EXECUTIVE SUMMARY AND CONCLUSION

Major objective of this work was to extend the shelf life of ready to cook idli batter using modified atmosphere packaging and the sub-objectives were

1. To understand the presently followed practices for the preparation of idli.
2. To optimize the process of preparation of the product with respect to ingredient ratios and fermentation time.
3. To improve the shelf-life of ready to cook idli batter by optimized process.

First chapter was conceptualized with an objective to understand the presently followed practices for the preparation of idli. A survey based study was conducted in eight regions through an oral interview scheduled which covered a sample size of 300. The results of the survey indicated that at house hold level 68% of the selected population preferred parboiled rice. Only 34 per cent used decorticated black gram whereas 49 per cent used black gram with husk removed after soaking. Majority (99.7%) of the respondents used 3:1 ratio of rice and black gram dhal for preparing idli. Fermentation time varied between 5 h to 12 h at the selected households. Majority (71.3%) of them fermented the idli batter for 11 to 12 h and 73% stored the idli batter in refrigerated condition. The results were similar to the practices reported in literature such as variety of rice, type of black gram, ratio of ingredients used for idli making, fermentation time and shelf–life of the batter.

Chapter 3 was aimed to optimize the process of preparation of the product with respect to ingredient ratios and fermentation time based on the instrumental texture profile of the idli using response surface methodology. Before framing the design using Central Composite Rotatable Design, preliminary trails were conducted to choose the best suited rice, variation of black gram and ratios of rice and black gram dhal. Five differently processed rice and ADT3 variety dhal were used for the preliminary study. Results of the preliminary study showed that IR20 parboiled rice and ADT3 variety black gram dhal with husk removed after soaking were best suited for idli making. The rice and black gram dhal were mixed at different ratios as per the CCRD. The independent parameters for this study were ratios of rice to black gram dhal and fermentation time. The dependent
parameters were the texture attributes namely hardness, adhesiveness, springiness, cohesiveness, chewiness and resilience.

The results obtained were subjected to regression analysis and ANOVA. Based on the results certain constraints were imposed on the dependent parameters to get idli with better texture properties and the predicted values were obtained for the dependent parameters.

From the study it was concluded that the optimum ratio of rice to black gram dhal is 3:1.575 with an optimum fermentation time of 14 h where a desirable value of 0.8279 will be obtained for the product. The results were validated by preparing idli at the optimized conditions. The results prove the designed model to be valid.

Chapter 4 focused on the objective to identify the optimum ratios of ingredients and fermentation time with respect to sensory attributes using Response Surface Methodology (RSM). The desirable sensory attributes were colour, fluffiness, sponginess and fermented aroma. The undesirable parameters were compactness, stickiness, firmness and sourness. The idli were prepared according to the framed design. The semi-trained panel members evaluated the idli using a 15mm rating scale. Data were analyzed using RSM and constraints were imposed on the experimental results as in Chapter 3. On sensory analysis followed by RSM analysis of idli prepared from various combinations of ingredients fermented at different duration up to 14 h, rice and dhal combination of 3:1.475 fermented to 10.2 h was found to be the best accepted product.

Principal Component Analysis was done to find the interrelationship between the sensory attributes of the idli. The PCA analysis revealed that PC1 and PC2 accounted for 78% of the total variance in the data matrix. It was clear that sensory attributes like sponginess and fluffiness associated with each other strongly on the positive side of the PC1 axis while firmness, compactness, stickiness were clustered together on the negative side of the PC1 axis. The third cluster is formed by fermented aroma and sourness on the positive side of PC2 axis. Sample from the experimental design point 6 was closely associated with desirable sensory attributes like sponginess and fluffiness followed by sourness and fermented aroma. On the other hand, design points 5, 1 and 2 were closely correlated with undesirable sensory attributes like firmness, compactness and stickiness.
Chapter 5 dealt with the chemical components of nutritional importance in the optimized product. The final product was low in fat indicating the break down into fatty acids during fermentation. Analysis of fatty acid profile and oligosaccharide profile was done using LCMS. The fatty acids namely Decanoic acid, Octadecanoic acid and Hexadecanoic acid were of high relative abundance in idli compared to unfermented batter. Regarding the oligosaccharide profile, the sugars namely trehalose, maltose, melezitose, maltotriose, maltotetrose and maltopentose were formed during fermentation. Results showed that the process of fermentation has led to the increase in nutrient content of the idli.

Chapter 6 aimed to improve the shelf-life of the batter using modified atmosphere packaging. Respiration dynamics was studied out to find the percentage of oxygen utilized and percentage of carbon dioxide released during fermentation of batter. Three packaging materials namely low density poly ethylene (LDPE), Poly propylene (PP), High Molecular (HM) of varying thickness were used for packing the idli batter. Twenty three gas combinations were used for MAP. The MAP packaged batter was stored at 30°C and analyzed for gas mixture followed by texture and sensory analysis of the product during the storage period. The results of the respiration dynamics of the idli batter showed that the batter consumed 7% of O₂ and evolved 12.6- 13% CO₂ at 12.02 h fermentation time. From this study it can be concluded that RTC idli batter packaged in medium thickness LDPE flushed with 0% CO2 and 7.5 to 15% O2 could increase the shelf-life up to seven fold increase without compromising the sensory qualities at 30°C.
Practical implications / Recommendations

Based on the results and interpretations of this work following recommendations can be made to further improve the commercial prospects of ready to cook idli batter.

1. A detailed survey on the consumer perception and acceptance as well as problems associated with the currently available packaged ready to cook idli batter should be done to estimate the true potential of commercial ready to cook idli batter.
2. Detailed study on shelf-life of Modified atmosphere packaged batter under refrigerated conditions should be done.
3. In-depth instrumental analysis of flavour and aroma compounds needs to be done.