Effect of Hydrogen Peroxide Concentration on Oilseed Protein Solubility

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Cucurbitin, a typical oilseed protein, was treated with 0–30% H_2O_2, lyophilized after removal of H_2O_2, and then tested for its solubility in water. Its solubility increased linearly from virtual insolubility in the absence of H_2O_2 exposure to about 65 mg/ml after exposure to either 20% or 30% H_2O_2. These results indicated that H_2O_2 is effective in producing several ratios of soluble-to-insoluble protein preparations, as represented by cucurbitin. Obtaining desired solubilities of oilseed proteins with H_2O_2 could provide ways for the development of new oilseed products.

Earlier we reported increases approaching 200-fold in solubilities of oilseed proteins in water after their exposure to 30% H_2O_2 (1). Since then, we have received inquiries concerning the optimal amount of H_2O_2 needed to render oilseed proteins water-soluble. In this communication, we show the effects of a range of H_2O_2 concentrations on protein solubility with cucurbitin as the model protein. Cucurbitin is the predominant seed storage protein of cucurbits such as pumpkin, squash, melon, gourd, etc. (2). It was used in this study because it is a typical oilseed protein (2) and is virtually insoluble in low ionic strength solutions (3) but becomes soluble after exposure to 30% H_2O_2 (1).

EXPERIMENTAL PROCEDURES

Cucurbitin was purchased from Nutritional Biochemicals Corp. (Cleveland, Ohio) and then recrystallized twice by the method of Vickery et al. (3). Specimens were treated with H_2O_2 as described earlier (1). In brief, one-g samples were suspended in 20 ml of H_2O_2, dialyzed two hr later against catalase until H_2O_2 was removed, and lyophilized. The amount of each lyophilized specimen that was soluble in distilled water, pH 6.5, at saturation was measured and was used to determine the effect of H_2O_2 on cucurbitin solubility.

RESULTS AND DISCUSSION

The effect of the exposure of cucurbitin to different concentrations of H_2O_2 on its solubility in distilled water is shown in Figure 1. The concentration of 20% H_2O_2 appeared to be the optimal concentration for rendering cucurbitin soluble; this concentration yielded a greater than 40-fold increase in solubility compared to the solubility without H_2O_2. Furthermore, virtually no increase in solubility over that with 20% H_2O_2 was produced by the stronger concentration of 30% H_2O_2 (Fig. 1), which was used in our original study (1).

Anticipated practical advantages of using less concentrated H_2O_2 in reaction mixtures than that used in our earlier study are that any potential loss of nutritive value from peroxide exposure (4) would be diminished, and removal of residual H_2O_2, such as by dialysis against catalase as was done in this study, would occur more readily. Thus, 20% H_2O_2 appeared the most practical concentration for rendering oilseed storage proteins water-soluble, as represented by cucurbitin.

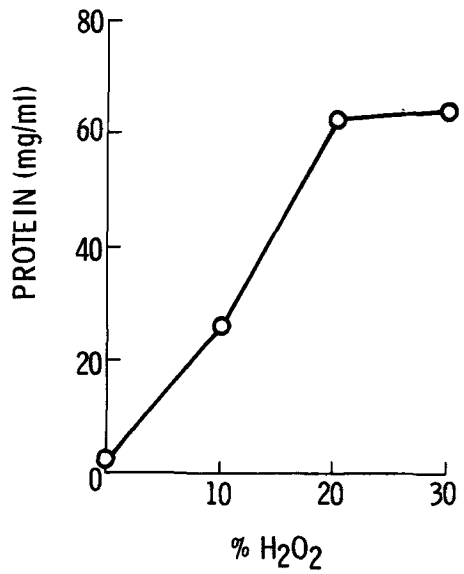

FIG. 1. Effect of the concentration of H_2O_2 on the solubility of cucurbitin in water.

The amount of protein that became soluble after H_2O_2 exposure was dependent on the concentration of H_2O_2 during exposure (Fig. 1). These results indicate that any desired ratio of soluble-to-insoluble protein can be obtained by the choice of H_2O_2 concentration used for protein exposure. The ability to control the solubility of an oilseed protein provides an additional means for the development of new products from oilseeds.

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