List of Figures

Fig No.	Title	Page No.
	Chapter 2	
Fig 2.1	Flow gradient used in the analysis of amino acids by HPLC. (A) acetate buffer: acetonitrile (9:1) and (B) acetate buffer : acetonitrile (1:9)	7
Fig 2.2	A thap	12
Fig 2.3	Sujen served on a brass cup	13
Fig 2.4	A perok kushi	13
Fig 2.5	A kula	13
Fig 2.6	A Deori woman filtering sujen	13
Fig 2.7	A vekur pitha	14
Fig 2.8	An Ahom woman filtering xaj pani	14
Fig 2.9	An apop pitha	15
Fig 2.10	A kiling before fumigation	15
Fig 2.11	Fermentation in a killing	16
Fig 2.12	A Mising woman filtering <i>apong</i>	16
Fig 2.13	An <i>ankur</i>	17
Fig 2.14	A humao	18
Fig 2.15	A Dimasa woman serving judima	18
Fig 2.16	Zutho after fermentation	19
Fig 2.17	Zutho served in bamboo mugs	19
Fig 2.18	A siiyeh	20
Fig 2.19	An Adi-Galo woman filtering opo	20
	Chapter 3	
Fig 3.1	FTIR spectra of the four different extracts of <i>A. heterophyllus</i> (AH) (Hex: Hexane; EA: Ethyl acetate; MeOH: Methanol; H20: Water)	24
Fig 3.2	FTIR spectra of the four different extracts of <i>C. extensa</i> (CE) (Hex: Hexane; EA: Ethyl acetate; MeOH: Methanol; H20: Water)	25
Fig 3.3	FTIR spectra of the four different extracts of O. <i>corymbosa</i> (OC) (Hex: Hexane; EA: Ethyl acetate; MeOH: Methanol; H20: Water)	25
Fig 3.4	FTIR spectra of the four different extracts of <i>A. malaccensis</i> (AM) (Hex: Hexane; EA: Ethyl acetate; MeOH: Methanol; H20: Water)	26
Fig. 3.5	HPLC chromatograms of the PPE for detection of phenolic compounds (AH: A. <i>heterophyllus</i> ; CE: C. <i>extensa</i> ; OC: O. <i>corymbosa</i> ; AM: A. <i>malaccensis</i>)	35
Fig. 3.6	(a) DPPH free radical scavenging activity assay of the PPE; (b) ABTS radical cation decolourisation assay of the PPE; (c) Hydroxyl radical scavenging assay of the PPE; (d) Hydrogen peroxide scavenging activity assay of the PPE. The results are means \pm SD (n=3); (AH: A. <i>heterophyllus</i> ; CE: <i>C. extensa</i> ; OC: <i>O. corymbosa</i> ; AM: <i>A. malaccensis</i>)	39

Fig 3.7	(a) Superoxide anion scavenging activity assay of the PPE; (b) Nitric	41
0	oxide scavenging activity assay of the PPE; (c) Ferrous-ion chelating assay of the PPE; (d) Ferric reducing antioxidant power assay of the	
	PPE. The results are means \pm SD (n=3); (AH: A. <i>heterophyllus</i> ; CE: C.	
Fig 3.8	<i>extensa</i> ; OC: <i>O. corymbosa</i> ; AM: <i>A. malaccensis</i>) HPLC chromatograms of the two plants' bioflavonoid extracts. The	48
118 3.0	detected compounds are 1. epigallocatechin, 2. catechin, 3. epicatechin, 4. epigallocatechingallate, 5. myricetin, 6. naringenin, 7. kaempferol, 8.	40
Fig 3.9	luteolin, 9. quercetin 10. apigenin Change in pH of the beers (n=3) during storage	52
Fig 3.10	Change in total phenolic content (TPC) of the beers $(n=3)$ during	53
- 15 3.10	storage	55
Fig 3.11	Change in radical scavenging activity (RSA) of the beers (n=3) during storage	54
Fig 3.12	Change in protein content of the beers (n=3) during storage	55
Fig 3.13	Change in colour (ΔE) of the beers (n=3) during storage	56
Fig 3.14	a. Effect of time and temperature on the: a. total phenolic content (TPC), b. radical scavenging activity (RAS), c. antibacterial activity (ABA) and d. antifungal activity (AFA) of the hexane (Hex) extracts	63
Fig 3.15	a. Effect of time and temperature on the: a. total phenolic content (TPC), b. radical scavenging activity (RAS), c. antibacterial activity (ABA) and d. antifungal activity (AFA) of the ethyl acetate (EA) extracts	64
Fig 3.16	a. Effect of time and temperature on the: a. total phenolic content (TPC), b. radical scavenging activity (RAS), c. antibacterial activity (ABA) and d. antifungal activity (AFA) of the methanolic (MeOH) extracts	65
Fig 3.17	a. Effect of time and temperature on the: a. total phenolic content (TPC), b. radical scavenging activity (RAS), c. antibacterial activity (ABA) and d. antifungal activity (AFA) of the aqueous (H2O) extracts	66
	Chapter 4	
Fig 4.1	The starter cake samples (i) Amou (ii) Perok-kushi and isolates (iii) <i>Amylomyces rouxii</i> TU460 (iv) <i>Rhizopus oryzae</i> TU465	27
Fig 4.2	Phylogenetic tree based on the ITS region gene sequence showing the evolutionary relationship between <i>Amylomyces rouxii</i> TU460 and <i>Rhizopus oryzae</i> TU465, and three other related species (<i>Amylomyces rouxii</i> CBS 438.76, <i>Rhizopus oryzae</i> 8-3M and <i>Aspergillus oryzae</i> YI- A6) whose ITS gene sequences were obtained from the NCBI database. The bar at the bottom of the figure represents the length of branch that	29
	represents an amount genetic change of 0.10	
Fig 4.3	SDS- PAGE of the two purified extracellular enzymes produced. Lane 1: 14-95 kDa protein marker, Lane 2: <i>Amylomyces rouxii</i> TU460 and	32
Fig 4.4	Lane 3: <i>Rhizopus oryzae</i> TU465 Iodine stained SDS-PAGE gels (with 1% starch) of the two enzymes after electrophoresis; (a) <i>Amylomyces rouxii</i> TU460 and (b) <i>Rhizopus</i>	32

	oryzae TU465	
Fig 4.5	LC chromatograms of the culture supernatants for the detection of	34
C	mycotoxins (i) Amylomyces rouxii TU460 (ii) Rhizopus oryzae TU465	
	(iii) Fusarium oxysporum MTCC 1755	
Fig 4.6	Microscopic view (100x) of the yeast strains	39
Fig 4.7	Molecular Phylogenetic analysis of the isolated and reference strains	42
C	based on the sequence of ITS region by maximum likelihood method	
Fig 4.8	Change in pH of the growth media with time	53
Fig 4.9	Change in total sugars content of the growth media with time	54
Fig 4.10	Change in alcohol content of the growth media with time	55
Fig 4.11	GC chromatograms for the detection of volatile organic compounds by	57
C	the yeasr strains. (i) S. cerevisiae TU4 (ii) S. cerevisiae TU7 (iii) S.	
	cerevisiae TU71 (iv) S. cerevisiae TU45 (v) S. cerevisiae TU46 (vi) S.	
	cerevisiae TU63 (vii) W. anomalus TU122 (viii) S. cerevisiae TU74	
Fig 4.12	Phylogenetic tree of the LAB strains obtained by molecular	61
-	phylogenetic analysis through maximum likelihood method	
Fig 4.13	Phylogenetic tree of the LAB strains obtained by molecular	62
-	phylogenetic analysis through maximum likelihood method	
Fig 4.14	Phylogenetic tree of the LAB strains obtained by molecular	62
-	phylogenetic analysis through maximum likelihood method	
Fig 4.15	Adherence of L. casei TEZU309 to CaCo-2 cells	80
Fig 4.16	Adherence of L. casei TEZU309 - Li to CaCo-2 cells	80
Fig 4.17	Adherence of L. casei TEZU374 to CaCo-2 cells	80
Fig 4.18	Adherence of L. casei TEZU374-Li to CaCo-2 cells	80
Fig 4.19	TEM image of <i>L. casei</i> TEZU309 cells	81
Fig 4.20	TEM image of <i>L. casei</i> TEZU374 cells	81
Fig 4.21	SDS-PAGE gel of the surface associated proteins. A – Protein marker,	82
	B – L. casei TEZU309, C - L. casei TEZU309 – Li, D- L. casei	
	TEZU374, E - <i>L. casei</i> TEZU374 - Li	
Fig. 4.23	HPLC chromatograms showing the production of different organic	83
	acids by utilization of D-glucose	
Fig. 4.24	HPLC chromatograms showing the production of different organic	85
	acids by utilization of maltose	
Fig. 4.25	HPLC chromatograms showing the production of different organic	87
	acids by utilization of lactose	
	Chapter 5	
Fig 1.1	The three basic substrates used for preparation of beer	4
Fig 5.3	Flow chart of the methodology followed for preparation of beer for one	10
	flask. Same methodology was followed for all the sets of beers (10	
F: 7 4	flasks per beer and 50 flasks in total)	10
Fig 5.4	The five different varieties of beer prepared in the laboratory	10
Fig 5.5	Triangular membership function for fuzzy analysis	13
Fig 5.6	Standard fuzzy scale	16
Fig 5.7	Graphical representation of triplet (a,b,c) and its membership function	18
Fig 5.8	The effect of time and temperature on protein content (%)	24
Fig 5.9	The effect of time and temperature on alcohol content (%)	25

$E_{12} = 5 \cdot 10$	The effect of time and temperature on L plantamen count (log CEU	26
Fig 5.10	The effect of time and temperature on <i>L. plantarum</i> count (log CFU ml-1)	26
Fig 5.11	The effect of time and temperature on TPC (mg/100g)	27
Fig 5.12	The effect of time and temperature on RSC (%)	28
Fig 5.13	The effect of time and temperature on titratable acidity (%)	20 29
115 5.15	Chapter 6	2)
Fig 6.1	(i) Treatment of drugs to the rats using feeding needle (ii) induction of	11
e	colitis in rats by intraperitoneal injection of lipopolysaccharides	
Fig 6.2	The reaction for the production of SAPE	16
Fig 6.3	13C NMR of the synthesized SAPE molecule	17
Fig 6.4	1H NMR of the synthesized SAPE molecule	17
Fig 6.5	FTIR plot of the synthesized SAPE molecule	18
Fig 6.6	The 3D structure of SAPE molecule	18
Fig 6.7	CNS activity of SAPE	22
Fig 6.8	Predicted binding cavity of the COX-2 (PDB ID: 4PH9)	23
Fig 6.9	Structure of (a) Ibuprofen (b) Indometacin	23
Fig 6.10	(A) Protein-ligand interactions between SAPE and active site residues	25
	of COX-2 enzyme. (B) Binding mode of SAPE at the active site	
	residues of COX-2 enzyme	
Fig 6.11	(A) Protein-ligand interactions between Ibuprofen and active site	25
	residues of COX-2 enzyme. (B) Binding mode of Ibuprofen at the	
	active site residues of COX-2 enzyme	
Fig 6.12	(A) Protein-ligand interactions between Indometacin and active site	26
8	residues of COX2 enzyme. (B) Binding mode of Indometacin at the	
	active site residues of COX-2 enzyme	
Fig 6.13	(A) Energy map of COX-2 interacting with SAPE depicting steric	27
8	interaction favourable (green), hydrogen acceptor favourable (turquoise	
	colour), hydrogen donor favourable (yellow colour) and electrostatic	
	favourable (blue and red colour) regions. (B) Electrostatic interaction	
	of SAPE at the enzyme active site indicating electronegative (blue) and	
	electropositive regions (red).	
Fig 6.14	(A) Energy map of COX-2 interacting with Ibuprofen depicting steric	27
8	interaction favourable (green), hydrogen acceptor favourable (turquoise	
	colour), hydrogen donor favourable (yellow colour) and electrostatic	
	favourable (blue and red colour) regions. (B) Electrostatic interaction	
	of Ibuprofen at the enzyme active site indicating electronegative (blue)	
	and electropositive regions (red).	
Fig 6.15	(A) Energy map of COX-2 interacting with Indometacin depicting	27
8	steric interaction favourable (green), hydrogen acceptor favourable	
	(turquoise colour), hydrogen donor favourable (yellow colour) and	
	electrostatic favourable (blue and red colour) regions. (B) Electrostatic	
	interaction of Indometacin at the enzyme active site indicating	
	electronegative (blue) and electropositive regions (red).	
$\Gamma' \subset 1 \subset$	MD simulation showing the RMSD plot of the docked protein ligand	28
F1g 6.16		
Fig 6.16	complex showing that SAPE-COX-2 is more stable than the ibuprofen	

Fig 6.17	Photograph of membrane stability assay in erythrocytes with PBS, Triter X and different concentrations (25, 50 and 100 up/ml) of SAPE	29
$Eig \in 19$	Triton X and different concentrations (25, 50 and 100 μ g/ml) of SAPE	30
Fig 6.18 Fig 6.19	Membrane stability assay of SAPE in erythrocytes Results of MTT assay of SAPE in PBMC	30 30
0	•	30 31
Fig 6.20	Treatment of HepG-2 cells with different concentrations (control, 25, 50, 100 and 200 μ g/ml) of SAPE	51
Fig 6.21	Results of MTT assay of SAPE in HepG-2 cells	31
Fig 6.22	Treatment of CaCo-2 cells with different concentrations (control, 25,	32
1.18 0.22	50, 100 and 200 μ g/ml) of SAPE	02
Fig 6.23	Results of MTT assay of SAPE in CaCo-2 cells	32
Fig 6.24	Results of Alamar Blue® assay of SAPE in CaCo-2 cells	33
Fig 6.25	Change in body weight of the different groups of rats (RG-CF: control without any treatment; RG-SP: treated with SAPE; RG-IM: treated with indometacin) until the day of induction of colitis	34
Fig 6.26	Excised intestines of the different groups of rats after treatment and euthanization (RG-CF: colitis free control group without any treatment; RG-CI: colitis induced group without any treatment; RG-SP: colitis induced group treated with SAPE)	35
Fig 6.27	SEM image of the intestinal section from RG-CF (colitis free control	36
	group without any treatment) rats	
Fig 6.28	SEM image of the intestinal section of RG-CI (colitis induced group without any treatment) rats	37
Fig 6.29	SEM image of the intestinal section of RG-SP (colitis induced group treated with SAPE) rats	38
Fig 6.30	SEM image of the intestinal section of RG-IM (colitis induced group treated with indometacin) rats	39
Fig 6.31	Results for assay of malondialdehyde (MDA) content in the intestinal tissue extract for different treatment groups of rats (RG-CI: colitis induced group without any treatment; RGCF: colitis free control group without any treatment; RG-SP: colitis induced group treated with SAPE; Group RG-IM: colitis induced group treated with indometacin)	41
Fig 6.32	Results for assay of catalase (CAT) concentration in the intestinal tissue extract for different treatment groups of rats (RG-CI: colitis induced group without any treatment; RGCF: colitis free control group without any treatment; RG-SP: colitis induced group treated with SAPE; Group RG-IM: colitis induced group treated with indometacin)	42
Fig 6.33	Results for assay of γ -glutamyltransferase (GGT) activity in the intestinal tissue extract for different treatment groups of rats (RG-CI: colitis induced group without any treatment; RG-CF: colitis free control group without any treatment; RG-SP: colitis induced group treated with SAPE; Group RG-IM: colitis induced group treated with indometacin)	43

Fig 6.34	Results for assay of glutathione S-transferase (GST) activity in the	44
115 0.01	intestinal tissue extract for different treatment groups of rats (RG-CI: colitis induced group without any treatment; RG-CF: colitis induced group treated with SAPE; Group RG-IM: colitis induced group treated with indometacin)	
Fig 6.35	Results for assay of interleukin 6 (IL-6) content in the intestinal tissue	
	extract for different treatment groups of rats (RG-CI: colitis induced group without any treatment; RGCF: colitis free control group without any treatment; RG-SP: colitis induced group treated with SAPE; Group RG-IM: colitis induced group treated with indometacin)	45
Fig 6.36	Results for assay of tumor necrosis factor alpha (TNF-α) content in the intestinal tissue extract for different treatment groups of rats (RG-CI: colitis induced group without any treatment; RG-CF: colitis free control group without any treatment; RG-SP: colitis induced group treated with SAPE; Group RG-IM: colitis induced group treated with indometacin)	46