1.0 ABSTRACT

Cereal malts are rich in enzymes and soluble materials, which could be used in food industry. Malting of different cereals in food and brewing industries is practiced. Rice is one among them. A local variety of rice called "Mottaikaruppan", which has not been studied before, was selected. The changes during the germination of dehusked rice and properties of the endogenous enzymes of the malted rice were studied in view of utilizing the malted rice in food industry.

Dehusked unpolished rice grains and paddy ("Mottaikaruppan" variety) were steeped in distilled water containing $0.1gl^{-1}$ $Na_2S_2O_5$ in a beaker for 12h and germinated in a moistened bag wetted with $0.15gl^{-1}$ $Na_2S_2O_5$ and kept in dark at 30°C for 6 days. Germination of dehusked unpolished rice (77.7%) was better than paddy (59.6%) at 5^{th} day. Addition of $0.1gl^{-1}$ gibberellic acid improved the malting of dehusked unpolished rice by 11.7% at 4^{th} day. Addition of Tween-80 (1.0ml/l) with gibberellic acid decreased the malting. Appreciable drop in starch (7.2%) and total protein (16.5%) contents were observed on 3^{rd} and 6^{th} day of germination respectively. Increase in reducing sugar, total sugar and soluble protein contents were observed during germination. Increase in malt amylase (39.96 to $155.34Ug^{-1}$ dry matter) and malt protease (0.008 to $0.026Ug^{-1}$ dry matter) activities were observed from the 2^{nd} day of germination. Based on these studies, germination of the dehusked unpolished rice grains was arrested on the 4^{th} day, dried at 35°C to a constant weight and powdered at room temperature in a domestic grinder. This powder of malted rice was used for further studies carried out on the extraction and separation of soluble proteins & sugars and characterization of malt enzymes.

Soluble protein was best extracted with 0.01M phosphate buffer (pH 7.0) – $10gl^{-1}$ NaCl, and this was not better than distilled water for sugar extraction. Extraction of sugars with 0.01M phosphate buffer (pH 7.0) – $10gl^{-1}$ NaCl improved with increasing temperature, but the soluble protein extraction was affected above 80°C due to thermal denaturation of proteins. Hot centrifugation of the extract showed positive effect on the extraction of soluble proteins in the temperature range of 50-70°C, while no influence on sugar extraction.

The rice supernatant contained one type of glucose polymer and four types of soluble proteins, while the supernatant of rice malted for 4 days contained two additional glucose polymers and one additional soluble protein or peptone or combination of both. These results confirmed the presence of endo-enzymes and their action on the reserve macromolecules such as starch and proteins to produce low molecular weight substances to be utilized for germination.

Among the extractants used to extract amylases and proteases from malted rice powder, $10gl^{-1}$ NaCl and 0.03M phosphate buffer (pH 7.5) were the best for the extraction of malt amylase and protease respectively. The optimum pH and temperature for the activities of malt amylase and protease were 5.0 & 7.2 and 60 & 50°C respectively. Under optimized conditions, the malt amylase and protease showed zero order kinetics for 25 and 165 minutes, respectively. The Km and Vmax of the malt amylase and protease were $4.5gl^{-1}$ (Soluble starch) & $2.5gl^{-1}$ (Casein) and 127.78 & $0.0882Ug^{-1}$ dry matter, respectively. Addition of $0.1gl^{-1}$ $CaCl_2$ to the 0.01M acetate buffer (pH 5.0), enhanced the malt amylase activity. Malt amylase was stable at 4°C, 30°C and 50°C for 3 days with the enzyme activity of 84.39, 84.39 and 51.57% respectively. The enzyme stored at 60°C and 70°C lost the total activity on 2nd and 1st days respectively. Suitable pH for the storage of rice malt amylase is pH 5.5 at all the temperatures studied. Presence of calcium ions enhanced the thermostability of the rice malt amylase.

Optimum pH and temperature for simultaneous extraction of malt amylase and protease were pH 7.4 and 50°C respectively. Incorporation of Triton X-100 (0.1%, v/v) improved extraction of amylase and protease by 11.5 and 1.8% respectively. Malt amylases of rice were stable over a wide range of pH (pH 4.0-8.0). Rice malt proteases retained more than 90.0% of their activity at pH 4.0 and 7.5. The malted rice supernatant contained α-amylase and amyloglucosidase and showed no naringinase like activity.

Presence of enzymes and increased amount of low molecular weight soluble substances of cereal malts are the important indicators for their nutritional value and utilization in the food and brewing industries.