fro 0.5 to 0.9 µg per gram of N_2 due to varietal differences in soybean. Trypsin inhibitor can completely be destroyed by boiling and by fermentation of soybean (Nout and Rombouts, 1990 and Tawali *et al.*, 1998).

Even though millets are poor in protein content, flavour and difficulty in processing, they are nutritionally superior to conventional food grains and exhibit hypoglycemic effect due to presence of higher proportion of unfavourable complex carbohydrates, resistant starch and release sugars slowly and are also rich in polyphenols, phytosterols, phytoestrogens, fibre content and saponins.

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