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Foaming Properties of Sesame Seed Protein Hydrolyzates

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Sesame seed protein isolates have been hydrolyzed using enzyme trypsin. The degree of hydrolysis (6, 8 and 10 %) was determined by the pH-stat method. The foaming capacity and foam stability was determined by the electrical conductivity method. The effect of degree of hydrolysis and pH on the foaming properties were also studied.

Key Words: Foaming, Sesame seed, Protein, Hydrolyzates.

INTRODUCTION

Proteins and protein hydrolyzates can be used as potential food additives because of their nutritional characteristics as well as the functional properties. The term functional properties connotes those physico-chemical properties which influence the behaviour of additives during preparation, processing, storage and consumption of food products. The foaming properties of proteins can be used in the preparation of dessert toppings, whipped creams and leavened bakery products.

Foams with respect to foods may be considered as the dispersion of gas in liquid. The gas bubbles are encapsulated in the liquid film containing the soluble components of the food. Foams are important in products such as whipped toppings, chiffon desserts and leavened bakery products.

The formation and stability of the foams are facilitated by the incorporation of a large number of small-sized gas bubbles and the presence of a surface active agent in the liquid phase. Air incorporation is achieved mechanically by whipping. The presence of a surface active agent or surfactant in the liquid phase is essential to reduce the interfacial tension between the two phases. The surfactant molecules consists of a hydrophilic part (a polar head) and a hydrophobic part (a non-polar tail). The surface active agent generally diffuses to the interfacial region forming a film or membrane with a hydrophilic region spread towards the aqueous phase while the hydrophobic part faces the gas bubble. The film protects the bubbles against coalescence. Traditional surface active agents used in food systems include mono and di-glycerides, sorbitols and their esters.

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Proteins are amphiphilic polymers that on providing sufficient energy in the form of whipping orient themselves at the interface just like the surfactant molecules. The water soluble protein diffuses to the interfacial region, undergoes conformational changes including unfolding and partial denaturation facilitating the formation of a polypeptide membrane in the form of a cohesive film around the gas bubble.

The demand for proteins in human diet is not met fully necessitating the development of new protein sources. Among the various non-conventional sources, oilseeds are rich sources of proteins. Seeds of sesame, cotton, castor and peanuts have been primarily harvested for their oil content.

Sesame seed is one of the most valuable oil seeds, called the queen of the oil seed crop because of its high yield of good quality of oil and meal. It contains about 50 % oil and *ca.* 25 % protein by weight. The protein content of the meal varies from 30 to 60 % by weight and contains relatively higher percentage of methionine.

Foaming properties in foods have been described in terms of whippability and foamability which are only qualitative parameters. The quantitative parameters of relevance include foaming capacity and foam stability.

Laboratory methods to evaluate the foaming properties are based on producing a foam and measuring the electrical conductivity of the foam[1-3]. Several methods have been used to produce foams such as stirring, shaking and bubbling[4].

EXPERIMENTAL

Preparation of protein isolates: In the present work defatted sesame seeds were taken as the substrates. The proteins were extracted by alkaline extraction followed by isoelectric precipitation. The proteins were hydrolysed using enzyme trypsin and mixed proteases. Protein content was estimated by two methods namely Kjeldahl method of nitrogen estimation[5] and by the method of Lowry[6].

Preparation of protein hydrolyzates: The sesame seed protein were hydrolyzed enzymatically using trypsin and mixed proteases to produce protein hydrolyzates. In order to produce protein hydrolyzates of varied functional properties, it was necessary to monitor the degree of hydrolysis of proteins. The degree of hydrolysis is defined as the percentage of the cleaved peptide bonds during hydrolysis compared to the total quantity of available peptide bonds. A pH-stat technique was used for monitoring the degree of hydrolysis. In this method the pH of the reaction mixture in unbuffered condition (free water hydrolysis) was monitored and maintained constant at the desired value by titrating with a standard solution of sodium hydroxide. The reaction was terminated at the desired degree of hydrolysis (6, 8 and 10 %) by decreasing the pH so as to inactivate the enzyme using trichloroacetic acid. After 0.5 h of incubation the contents were centrifuged. The residue was discarded and the centrifugate was utilized for the determination of foaming properties.

Production of foams: In the present work, foams have been produced by stirring aqueous solutions of protein or enzymatically produced protein hydrolyzates[7]. The

foaming properties of the protein hydrolyzate solutions have been determined as a function of degree of hydrolysis and pH. At a given degree of hydrolysis, the foaming properties of the hydrolyzates have been determined at four different pH values.

Determination of foaming properties: In the electrical conductivity method, the conductance of the foam produced has been measured, immediately after producing the foam, using a conductivity meter. Since foams consist of a number of bubbles separated by liquid and solid films, foaming properties may be determined by measuring the conductivity of foams which contain conducting fluids adsorbed to the film of foams. The initial conductivity of the foam was taken as a measure of the foaming capacity of the protein or protein hydrolyzate. The decrease in conductance of the foam was plotted as a function of time. The time at half the value of foam, referred to as half life, has been taken as measure of foam stability. The foaming properties were determined as a function of pH and degree of hydrolysis[8].

RESULTS AND DISCUSSION

The sesame seed protein isolate did not exhibit any foaming property. Trypsin hydrolysis produced protein hydrolyzates with better foaming properties indicating an improvement in the functional properties due to enzyme hydrolysis.

The experimental data on variation of electrical conductivity of foams of trypsin mediated sesame seed protein hydrolyzates is shown in Table-1.

The foaming properties of the hydrolyzates have been found to decrease as pH increased from 3.5 to 9.0. An increase in the foaming capacity has been observed as the degree of hydrolysis increased from 6 to 10 % at a given pH.

The effect of degree of hydrolysis and pH on the stability of the foams of trypsin mediated sesame seed protein hydrolyzates has been found to be negligible. Maximum foam stability of 3.2 ± 0.5 min has been observed at pH 3.5 for 6 % degree of hydrolysis.

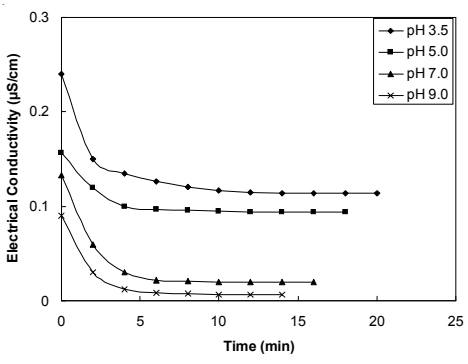

Fig. 1. Variation of electrical conductivity of trypsin mediated sesame seed protein hydrolyzates at 10 % degree of hydrolysis (DH) at different pH values

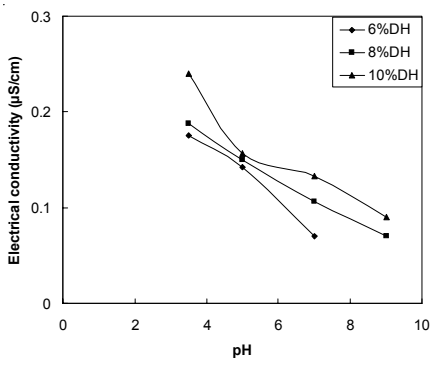

Fig. 2. Variation of foaming capacity of trypsin mediated sesame seed protein hydrolyzate at different degree of hydrolysis (DH) and at pH values

TABLE-1
VARIATION OF ELECTRICAL CONDUCTIVITY OF FOAMS OF TRYPSIN MEDIATED SESAME SEED PROTEIN HYDROLYZATES AT DIFFERENT DEGREE OF HYDROLYSIS AND pH VALUES

Degree of hydrolysis	Time (min)	Electrical conductivity (μS/cm)			
		pH 3.5	pH 5.0	pH 7.0	pH 9.0
6 %	0	0.176	0.142	0.070	-
	2	0.085	0.075	0.025	-
	4	0.054	0.065	0.019	-
	6	0.047	0.064	0.018	-
	8	0.046	0.063	0.017	-
	10	0.045	0.062	0.016	-
	12	0.044	0.062	0.015	-
	14	0.044	0.062	0.015	-
	16	0.044	-	0.015	-
	18	0.044	-	0.015	-
8 %	0	0.188	0.150	0.106	0.070
	2	0.125	0.080	0.090	0.039
	4	0.09	0.060	0.072	0.029
	6	0.085	0.057	0.071	0.024
	8	0.084	0.056	0.070	0.023
	10	0.083	0.055	0.069	0.023
	12	0.082	0.054	0.068	0.023
	14	0.082	0.054	0.068	0.023
	16	0.082	0.054	0.068	-
	18	0.082	0.054	0.068	-
10 %	0	0.240	0.157	0.133	0.090
	2	0.150	0.120	0.060	0.030
	4	0.135	0.100	0.030	0.012
	6	0.126	0.097	0.022	0.009
	8	0.121	0.097	0.021	0.008
	10	0.117	0.096	0.020	0.007
	12	0.115	0.095	0.020	0.007
	14	0.114	0.094	0.020	0.007
	16	0.114	0.094	0.020	-
	18	0.114	0.094	-	-
	20	0.114	-	-	-

Conclusion

The present study was initiated with the aim of recovering valuable proteins from cheap non-conventional protein sources which are as such unfit for human consumption and evaluate their functional properties for potential application as food additives. The methodology was based on enzymatic hydrolysis of protein sources to obtain protein hydrolyzates.

Trypsin has been found to be effective in improving the foaming properties of sesame seed protein hydrolyzates. The foaming activity of protein hydrolyzates has been found to be higher at lower pH values and decreases with increase in pH.

At given pH, the foaming capacity increased with increase in degree of hydrolysis from 6 to 10 %.

Electrical conductivity method has been found to be a simple and reliable method for evaluating the foaming properties of potential food additives such as proteins and protein hydrolyzates. Quantitative parameters such as foaming capacity and foam stability can be determined by electrical measurements.

Trypsin mediated sesame seed protein hydrolyzate have been found to have greater foaming capacity and hence these peptide fractions are potential food additives in the manufacturing of whipped toppings and icecreams.

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