Increased Oilseed Protein Solubility after Peroxide Exposure

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ABSTRACT

Oilseed proteins of peanut (arachin), pumpkin (cucurbitin) and soy (11-S glycinin) were exposed to 30% H_2O_2. Solubilities of arachin, cucurbitin, and glycinin increased 8.5-fold, 40-fold, and ca. 200-fold, respectively, in aqueous (arachin and cucurbitin) or acidic (glycinin) media. Implications for utilization of oilseed proteins following exposure to H_2O_2 are discussed.

INTRODUCTION

Modifications of protein solubility and other functional properties are desirable in the preparation and utilization of oilseed proteins in foodstuffs. Therefore, solubility changes accompanying the peroxide-induced conformational transitions of oilseed protein (1) were of interest. In this communication, we report the effects of exposure of purified oilseed proteins to peroxide on their solubilities in water (peanut and cucurbit seed proteins) and in an acidic medium (acidic-insoluble soybean protein).

EXPERIMENTAL PROCEDURES

Peanut protein (arachin) was isolated by the method of Neucere (2). Cucurbit seed protein (cucurbitin) was purchased from Nutritional Biochemicals Corp. (Cleveland, OH), and then recrystallized twice by the method of Vickery et al. (3). The 11-S component of glycinin was isolated from hexane-extracted soy meal according to Briggs and Mann (4) and was purified by isoelectric precipitation (5).

Samples (1 g) were suspected in either 20 mL of H_2O or 30% H_2O_2 (both pH 6.5) with a Tekmar SDT-100N Tissumizer operating at high speed for two 5-sec intervals. The preparations were centrifuged at 2000 g for 15 min and the supernatants, 2 hr later, were dialyzed against water that contained catalase and, when H_2O_2 was removed, lyophilized. Sufficient catalase (3900 units per mg, Sigma Chemical Co., St. Louis, MO) was added to the dialysis medium to obtain rapid destruction of diffused H_2O_2. To ensure H_2O_2 removal, dialysis medium that contained catalase was renewed until H_2O_2 destruction ceased.

For solubility measurements, saturated protein solutions were prepared by the procedure described above in either H_2O, pH 6.5, (arachin and cucurbitin) or 0.05 M acetate buffer, pH 4.7, (11-S glycinin) and centrifuged at 2000 g for 15 min. Supernatants were analyzed for protein by Kjeldahl analysis.

RESULTS AND DISCUSSION

Increases in protein solubility after exposure of each protein to H_2O_2 are shown in Table I. The increase for each protein was relatively large, but the increased solubility for glycinin should not be considered a representative or typical example—acid-insoluble 11-S glycinin was only included to determine how extreme the increase might be. The results show, however, that solutions of 6.5% protein were produced in distilled water whereas before exposure to H_2O_2, solutions of less than 0.8% and 0.2% were obtained for arachin and cucurbitin, respectively (Table I).

Since H_2O_2 has been established as an antimicrobial agent in milk processing and as a bleaching agent for fish protein, its effects on nutritive values of these proteins have been examined (6-10). Depending on concentrations and periods of exposure, H_2O_2 generally decreases nutritive values, but not necessarily digestibilities, of the proteins by oxidizing certain amino acids, particularly sulfur-containing amino acids (for a review see reference 11). The effects of H_2O_2 on the nutritive values and functional properties of cucurbit, peanut and soybean proteins were not (and will not be) examined by us, but possible modifications, such as oil emulsification, water binding, etc., should be of interest to others. Perhaps retardation of the formation of nephrotoxic lysinoalanine by H_2O_2 (7) during protein processing might be of particular concern.

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TABLE I

Protein Solubility in Aqueous[a] or Acidic[b] Media

Protein	Before H_2O_2 (mg/mL)	After H_2O_2 (mg/mL)	Increase in solubility
Peanut protein (arachin)	7.6 ± 0.01	64.8 ± 0.02	8.5-fold
Cucurbit protein (cucurbitin)	1.6 ± 0.01	65.0 ± 0.03	40-fold
Soy protein (11-S glycinin)	trace[c]	0.2 ± 0.005	ca. 200-fold

[a]Peanut and cucurbit seed proteins in distilled water, pH 6.5.
[b]Acid-insoluble soy protein in 0.05 M acetate buffer, pH 4.7.
[c]Less than 0.001 mg of protein/mL.

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ERRATUM

In the article "Rapid Determination of Wax in Sunflower Seed Oil" appearing in the July 1982 issue of *JAOCS* (Morrison, III, 59:284 [1982]), the following error was printed under Results and Discussion, paragraph 2. The quadratic equation should read "$y = -10.03 + 15.66\ (x) -.0209\ (x^2)$" and not "$y + 1.68 + 0.56\ (x) + 1.3 \times 10^{-5} \times 2$".