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PROTEINS ISOLATED FROM TOMATO SEEDS

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Proteins isolated from tomato seeds are characterized. The solubility and other useful properties are investigated. The most stable emulsions are formed from the proteins precipitated at pH 5.0.

The recovery of proteins from food wastes would expand the raw-material base of the food industry and reduce the loss of protein. Tomato seeds are a nontraditional source of food protein and oil. In contrast to other plant proteins, they contain a large quantity of lysine, reaching 136% of the recommended amount in ideal protein. The total essential aminoacids in defatted tomato-seed flour is 42%, which is comparable with soy flour. Non-food substances are not found in this source of edible protein. [1-3].

We have previously [4, 5] studied the chemical composition and reported the general characteristics of seed and skin proteins and reviewed the properties of protein fractions from tomato seeds.

The method for isolating food preparations is important in determining the useful properties of the proteins. Therefore, we studied the properties of proteins isolated from tomato seeds as a function of the conditions under which the proteins are precipitated from the extract. The proteins are isolated from defatted powdered tomato seeds by extraction at pH 9.0 for 1 h at room temperature with subsequent precipitation at various pH values. As the pH decreases, the yield of precipitated proteins decreases from 12.8 (pH 5.0) to 7.0% (pH 3.7).

Table 1 presents data for the useful properties of proteins isolated under various conditions. All studied samples exhibited high sorptivity for water and fat that decreased smoothly from 885 to 643% and from 360 to 199%, respectively, as the precipitation pH increased.

The solubility of the isolated proteins was estimated by turbidimetric titration as a function of the pH of maximum precipitation. Figure 1 shows the turbidimetric titration curves for tomato-seed fractions. It can be seen that the pH of maximum precipitation for all samples lies in the range 4.0-5.8. The shapes of the curves for proteins precipitated at pH 4.6 and 5.0 are practically identical (pH 4.4-5.8). The solution rapidly becomes cloudy when the pH of maximum precipitation is reached. This is probably due to the marked tendency of the proteins to aggregate. Such changes in the properties of the isolated proteins may be caused by structural factors or isolation conditions.

One of the most important useful properties that determines the consumer value of a prepared food product is the ability to act as an emulsifier. The stability of emulsions is determined by the rate at which 50% of the nonpolar phase (decane) separates from the emulsion [6]. Table 2 presents results from the stability determination of the prepared emulsions. It was found that stable emulsions are formed by proteins precipitated at pH 5.0, even with a protein concentration of $8 \cdot 10^{-3}$%. For proteins precipitated at pH 4.0 and 4.6, the threshhold of stability for the emulsions is an order of magnitude greater, $4 \cdot 10^{-2}$%. The emulsions are least stable for proteins precipitated at pH 3.7 (protein concentration 0.1%).

Thus, the proteins isolated from tomato seeds are characterized. The protein yield is determined as a function of precipitation pH. The solubility and absorptivity for water and fat are studied for proteins precipitated at various pH values. The most stable emulsions are formed by proteins precipitated at pH 5.0.

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TABLE 1. Yield and Properties of Proteins Isolated as a Function of Precipitation pH

Index, %	pH			
	3.7	4.0	4.6	5.0
Yield of protein	7.0	10.6	12.4	12.8
Water absorptivity	360	304	275	199
Fat absorptivity	885	641	548	643

TABLE 2. Stability of Decane Emulsions Stabilized by Proteins Isolated from Tomato Seeds (pH 7.0, 293 K, disperser rotation rate 3,000 rpm, emusifying time 2 min, phase ratio decane: water = 1:4, v/v)

Protein conc., %	Isolated at pH 3.7, $\tau_{1/2}$, sec	Isolated at pH 4.0, $\tau_{1/2}$, sec	Isolated at pH 4.6, $\tau_{1/2}$, sec	Isolated at pH 5.0, $\tau_{1/2}$, sec
1.0	Stab.	Stab.	Stab.	Stab.
0.1	Stab.	Stab.	Stab.	Stab.
0.2	1260	Stab.	Stab.	Stab.
0.04	360	Stab.	Stab.	Stab.
0.008	10	180	87480	Stab.
$1.6 \cdot 10^{-4}$	10	180	300	300
$3.2 \cdot 10^{-5}$	10	30	10	120
$6.4 \cdot 10^{-6}$	10	30	10	90

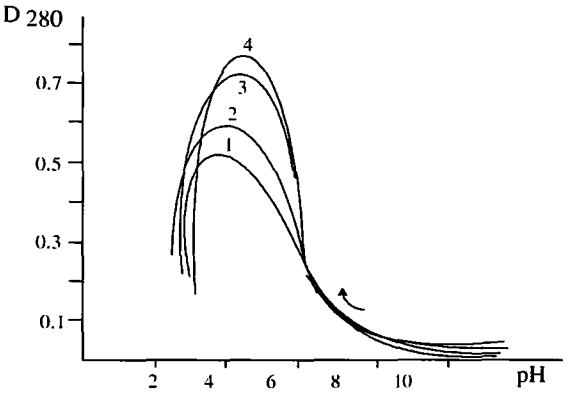

Fig. 1. Turbidometric titration curves (protein concentration in solution, 0.03%): Isolated at pH 3.7 (1), 4.0 (2), 4.6 (3), 5.0 (4).

EXPERIMENTAL

Tomato seeds of the Volgograd variety were used. The powdered seeds were defatted by hexane and petroleum ether. Ground seeds (200 g) were covered with hexane (1:20 w/v) and stirred by a magnetic stirrer for 1 h. The extraction was repeated five times.

Proteins were isolated by extraction of the powder at pH 9.0 (powder:extractant = 1:10) for 1 h at room temperature. The protein solution was separated from the solid by centrifugation (5 min, 6,000 rpm).

The proteins were precipitated (5% HCl) at various pH values (3.7, 4.0, 4.6, 5.0). The precipitated proteins were separated by centrifugation, washed with distilled water, and lyophilized. The maximum yield of protein was 12.8%. The protein content in the precipitate was 79.4% (N×6.25).

The ability to absorb water and fat [7], the solubility of the precipitated proteins [8], and the stability of the emulsions [6] were determined by the literature methods.

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