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Effect of pH Variation on Solubility of Seed Proteins in Some New and Hybrid Varieties of Legume and Oil Seeds

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The effect of pH variation (ranging from 0.5-13.5) on the solubility of seed protein of seven varieties of leguminous and oil seeds *viz.*, *Glycine max* (NRC-37), *Vigna radiata* (LGG-460), *Phaseolus mungo* (LBG-20), *Cicer arietinum* (JG-130), *Lens esculenta* (JL-3), *Sesamum indicum* (JTS-8) and *Guizotia abyssinic* (JNC-6). All seven varieties exhibited characteristic curves towards maximum solubility ranging from 12.0 to 12.5 pH.

Key Words: Solubility, Seed protein, pH value, Hybrids varieties, Legume seeds, *Glycine max, Vigna radiata, Phaseolus mungo, Cicer arietinum, Lens esculenta, Sesamum indicum, Guizotia abyssinic*.

INTRODUCTION

The use of seed (legumes and oil) protein by the food industries has been increased tremendously and studies on above aspects in form of research towards utilization of seed as protein in food. Seed proteins improvement as an ingredient primarily to increase nutritional quality having desirable attributes for structure, texture, flavour and colour are characteristics in formulated food products.

The knowledge of protein structure and size amongst different varieties of legume and oil seeds will help the understanding of the protein properties. This will help to formulate strategy in favour of permission and manipulation of these properties for development of food products[1-3]. Nutritional and functional qualities of protein are largely determined by its amino acid content and solubility of nitrogen[4]. Food intake and growth indices were also dependent[5] on pH. Functional characterization of protein can be generalized as hydration, emulsification and texture and rheological. These characteristics can measured through their nitrogen solubility, water absorption,

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viscosity, swelling, gelation, fat absorption, foaming, whipping, adhesion, fibre/texture, aggregation, dough formation and extractability.

Nitrogen solubility is one of important aspects of hydration in evaluation of protein quality, since many functional properties of protein depend upon their capacity to go into solution initially. Solubility may be affected by many factors such as pH during extraction or solubilization, size of meal particle, temperature, meal solvent ratio, composition of solvent and character of protein[6].

Present study aims to determine the solubility and behaviour of seed proteins of legume and oil seed protein at different pH that may help in future formulation. The understanding of functional properties of seed protein and their successful extraction and purification in large quantities the study will also help in calibration of additives in the cereal diets of food product commonly marketed as supplementary protein to enrich their nutritive value. The new varieties of legume and oil seeds under consideration, therefore, studies were carried to find out the protein solubility in range of wide pH (0.5-13.5).

EXPERIMENTAL

The sun-dried seeds were studied for their protein content and protein solubilization with pH variation in the powdered form, because size of seed powder has been shown to influence the nitrogenous extraction[7-9]. These seeds were already analyzed for their proximate and toxic principles[10,11].

The effect of pH variation of the extractant on the protein solubilization were studied by varying pH of water, ranging from 0.5 to 13.5, brought by addition of hydrochloric acid or sodium hydroxide solution. 1 g of seed powder was suspended in 20 mL of extractant of desired pH. The content were shaken in electrical shaker for about 2 h at room temperature and centrifuge for 20 min at 2000 rpm in a low speed centrifuge. The nitrogen solubilized was determined in supernatant so obtain was determined by micro Kjeldhal method by using KEL-PLUS-DISTYL-EM.

RESULTS AND DISCUSSION

The seeds of *Glycine max* (NRC-37), *Vigna radiata* (LGG-460), *Phaseolus mungo* (LBG-20), *Cicer arietinum* (JG-130), *Lens esculenta* (JL-3), *Sesamum indicum* (JTS-8) and *Guizotia abyssinic* (JNC-6) were found already analyzed for their proximate principles. The amount of protein present in the seeds of *Glycine max, Vigna radiata, Phaseolus mungo, Cicer arietinum, Lens esculenta, Sesamum indicum* and *Guizotia abyssinic* was found[10] to be 39.8, 29.3, 21.8, 20.12, 25.37, 24.9 and 28.4 %, respectively.

These varieties were studied for their protein solubility behaviour in considerable wide pH range from 0.5 to 13.5. The results are given in Table-1. The solubility of seed protein was found to be maximum *i.e.* 20.8 % at 12.0 pH in *Glycine max* variety NRC-37, 26.87 % at 12.0 pH in *Vigna radiata* variety LGG-460, 30.10 % at 12.0 pH in *Phaseolus mungo* variety LBG-20, 39.14 % at 12.5 pH in *Cicer arietinum* variety JG-130, 32.76 % at 12.0 and 12.5 pH in *Lens esculenta* variety JL-3, 36.8 % at 12.0 pH in *Sesamum indicum* variety JTS-8 and 25.41 % at pH 12.0 found in *Guizotia abyssinic* variety JNC-6.

TABLE-1
EFFECT OF pH VARIATION ON THE SOLUBILITY OF SEED PROTEINS OF SEVEN NEW VARIETIES OF LEGUMINOUS AND OIL SEEDS

pH value	Percentage of protein solubilized						
	GM	VR	PM	CA	LE	SI	GA
0.5	10.90	10.44	18.02	19.50	13.70	20.20	20.00
1.0	13.19	13.41	19.03	09.74	06.89	10.52	12.32
1.5	14.27	13.41	22.0	11.95	11.20	15.78	15.38
2.0	04.39	08.21	07.01	06.52	07.75	07.87	06.16
2.5	04.39	06.71	10.03	14.13	09.48	03.51	04.61
3.0	08.24	04.47	05.01	13.04	11.20	04.38	03.08
3.5	04.39	05.22	08.02	06.52	06.03	04.38	04.61
4.0	09.87	04.47	05.01	06.52	08.62	05.26	09.22
4.5	05.47	05.97	10.03	06.52	04.30	05.26	08.47
5.0	08.79	08.95	05.01	08.69	11.20	03.51	06.16
5.5	09.87	07.46	06.01	06.52	05.17	04.38	03.08
6.0	06.04	04.47	05.01	11.95	06.89	02.63	03.08
6.5	07.14	10.44	13.04	14.13	10.34	01.75	06.16
7.0	12.63	09.70	14.03	14.13	10.34	07.02	08.47
7.5	10.80	11.94	08.02	32.61	25.80	03.51	05.39
8.0	07.14	06.71	12.04	28.26	27.59	07.02	12.32
8.5	04.39	09.70	09.02	05.43	05.17	08.75	03.84
9.0	13.19	05.97	06.01	10.86	06.03	04.38	04.61
9.5	06.04	05.97	10.03	08.69	09.48	07.02	06.16
10.0	12.63	07.46	13.04	28.26	15.49	07.02	13.83
10.5	07.14	06.71	08.02	09.74	06.89	04.38	03.08
11.0	06.04	05.97	07.01	08.69	06.03	08.75	11.54
11.5	10.80	08.95	18.02	17.30	11.20	07.02	06.90
12.0	20.80	26.87	30.10	30.40	32.76	36.86	25.41
12.5	14.80	16.41	18.02	39.14	32.76	24.59	18.48
13.0	07.68	17.16	18.02	21.70	19.82	18.43	15.38
13.5	09.87	17.16	24.08	19.53	13.70	20.20	18.48

GM = *Glycine max* NRC-37; VR = *Vigna radiata* LGG-460; PM = *Phaseolus mungo* LBG-20; CA = *Cicer arietinum* JG-130; LE = Lens esculenta JL-3; SI = *Sesamum indicum* JTS-8; GA = *Guizotia abyssinic* JNC-6.
Each value is an average of three estimations.

The solubility of seed protein was found minimum *i.e.* 4.39 % at 2.0, 2.5, 3.5 and 8.5 pH in *Glycine max* variety NRC-37, 4.47 % at 3.0,4.0 and 6.0 pH in *Vigna radiata* variety LGG-460, 5.01 % at 3.0, 4.0, 5.0, 6.0 pH in *Phaseolus mungo* variety LBG-20, 5.43 % at 8.5 pH in *Cicer arietinum* variety JG-130, 4.30 % at 4.5 pH in *Lens esculenta* variety JL-3, 1.75 % at 6.5 pH in *Sesamum indicum* variety JTS-8 and 3.08 % at pH 3.0, 5.5, 6.0 and 10.5 pH found in *Guizotia abyssinic* variety JNC-6.

The solubility of seed protein was found to fluctuate in *Glycine max* variety NRC-37 between 4.39 to 20.8 % in *Vigna radiata* variety LGG-460 between 4.47 to 26.87 %, in *Phaseolus mungo* variety LBG-20 between 5.01 to 30.10 %, in *Cicer arietinum* variety JG-130 between 5.43 to 39.14 %, in *Lens esculenta* variety JL-3 between 4.30 to 32.76 %, in *Sesamum indicum* variety JTS-8 between 1.75 to 36.8 % and in *Guizotia abyssinic* JNC-6 between 3.08 to 25.41 % at the remaining pH.

It was found that alkaline medium were more effective in extraction of protein from food legume and oil seeds. As the acidity was increased, solubility drastically reduced rapidly and minimum is observed. This is isoelectric region.

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