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The importance of utilizing oilseed meals as supplementary protein sources for human consumption has received considerable attention in recent years. The different oilseed meals that are utilized for this purpose are from peanut, soyabean, rapeseed, mustard, sesame, cottonseed and sunflower seed. India is one of the major oilseed producing countries in the world and has the largest production of sesame seeds (0.5 million tonnes) representing nearly 40% of the world's production of sesame seed (CSIR, 1972; FAO, 1973). A major portion of this production ~80% is utilized for the extraction of oil and the rest for edible purposes in traditional foods. Among the vegetable proteins, the proteins from sesame seed has a special significance as a rich source of sulphur containing amino acids, acceptable for human consumption (Block and Bolling, 1951; Sastry et al., 1974). The nutritive value of sesame flour is significantly enhanced by supplementation with lysine which is the limiting amino acid in this protein (Almqvist and Grau, 1944; Joseph et al., 1962). Also sesame proteins

constitutes a valuable supplement to pulse, soyabean, groundnut and Bengalgram proteins (Kuppuswamy et al., 1958). This potential source of protein in the sesame seed cake remaining after extraction of oil is mostly used as a cattle fodder. In the literature, very little work is available on the chemical and physico-chemical properties of sesame seed proteins. In what follows an account of information available on sesame seed proteins is presented.

#### Present state of knowledge regarding sesame seed proteins:

The work on sesame seed proteins has mostly centred round the isolation of the total protein from fat-free meal, the solubility of the protein as a function of pH and the fractionation of different protein components present in it. A few of its physico-chemical properties including electrophoresis, amino acid composition and isoelectric point have been reported. Limited studies on the association-dissociation of the major protein of the sesame seed at different pH and ionic strength, the molecular weight of this protein from ultracentrifugation studies and its diffusion coefficient have also been reported.

#### Extractability studies of sesame seed proteins:

Ritthausen (1880) obtained several preparations of proteins from sesame seed by extracting the protein from oil free cake under variable conditions of alkali,

sodium chloride concentration and temperature. The different preparations were analysed for elementary composition, e.g. carbon, nitrogen, etc.

Adolph and Lin (1936) carried out solubility of sesame seed proteins from the fat free meal in sodium chloride, sodium hydroxide and sodium carbonate and showed that prior treatment of the meal with methanol or a temp of 110° decreases the solubility considerably.

Basu and Sen Gupta (1947) carried out similar solubility studies with defatted sesame seed proteins in various pH's, sodium bisulfite and sodium chloride solutions and showed that sodium chloride (6%) at pH 9.0 extracted nearly 87% of the protein.

Nath and Giri (1957a) carried out peptisation studies of sesame protein with 10% sodium chloride solution. The effect of particle size of the meal, ratio of sample weight to solvent volume, time of stirring, temperature, salt concentration and pH on the extractability of total protein from the meal were studied.

Deschamps et al., (1966) reported the dispersibility of sesame seed proteins with pH and showed that the protein was soluble below pH 3.0 and above pH 7.0. They also reported an isoelectric point of 4.5 from precipitation studies.

Guerra and Park (1975) carried out studies on the solubility of defatted sesame seed meal in aqueous solution over various pH's and salt solutions. Maximum solubility was found in alkaline solution and the proteins were almost insoluble in acidic solutions. The solubility of the protein in sodium chloride or calcium chloride solution was increased upon increasing the salt concentration upto 1M whereas in sodium sulfite or disodium monohydrogen phosphate solution, the solubility of the protein was higher at lower salt concentrations but decreased at higher salt concentrations at pH 8.

Isolation of different fractions and studies pertaining to them:

The available information in the literature indicates the presence of four different protein fractions constituting the total proteins from the sesame seed. There has been some ambiguity in nomenclature of the different fractions (Jones and Gersdorff, 1927; Nath and Giri, 1957b; Salem and Heikheit, 1964). For the present work we will adopt the nomenclature of Nath and Giri (1957b). The major protein which constitutes nearly 65-70% of the total protein present in the sesame seed, has been designated as  $\alpha$ -globulin (Jones and Gersdorff, 1927). The other fractions have been named as  $\beta$ ,  $\gamma$  and  $\delta$  globulins (see subsequent discussion).

Jones and Gersdorff (1927) were the first to make serious attempt on fractionation of different protein components of sesame seed proteins. They utilized a variety of procedures e.g. heat coagulation, fractional precipitation with varying concentration of ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , dilution of the total protein extract from high salt molarity and acid coagulation. These authors by their methods observed three different protein fractions in the sesame seed proteins.

Nath and Giri (1957b) following and modifying the approaches of Jones and Gersdorff (1927) have isolated different protein fractions as follows. The clarified 10% sodium chloride extract of the meal brought to pH 7.0 (in buffer) was diluted 1:10 times with distilled water and centrifuged. The precipitate obtained was redissolved in the same volume and concentration of sodium chloride and the process of precipitation and centrifugation repeated. The precipitate was dispersed in water and dialysed free of salt and dried. Nath and Giri (1957b) observed that this fraction was the major component  $\alpha$ -globulin, of Jones and Gersdorff (1927). The fraction had an isoelectric point of 4.65 and was homogeneous between pH 3-12.

The supernatant left after centrifugation of the diluted 10% sodium chloride extract (see above) was saturated to 40%  $(\text{NH}_4)_2\text{SO}_4$  and centrifuged. The precipitate so obtained was redissolved in 10% NaCl and was

precipitated again by 40%  $(\text{NH}_4)_2\text{SO}_4$  and this fraction was identified as  $\beta$ -globulin of Jones and Gersdorff (1927). Nath and Giri (1957b) observed a slight contamination of  $\alpha$ -globulin in  $\beta$ -globulin fraction from electrophoretic measurements.

The above supernatant remaining after  $\beta$ -globulin isolation was brought to 60%  $(\text{NH}_4)_2\text{SO}_4$  saturation. The precipitate was subjected to similar treatment of dissolution and precipitation as in  $\beta$ -globulin isolation. The electrophoretic pattern of this fraction indicated two more protein components along with  $\beta$ -globulin and were designated as  $\gamma$  and  $\delta$  globulins.

The major protein fraction  $\alpha$ -globulin isolated by dilution method was termed amorphous  $\alpha$ -globulin by Jones and Gersdorff (1927). The precipitate, obtained by adding 20-30%  $(\text{NH}_4)_2\text{SO}_4$ , when dissolved in 2% sodium chloride at 60° yielded crystalline  $\alpha$ -globulin on cooling (Nath and Giri, 1957b).

Saleh and Bekheit (1964) also studied different procedures for fractionation of protein components from sesame seed proteins and reported their electrophoretic measurements.

#### Physico-chemical properties of $\alpha$ -globulin:

Serious attempts on the study of the physico-chemical properties of sesame seed proteins appeared in the early sixties. Sinha and Sen (1962) from the sedimen-

tation velocity studies observed the presence of four protein components in the total protein in 10% sodium chloride with sedimentation coefficients of 2, 7, 13 and 19S. These authors obtained a sedimentation coefficient of 13S for the major protein,  $\alpha$ -globulin, in 10% sodium chloride. The effect of pH below pH 4.5 and above pH 9.0 indicated dissociation of the protein, which was independent of the variety of the seeds. Between pH 4.5 and pH 9.0  $\alpha$ -globulin preparation appeared to be stable and indicated the presence of low concentrations of 19S and 23S components depending upon the pH of the solution. The moving boundary electrophoretic results of  $\alpha$ -globulin indicated a single peak at pH's 4.1 and 3.2 although two partially resolved peaks were observed at pH 2.45. In addition, these authors have reported the absorption spectrum of  $\alpha$ -globulin with an absorption maximum between 278-280 nm. The value of  $\epsilon_{1\%}^{1\text{cm}}$  at 280 nm was found to be 10.8.

Ventura and Lima (1963) studied the sedimentation and diffusion characteristics of  $\alpha$ -globulin. Ultracentrifugal analysis of this protein revealed a major component with a  $S_{20,w}$  value of 13.0. The values of frictional ratio was 1.5 and partial specific volume 0.735 for the protein. The calculation of molecular weight by a combination of diffusion, sedimentation and partial specific volume data yielded a value of  $450,000 \pm 30,000$  daltons.

Guerra and Park (1975) recently investigated the subunit composition of total sesame seed protein by SDS-polyacrylamide gel electrophoresis in the presence of  $\beta$ -mercaptoethanol by the method of Weber and Osborn (1969). Seven fractions of molecular weights of 51,000; 31,000; 28,500; 25,500; 21,800, 20,500 and 17,900 have been identified by them.