

## CHAPTER 6

### SUMMARY AND CONCLUSION

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The Indian food and beverage industry has witnessed drastic changes in recent years. Healthier product alternatives, including beverages specifically designed to provide energy, nutrition and health to the human body, are becoming top priority. The desire for health and concern for ill-health has driven consumers towards these beverages. Healthier product alternatives, including beverages specifically designed to provide energy, nutrition and health to the human body, are among becoming top priority.

Fermented products which are becoming extinct can be reinvented by applying modern technologies for mass production to meet the consumers rising demand for healthy beverages. Present day consumers prefer foods that promote good health and prevent disease. Furthermore, these foods must fit into current lifestyles providing convenience of use, good flavor, and an acceptable price value ratio. Such foods constitute current and future waves in the evolution of the food development cycle. Development and marketing of this fermented beverage will not only conserve the traditional fermented beverage but will also be a ready to consume probiotic product for the consumers readily available in the markets.

The current research study is related to a fermented product development aims to combine the potential health benefits of the good bacteria with their ability to grow in with cereals, resulting in a nutritionally healthy and desirable product for the consumers. Ambil is an indigenous natural cereal based lactic fermented beverage traditionally from Maharashtra. So far the process of its preparation remains a household art, which may lead to wide variation in its final quality and short shelf life. No work of scientific significance has been reported in literature, on its probiotic properties, nutritional value, shelf life and packaging, acceptability and feasibility of its modification in terms of base ingredients and flavors. With this background, the present study was

planned with the aim of utilizing cereal grains and millets namely rice, barley, pearl millet, finger millet and buttermilk to develop a dairy based fermented drink with traditional and modern food flavors.

Thus, the present study was undertaken with 4 major objectives: (i) To access the acceptability of FOS added ambils in terms of various organoleptic attributes and overall acceptability using composite score; (ii) To evaluate the probiotic profile of buttermilk and modified ambils; (iii) To determine the physicochemical properties, nutritional composition of buttermilk and ambils and shelf life of fresh and packaged ambils; and (iv) To study the consumer acceptability of packaged ambil and its market potential.

*In Phase I of the study*, four FOS added cereal-millet based ambils namely rice ambil, pearl millet ambil, barley ambil and finger millet ambil using four different flavours viz rose, khus, chocolate and salt cumin were studied for their organoleptic acceptability using composite score by a panel of 25 semi trained panel members. Amongst all the cereal-millet based ambils, rice ambil was most acceptable by panel members. Salt-cumin flavour had the highest acceptability amongst all the cereal-millet based ambils, rice ambil (18.17), barley ambil (17.51), pearl millet ambil (17.49) and finger millet ambil (17.19). Among all the ambils, the consistency score reduced for barley, pearl millet and finger millet ambils as compared to rice ambil. All the sensory attributes decreased for pearl millet and finger millet ambils as compared to rice and barley ambils. Color, consistency, taste and overall acceptability of finger millet ambils was least acceptable amongst all the ambils. Rose color scored significantly ( $p < 0.01$ ) higher in rice and pearl millet ambils. Salt cumin flavour could mask the smaller changes seen in organoleptic properties of all the cereal ambils prepared with different flavours. All the ambils prepared from different cereals and flavours had an overall acceptability score of more than 75%. The overall acceptability scores for rice ambil was highest

amongst all and scored 88% scores. Addition of 5% FOS as a prebiotic to ambils did not alter the taste of all the ambils with different flavours.

Thus it can be concluded that, all the cereal-millet based ambils with different flavors have shown good acceptability in terms of various organoleptic attributes and salt cumin ambil was the most preferred followed by rose flavor. Amongst the various FOS added cereal and millet based ambils, rice and barley ambils were the most preferred ones and there was no significant difference in the OA scores of all the ambils. Indigenous pulses, other cereals and flavours can be used to provide a wider variety, enhancing the nutritional value and further study its organoleptic qualities and shelf stability.

*In Phase II of the study*, the probiotic profiling of buttermilk and all fresh ambils was done. The samples were diluted and subjected to DNA isolation, PCR and gel electrophoresis. Sequence analysis of the PCR products was done to match and identify the *Lactobacillus* and *Bifidobacterium* strains. Results of this phase of the study revealed that, Probiotic microorganisms *Lactobacillus* and *Bifidobacterium* were present in all fresh ambils. Predominant species isolated from Genus *Lactobacillus* were *Lactobacillus acidophilus*, *Lactobacillus reuteri*, *Lactobacillus casei* and *Lactobacillus paracasei*. Predominant species isolated from Genus *Bifidobacterium* were *Bifidobacterium bifidum*, *Bifidobacterium animalis*, *Bifidobacterium adolescentis*. Probiotic bacteria from the ambils were isolated and studied upto the strain level, *Lactobacillus acidophilus* was the most predominant bacteria with 100% indent ratio. Predominant *Lactobacillus* strain present in buttermilk and all the ambils with 100% homology was *Lactobacillus acidophilus* strain JCM 1132. Predominant strains isolated from buttermilk were *Bifidobacterium pseudocatenulatum* strain B1279 and *Bifidobacterium catenulatum* strain DSM 16992 and with 99% homology. Predominant strains isolated from rice ambil were *Bifidobacterium stercoris* strain Eg1, *Bifidobacterium faecale* strain CU3-7 and *Bifidobacterium adolescentis* strain ATCC 15703 with

99% homology. Predominant strains isolated from pearl millet ambil were *Bifidobacterium bifidum* NBRC 100015, DSM 20456, KCTC 3202 with 99% homology. Predominant strains isolated from barley ambil were *Bifidobacterium stercoris* strain Eg1 and *Bifidobacterium adolescentis* strain ATCC 15703 with 99% homology. Predominant strains isolated from finger millet ambil were *Bifidobacterium animalis* strain YIT 4121 with 99% homology.

Some of the LAB reported in these fermented foods are demonstrated to confer a beneficial effect to the host, in another sense they possess probiotic properties. Thus, Ambils can be considered as probiotic beverage as it contains species of *Lactobacillus* and *Bifidobacterium* thus can be considered as a therapeutic beverage because of the many health beneficial probiotic bacteria present. There is an abundant opportunity available for food microbiologists to explore the Indian fermented foods for the isolation of new LAB strains for their potential role in probiotic research.

*In Phase III of the study*, rice ambil was packaged in 200ml tetrapacks using UHT at 132°C for 3 seconds and studied for its physicochemical properties and nutritional composition along with all the fresh ambils. Shelf life stability was studied for 5 days for fresh ambils and 6 months for packaged rice ambil for their organoleptic evaluation, physicochemical properties and microbial changes. pH of buttermilk was 4.2, and amongst the various cereal- millet based ambils it was highest in barley ambil (4.68) followed by pearl millet (4.58) and rice ambil (4.56) with no significant difference. A significant difference ( $p < 0.000$ ) was found amongst all the ambils, rice ambil (23.3 mPa.s @20°) was highest as compared to others, followed by barley ambil (22.9 mPa.s @20°). Significant difference in protein content was found between all the ambils, pearl millet ambil (1.22g) and barley ambil (1.22g) having the highest. Carbohydrate content and total calories was determined, rice ambil had the highest CHO (6.4g) content and pearl millet ambil having highest calories (3.5kcal). Total fat (0.9g), saturated fat (0.2g) and MUFA (0.17g) content was highest in finger millet ambil. Folic acid and B vitamins were seen highest in pearl millet and barley ambils. Vitamin A content was highest in finger millet ambil (53 IU), and least in rice ambil (43

IU). Sodium (329 mg) and potassium (123mg) were found highest in barley ambil, magnesium (25.2mg) and phosphorus (35mg) highest in pearl millet ambils. Nutrient losses occurred during the UHT treatment in Vitamin B3 (-0.44%), folic acid (-0.04%), sodium (-0.27%) and potassium (-0.45%). Moisture content also reduced (-0.01%). Significant difference was observed in the shelf life of rice ambil (5.9) at the end of day 5, but still the product was graded fairly acceptable by the panel. Finger millet ambil stayed good for 2 days and gradually the acceptability scores reduced significantly after that. Microbial content also increased significantly over the period of 5 days but it was under the spoilage limits for all ambils.

Thus, it can be concluded that packaged rice ambil is a low calorie and low fat beverage with moderate calcium. Negligible nutrient losses occurred during UHT treatment of rice ambil. Shelf life of all refrigerated fresh ambils was 3 days in terms of taste and overall acceptability. Shelf life of packaged ambil was upto 6 months. Finger millet ambil stayed good for 2 days and gradually the acceptability scores reduced significantly after that. Microbial content also increased significantly over the period of 5 days but it was under the spoilage limits for all ambils.

*In Phase IV of the study*, the frequency of consumption of health beverages and consumer acceptability of packaged rice ambil was studied using hedonic scale. Market potential was studied using a feedback form. Results depicted that frequency of consumption of curd/ buttermilk (95.2%) and fruit juices (93.3%) was observed highest in subjects of age 40-59 years. Frequency of consumption of probiotic beverages available commercially was observed highest (52.6%) in the age group of 10-19 years. Consumer acceptability was found highest in the age group of elderlies (98%) followed by 40-59 years (95%) of age. 91% consumers gave the rating >7 which indicates positive acceptability of packaged rice ambil across all age groups. Market potential was studied in terms of idea and need of the product, expected cost, desirable flavours and package size of packaged rice ambil. Results revealed that 94% of the consumers were willing to purchase the drink if available commercially in market. Preferred price range was found to be between Rs. 10-15 as

suggested by 40-45% of the consumers. However, some consumers (39%) were even willing to pay in the price range of Rs. 15-20 and even more as well as were willing to recommend it to other people as well.

Results mentioned above concludes that packaged rice ambil had a good acceptability amongst all the age groups and has a good market potential. Data from the consumer acceptability trials also depicted that likability of the ambil increases significantly with age. Major factors affecting consumer purchase behaviour are taste and nutrition followed by price, brand and appearance.

Thus to sum up, it can be said that, all the cereal-millet based ambils with different flavors have shown good acceptability, fresh ambils can be considered as probiotic beverage as it contains strains of species of *Lactobacillus* and *Bifidobacterium* thus can be recommended for use as a therapeutic beverage in various disease conditions. Packaged rice ambil is a low calorie and low fat beverage with moderate calcium. Negligible nutrient losses occurred during UHT treatment of rice ambil. Shelf life of all refrigerated fresh ambils was 3 days in terms of taste and overall acceptability, except finger millet ambil (2 days). Shelf life of packaged ambil was upto 6 months. Packaged rice ambil had a good acceptability amongst all the age groups and has a good market potential.