ABSTRACT

Adjuncts are an additional source of carbohydrate extract used to partially replace or supplement the malt in beer. They are also used to reduce the overall material costs and to utilize indigenous sources. Rice (*Oryza sativum*) is widely used as an adjunct in the world for the production of alcoholic beverages such as beer. The ratio of malt to adjunct must fall within an acceptable range. Each brewer according to the quality specifications for the final beer and the cost estimation sets adjunct ratios. Thus the major objective of this project was to increase the rice usage in beer as an adjunct.

Alpha amylase and Beta amylase are the main two enzymes involved in brewing. Alpha amylase is more thermo stable than Beta amylase. Alpha amylase cleaves starch randomly except near ends of branch points while Beta amylase cuts off maltose from non-reducing ends of molecules. Alpha amylase mainly produces dextrin molecules and Beta amylase produces Beta maltose which is the major sugar in wort. It is considered that additional Beta amylase enzymes are in malt. This additional enzyme amount can be used for saccharification of other carbohydrate sources in mashing where the ground malt and the solid adjuncts (grist) are mixed with water at a set temperature and with a set volume of liquor (water) to produce wort.

The first approach was to identify the optimum ratio of malt and rice for saccharification. More than 50% rice amount can be saccharified by additional Beta amylase enzymes in malt, For Lion Larger it is used about 29.2 % rice and 70.2% malt amount as weight basis. That usage was increased up to 40% with keeping the quality of it. For that three different larger samples were prepared by changing the rice, malt and water amount of the original recipe. The amount of extract was calculated according to the IBD (Institute of Brewing & Distillation) method. The existing recipe was changed by gradually increasing the rice usage step by step. The rice usage starting from 30% and gradually increased by 35% and finally up to 40%.This was done in the commercial scale while the Lion Larger quality limits were maintained at all the stages of the beer production. Then beer samples were organoleptically analyzed by the well trained sensory panel. The Triangular test was done to identify the differences. Beer samples were scored for overall acceptability on 9-point hedonic scale using 12 well trained panels, where 4 samples were presented in 1 session in a well prepared sensory room. Data was statistically analyzed with Freidman test using MINITAB statistical analysis package (version 14.1).

According to that aroma and colour gave significant difference when comparing with other beer samples. About sixty thousand rupees cost saving could be achieved by this project for each batch of the beer annually that is about 7.2 millions rupees of cost saving.