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STUDIES ON THE PREPARATION, PROCESSING

AND PROPERTIES OF SOYMILKS

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ABSTRACT

The effect that presoaking of soybeans in solutions of various chemicals has on the reduction of "beany" flavour in soymilk was investigated. Of the chemicals used, sodium carbonate and sodium hydroxide had a significant effect. Sodium carbonate soaking at 0.4 M concentration for 18 - 24 hours was significantly better than any other presoak treatment. Soymilk prepared from carbonate presoaked beans contained more protein and had a higher viscosity than milks prepared from water or sodium hydroxide presoaked beans. Beans presoaked in carbonate were easier to process than beans presoaked in water or hydroxide. There was no significant difference in the amino acid pattern of the proteins in the soymilks prepared by the three methods. The activity of lipoxidase as a major source of "beany" flavour in soymilk has been questioned.

The rate of inactivation of trypsin inhibitors in soymilks prepared from carbonate presoaked beans was faster than that in the water presoaked preparation when heated to 98°C. This effect was primarily associated with the rise in pH that occurred in the soymilks from carbonate presoaked beans. The effect of alkaline pHs at 98°C on the inactivation of trypsin inhibitor was examined and it was found that the rate of inactivation was changed from zero order at pH 6.8 to first order kinetics at pH 9.9. This effect of pretreatment was not noticeable when both milks were processed at 115°C in sealed cans because of the constancy of pH under these conditions.

The influence of heat processing conditions on the enzymatic digestibility of proteins in both soymilks was also studied. The digestibility with trypsin increased with the degree of heat treatment up to the point where the trypsin inhibitor had been destroyed, after

which further heating resulted in lower digestibilities. The optimum heat processed soymilks prepared from carbonate presoaked beans gave higher digestibilities than those of the water presoaked preparations under the conditions used.

Pepsin digestion (at 0.125% of 1 : 2,500 pepsin) showed no appreciable differences between soymilks prepared by either presoaking procedures. The degree of digestibility with pepsin plus trypsin of the proteins in the optimum heat processed carbonate presoaked preparation was similar to the digestibility of acid precipitated freeze-dried casein under identical conditions.

The changes in viscosity during processing of soymilks prepared from carbonate presoaked beans was different from that of the water presoaked soymilk. Of the factors which affect the viscosity of soymilk during processing, denaturation, aggregation and hydration-dehydration processes probably play the most important roles. Nevertheless, the proteins in both soymilks were very stable under the processing conditions used.

About 0.1 percent of sodium chloride was formed in the carbonate presoaked preparation during neutralisation with hydrochloric acid. When this amount of sodium chloride was added to the water presoaked preparation either in the raw state or during heat treatment, the proteins became unstable. This effect could be eliminated if the addition of sodium chloride was made after even slight denaturation of the proteins. Addition of up to 0.25 percent of sodium chloride had no effect on the stability of proteins in the carbonate presoaked preparation. The instability of proteins in soymilks in presence of sodium chloride was considered to be primarily due to aggregation.

Soy milk that has been heat treated to destroy the trypsin inhibitor is difficult to concentrate because its viscosity increases exponentially with increase of solids content. This imposes a concentration limit of around 17 - 18 percent total solids due to the formation of a gel-like structure beyond this. The possible factors which contribute to this gel formation during concentration were investigated. A sulphhydryl-disulphide interchange reaction was mostly responsible for the increase in viscosity of the concentrate up to about 16 percent total solids but above this concentration other forces predominated. The possibility that gelation occurred through intermolecular cross-linkages by calcium ions was eliminated. Sodium sulphite and N-ethyl maleimide were effective in reducing this viscosity increase to some extent but when the concentrate was heat sterilised sodium sulphite ceased to have any effect on the viscosity and with N-ethyl maleimide the viscosity of the sterilised concentrate was about 50 percent of the unstabilised sample. Forewarming by heating to $115^{\circ}\text{C}/5$ min. caused an increase in viscosity during concentration but effectively stabilised the product against further increases in viscosity on sterilisation.

The effect of processing conditions on the nutritional quality of proteins in soymilks was studied using a number of in vitro methods. The results indicated that the nutritive values of the soymilks prepared from carbonate presoaked beans by three different processes (98°C for 40 minutes; 115°C for 18 minutes; preheated at 115°C for 5 minutes, concentrated to 15.5 percent solids content and then sterilised to a F_0 value of 5.5) were about the same and were better than that prepared from the water presoaked preparation processed at 115°C for 18 minutes. Methods of process

control and quality assessment of soymilk are discussed. Flow and mass balance sheets for the process developed have been presented.

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