



***Dedicated to  
My Beloved Parents  
Mr. Kalyan Chandra Das and Mrs. Jatila Das***

## DECLARATION

I hereby declare that the thesis entitled “**Development of a probiotic enriched bottle gourd (*Lagenaria siceraria*) beverage from local cultivar of Assam and evaluation of its health benefits**”, submitted to the School of Engineering, Tezpur University in partial fulfillment for the award of the degree of Doctor of Philosophy in Food Engineering and Technology, is a record of a bonafide research work accomplished by me under the supervision of Professor Sankar Chandra Deka. Any texts, figures, theories, results or designs that are not of my own devising are appropriately referenced in order to give due credit to the original author(s). All the sources of assistance have been assigned due acknowledgement. I also declare that neither this work as a whole nor a part of it has been submitted to any other universities or institute for any degree, diploma, associateship, fellowship or any other similar title or recognition.

Date:

(**Manas Jyoti Das**)

Place:

Reg. No. TZ189895 of 2018



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(संसदके अधिनियम द्वारा स्थापित केंद्रीय विश्वविद्यालय)

(A Central University established by an Act of Parliament)

तेजपुर-784028 :: असम/ **TEZPUR-784028 :: ASSAM**

**Prof. Sankar Chandra Deka, FRSC, FRSB**  
Department of Food Engineering and Technology  
School of Engineering  
Tezpur University

Email: sankar@tezu.ernet.in  
Phone: 03712-26-7100

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## **CERTIFICATE OF THE SUPERVISOR**

This is to certify that the thesis entitled “**Development of a probiotic enriched bottle gourd (*Lagenaria siceraria*) beverage from local cultivar of Assam and evaluation of its health benefits**” submitted to the Department of Food Engineering and Technology, School of Engineering, Tezpur University in partial fulfillment for the award of the degree of Doctor of Philosophy in Tezpur University is a record of research carried out by Mr. Manas Jyoti Das under my supervision and guidance.

All the help received by him from various sources has been duly acknowledged. No part of this thesis has been submitted elsewhere for the award of any other degree.

Date:

**(Prof. Sankar Chandra Deka)**

Place:

## Acknowledgements

My thesis entitled “Development of a probiotic enriched bottle gourd (*Lagenaria siceraria*) beverage from local cultivar of Assam and evaluation of its health benefits” would not have been possible without the generous help and support of a good number of people.

First, I would like to express my sincere gratitude to my mentor and guide, Prof. Sankar Chandra Deka for enlightening me with the first glance of research, his guidance, patience, motivation, and continuous support towards research activities.

I will be ever thankful to Prof. Dhruva Kumar Bhattacharyya, The Vice-Chancellor, Tezpur University for providing me permission and necessary facilities to carry out and submit the research work.

I would like to thank the members of my Doctoral Committee, Prof. Manabendra Mandal, and Prof. Raj Kumar Duary, for their insightful comments and encouragement which incited me to widen my research from various perspectives.

I express my sincere thanks to all my DRC members, faculty and staff of the Department of Food Engineering and Technology for their constant support, valuable suggestions, and insights into my research. These suggestions and insights have helped me in many ways in articulating and developing the thesis.

I sincerely acknowledge Prof. Anand Ramtake, Prof. Suvendra Kumar Ray, Dr. Suman Dasgupta, Dept. of MBBT Tezpur University and Dr. Pranabesh Chattophadyay, Defence Research Laboratory, Tezpur for providing me the access to their laboratories and research facilities.

I am indebted to the Department of Biotechnology, Govt. of India, and Tezpur University for providing financial assistance in the form of externally funded projects and fellowships.

I would like to thank Quality Control Laboratory, Tezpur University, SAIC, Tezpur University, Defence Research Laboratory, Tezpur, India for carrying out analysis of my samples.

I would specially like to thank Dr. Arup Jyoti Das, Dr. Debananda Gogoi, Dr. Dipanjan Banerjee, Dr. Sourav Chakraborty and Mr. Amartya Banerjee without whose precious support it would not be possible to conduct this research.

I thank my fellow research scholars and lab mates in particular, Lopa Mudra Sarma, Bhaskar Jyoti Kalita, Duyi Samyor, Pallab Borah, Kumar Kashyap Hazarika, Pitambar Baishya, Kuldip Gupta, Niraj Singh, Pankaj Gogoi, Raju Ram Boro, Rewrewa Narzary, Sanjib Gogoi, Barkhang Brahma, Singamayum Khurshida, Yesmin Ara Begum, KCS Mangang, Maibam Baby Devi, Urbashi Neog, Sangita Muchahary, Hemanta Chutiya, Payel Dhar, Tapasya Kumari, Kapil Deb Nath, Nun Haokip, Preeti Sarkar, GVS Bhagyaraj, Pritam Das, Taufiqul Islam, Pankaj Lochan Sarma, Kristi Kaberi Borah, Archana Sinha, Bidyut Sarania, Sanghita Das, Pollopalli Subramanyam, Pakter Niri, Ajay Kakoti, Parikshit Das, Vicky Sarma for the stimulating discussions and for all the fun we have had in the last few years.

I would like to acknowledge Mr. Jitu Mani Das, Assistant Librarian, Tezpur University for all his help during my thesis preparation.

I thank Mrs. Nijara Deka for her motherly care and assistance from the very beginning.

Finally, I thank my parents, my mahideu, my bhonti for all their support and the Almighty for giving me the strength and will to carry out the research work and write my thesis.

## List of Tables

<b>Table No.</b>	<b>Captions</b>	<b>Page No.</b>
Table 3.1	Experimental design and data for response surface analysis.	22-23
Table 3.2	ANOVA tables of the fitted model for the response variables.	31
Table 3.2.1	Cell Viability	31
Table 3.2.2	TPC	32
Table 3.2.3	Terpenoids	33
Table 3.2.4	DPPH	34-35
Table 3.3	Optimized condition for the pasteurization technique.	43
Table 3.4	Statistical and model parameters of death and reaction order kinetics.	44
Table 3.5	Physicochemical and functional properties of MW-US treated juice as compared to conventionally processed and raw juice.	45
Table 3.6	HPLC analysis of phenolic compounds of MW-US treated juice as compared to conventionally processed and raw juice.	46
Table 3.7	Amino acids composition of MW-US treated juice as compared to conventionally processed and raw juice. (% w/w).	47-48
Table 3.8	Water soluble vitamins in the MW-US treated juice as compared to conventionally processed and raw juice.	48
Table 3.9	Fat soluble vitamins in the MW-US treated juice as compared to conventionally processed and raw juice.	49
Table 3.10	DPPH free radical scavenging activity of MW-US treated juice as compared to conventionally processed and raw juice.	50
Table 3.11	Total color change in the MW-US treated juice as compared to conventionally processed and raw juice.	52
Table. 4.1	The relative organ weight of rats treated with a single dose of lyophilized <i>Lagenaria siceraria</i> juice for 14 days in acute oral toxicity study	79

Table. 4.2	Effect of lyophilized <i>Lagenaria siceraria</i> juice on haematological parameters in acute oral toxicity study	79-80
Table. 4.3	Effect of lyophilized <i>Lagenaria siceraria</i> juice on biochemical parameters in acute oral toxicity study	80
Table. 4.4	The effect of lyophilized <i>Lagenaria siceraria</i> juice on body weight of rats (g) at different days during the sub-acute oral toxicity study.	84
Table. 4.5	The relative organ weight of rats treated with different doses of the lyophilized <i>Lagenaria siceraria</i> juice for 28 days of sub-acute oral toxicity study.	84
Table. 4.6	Effect of the lyophilized <i>Lagenaria siceraria</i> juice on haematological parameters in sub-acute oral toxicity study.	85-86
Table. 4.7	Effect of the lyophilized <i>Lagenaria siceraria</i> juice on biochemical parameters in subacute oral toxicity study	86
Table 5.1	Similarity values of bottle gourd juice samples and quality attributes in general	110
Table 5.2	Ranking of juice samples and quality attributes in general	111
Table 6.1	Growth characteristics at different pH, NaCl concentration and temperature	129
Table 6.2	Acid tolerance	130
Table 6.3	Bile Tolerance	130
Table 6.4	Susceptibility of LAB strains to different antibiotics	131

## List of Figures

<b>Figures No.</b>	<b>Captions</b>	<b>Page No.</b>
Figure 3.1	Microwave and ultrasound processing of <i>Lagenaria siceraria</i> juice	20
Figure 3.2	Effect of interaction of (u) Microwave power and microwave temperature, (v) Microwave power and ultrasound amplitude percentage, (w) Microwave power and ultrasound exposure time, (x) Microwave temperature and ultrasound amplitude percentage, (y) Microwave temperature and ultrasound exposure time, (z) Ultrasound amplitude percentage and ultrasound exposure time on cell viability.	37-38
Figure 3.3	Effect of interaction of (u) Microwave power and microwave temperature, (v) Microwave power and ultrasound amplitude percentage, (w) Microwave power and ultrasound exposure time, (x) Microwave temperature and ultrasound amplitude percentage, (y) Microwave temperature and ultrasound exposure time, (z) Ultrasound amplitude percentage and ultrasound exposure time on total phenolic contents of the juice	39
Figure 3.4	Effect of interaction of (u) Microwave power and microwave temperature, (v) Microwave power and ultrasound amplitude percentage, (w) Microwave power and ultrasound exposure time, (x) Microwave temperature and ultrasound amplitude percentage, (y) Microwave temperature and ultrasound exposure time, (z) Ultrasound amplitude percentage and ultrasound exposure time on total terpenoid contents of the juice	40-41
Figure 3.5	Effect of interaction of (u) Microwave power and microwave temperature, (v) Microwave power and ultrasound amplitude percentage, (w) Microwave	42



	power and ultrasound exposure time, (x) Microwave temperature and ultrasound amplitude percentage, (y) Microwave temperature and ultrasound exposure time, (z) Ultrasound amplitude percentage and ultrasound exposure time on DPPH free radical scavenging activity of the juice	
Figure 3.6	Comparison between experimental and predicted values for (a) cell viability (b) TPC (c) DPPH and (d) terpenoids	44
Figure 3.7	Antioxidant activity of MW-US processed juice, values are mean $\pm$ S.D. of triplicate determination	51
Figure 3.8	Storage study of MW-US processed juice (in terms of DPPH free radical scavenging activity), values are mean $\pm$ S.D. of triplicate determination.	53
Figure 3.9	Storage study of MW-US processed juice (in terms of pH values), values are mean $\pm$ S.D. of triplicate determination	53
Figure.4.1	Certificate from Animal Ethical Committee, Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) and approved by Institutional animal Ethical Committee of Defence Research Laboratory, Tezpur, Assam India.	65
Figure. 4.2	Male wistar rats ( <i>Rattus norvegicus</i> )	66
Figure. 4.3	Male wistar rats ( <i>Rattus norvegicus</i> ) for anti-diabetic study.	72
Figure. 4.4	The blood glucose levels checked from the tail vein of Male wistar rats ( <i>Rattus norvegicus</i> )	73
Figure. 4.5	(a) Effect of different concentration of lyophilized <i>Lagenaria siceraria</i> juice on % inhibition of haemolysis of erythrocytes incubated in hypotonic solution. (b) Picture representing haemolysis after incubated with lyophilized <i>Lagenaria siceraria</i> juice (0-100 $\mu$ g/ml)	75-76

- w.r.t. positive control (Triton X-100) (n=3). Reading at 535 nm
- Figure. 4.6 Results of cell viability assay of (a) LS (*Lagenaria siceraria*) in HPBMCs in 0-100 µg/ml for 24 h measured by MTT based method. The viability is calculated as % of control and finally expressed as Mean±SD (n=3). Histopaq buffer was used for separation of PBMCs. Human PBMC were viable at a tested dose 5 µg, 10 µg, 25 µg, 50 µg and 100 µg per ml of solution for lyophilized *Lagenaria siceraria* juice incubated for 24 h. 77
- Figure. 4.7 Results of cell viability assay of lyophilized *Lagenaria siceraria* juice in THP-1 in 0-100 µg/ml for 24 h measured by MTT based method. The viability is calculated as % of control and finally expressed as Mean±SD (n=3). 78
- Figure. 4.8 (a) Wistar rats' organs preserved in a fixation medium of 10% buffered formalin for histopathological study. 81  
 (b) The organ paraffin blocks.  
 (c) The microtome cut organ paraffin section (arrow showing section of kidney).  
 (d) The organ sections stained with haematoxylin and eosin, and processed for light microscope
- Figure. 4.9 Histopathological examination of Liver and Kidney of control and treated rats of the acute oral toxicity study 82  
 (a). Control group liver section showing central vein  
 (b). Liver section of lyophilized *Lagenaria siceraria* juice treated group showing central vein  
 (c). Control group liver section showing portal vein  
 (d). Liver section of lyophilized *Lagenaria siceraria* juice treated group showing portal vein  
 (e). Control group kidney section

	(f). Lyophilized <i>Lagenaria siceraria</i> juice treated group kidney section	
Figure. 4.10	Histopathological examination of Liver and Kidney of control and lyophilized <i>Lagenaria siceraria</i> juice treated rats (1000mg/kg) of the sub-acute oral toxicity study (a). Control group liver section showing central vein	87
Figure. 4.11	Inhibition of $\alpha$ -amylase enzyme activity	88
Figure. 4.12	Inhibition of $\alpha$ -Glucosidase enzyme activity	89
Figure. 4.13	Inhibition of DPP4 enzyme by different concentration of <i>Lagenaria siceraria</i> juice	89
Figure. 4.14	Insulin mediated 2NBDG uptake was enhanced in LS ( <i>Lagenaria siceraria</i> ) juice treated (L6) cells at 10 $\mu$ g/ml concentration' 2NBDG =D-Glucose, 2-deoxy-2-((7-nitro-2,1,3-benzoxadiazol-4-yl) amino)- I=Insulin, P=Palmitate, L= Lyophilized <i>Lagenaria siceraria</i> juice	90
Figure. 4.15	Animal weight change during the anti-diabetic study	91
Figure. 4.16	Fasting blood glucose	92
Figure. 4.17	Oral Glucose Tolerance Test	93
Figure. 4.18	Intraperitoneal Insulin Tolerance Test	93
Figure. 4.19	Histopathology of pancreas (a). Control group displaying normal histomorphology of the pancreas (arrow showing normal islets of Langerhans cells). (b). Diabetic control group (arrow showing abnormality in the islets of Langerhans cells). (c). Group treated with insulin (arrow showing abnormality in the islets of Langerhans cells with presence of vacuoles). (d). Group treated with lyophilized <i>Lagenaria siceraria</i> juice (arrow showing abnormality in	94

the islets of Langerhans cells with presence of vacuoles).

Figure. 4.20	Real Time PCR analysis showing TNF $\alpha$ mRNA level in THP-1 macrophage pre-treated with or without <i>Lagenaria siceraria</i> juice in varied concentration, in presence or absence of LPS (100ng/ml) for 4 h.	95
Figure. 4.21	Real Time PCR analysis showing IL-1 $\beta$ mRNA level in THP-1 macrophage pre-treated with or without <i>Lagenaria siceraria</i> juice in varied concentration, in presence or absence of LPS (100ng/ml) for 4 h.	96
Figure. 4.22	Luciferase activity measured for NF-kB gene on LPS induced inflammation in THP-1 macrophage with or without <i>Lagenaria siceraria</i> juice in varied concentration	96
Figure 5.1	The BGJ samples viz., sample 1 (raw), sample 2 (conventionally treated) and sample 3 (microwave-ultrasound based combined treated)	108
Figure 5.2	The sensory scores of the bottle gourd juice samples under different quality attributes	109
Figure 5.3	The sensory scores for different QA of bottle gourd juice in general	110
Figure. 6.1	Extraction of soluble dietary fibre from <i>Lagenaria siceraria</i> pomace (a). <i>Lagenaria siceraria</i> pomace (b). <i>Lagenaria siceraria</i> pomace dried and grounded powder (c). <i>Lagenaria siceraria</i> pomace soluble dietary fibre	123
Figure. 6.2	Electropherogram data of <i>Lactobacillus plantarum</i> (Page1)	126
Figure. 6.3	Electropherogram data of <i>Lactobacillus plantarum</i> (Page2)	127

Figure. 6.4	Electropherogram data of <i>Limosilactobacillus fermentum</i>	128
Figure. 6.5	Antibiosis activity of the LAB strains against <i>E. coli</i> MTCC 40, <i>S. aureus</i> MTCC 3160 and <i>A. niger</i> MTCC 281. <i>LP</i> = <i>Lactobacillus plantarum</i> <i>LF</i> = <i>Limosilactobacillus fermentum</i>	132
Figure. 6.6	Growth of bacteria in MRS media in time interval	133
Figure.6.7	Growth of bacteria in carbohydrate free MRS media with 2% <i>Lagenaria siceraria</i> soluble dietary fiber	133
Figure.6.8	Change in viable cell counts of probiotic bacteria (log c.f.u. /ml) present in the probiotic juices with time.	134
Figure. 6.9	Change in acidity expressed as % lactic acid (v/v) of the probiotic juices with time.	135
Figure. 6.10	Change in pH of the probiotic juices with time.	136
Figure.6.11	Change in TPC of the probiotic juices with time.	136
Figure. 6.12	Change in DPPH free radical scavenging activity of the probiotic juices with time.	137

## List of abbreviation

HTST	High Temperature and Short Times
UV	Ultra-Violate
MW-US	Microwave and Ultrasound
ATCC	American Type Cell Culture
HPLC	High Performance Liquid Chromatography
USA	United State of America
BGJ	Bottle Gourd Juice
rpm	Revolutions Per Minute
FCCD	Face Centred Composite Design
MP	Microwave Power
MT	Microwave induced Temperature
UA	Ultrasound Amplitude
UT	Ultrasound exposure Time
TPC	Total Phenolic Content
DPPH	2,2-diphenylpicrylhydrazyl
FCR	Folin-ciocalteu Reagent
BHA	Butylated Hydroxyanisole
UV-VIS	Ultraviolet-visible
TS	Total Solids
TSS	Total Soluble Solids
TA	Titratable Acidity
RP-HPLC	Reverse Phase High Performance Liquid Chromatography
AOAC	Association of Official Analytical Chemists
UHPLC	Ultra-High-Performance Liquid Chromatography
DAD	Diode Array Detector
NO	Nitric Oxide
SOD	Superoxide Radical Scavenging
RP	Reducing Power
ANOVA	Analysis of variance
Df	Degrees of freedom
S.D.	Standard Deviation

RMSE	Root Mean Square Error
SSE	Sum of Square Error
BDL	Below Detectable Limit
ROS	Responsive Oxygen Species
NS	Not satisfactory
FA	Fair
ME	Medium
GD	Good
EX	Excellent
POM	Proportional Odd Modelling
OSS	Overall Sensory Scores
OMF	Overall Membership Function
SFS	Standard Fuzzy Scale
VG	Very Good
SV	Similarity Values
FL-POM	Fuzzy Logic and Proportional Odd Modelling
HPBMC	Human Peripheral Blood Mononuclear Cells
RBC	Red Blood Cells
ES	Erythrocyte Suspension
FBS	Foetal Bovine Serum
CPCSEA	Committee for the Purpose of Control and Supervision of Experiments on Animals
OECD	Organization of Economic Co-Operation and Development
Hb	Haemoglobin
PCV	Packed Cell Volume
MCV	Mean Corpuscular Volume
MCH	Mean Corpuscular Haemoglobin
MCHC	Mean Corpuscular Haemoglobin Concentration
WB	White Blood Cell
PDW	Platelet Distribution Width
ALP	Alkaline Phosphatase
AST	Aspartate Aminotransferase
ALPT	Alanine Aminotransferase

DPP4	Dipeptidyl Peptidase-4
FBG	Fasting Blood Glucose
BW	Body Weight
OGTT	Oral Glucose Tolerance Test
IPITT	Intraperitoneal Insulin Tolerance Test
LPS	Lyophilized Lagenaria siceraria
PCR	Polymerase Chain Reaction
LS	Lagenaria siceraria
MCV	Mean Corpuscular Volume
MCH	Mean Corpuscular Haemoglobin
MCHC	Mean Corpuscular Haemoglobin Concentration
IPITT	Intraperitoneal Insulin Tolerance Test
MRS	De Man, Rogosa and Sharpe
BLAST	Basic Local Alignment Search Tool
CLUSTALW	Clustal O and Clustal Omega
LAB	Lactic Acid Bacteria
MHA	Mueller–Hinton agar
MTCC	Microbial Type Culture Collection
LP	<i>Lactobacillus plantarum</i>
LF	<i>Limosilactobacillus fermentum</i>



## List of Symbols

mAU	Milli absorbance unit
ml	Millilitre
$\mu$ l	Microlitre
Nm	Nanometer
Da	Dalton
kDa	Kilodalton
mg	Milligram
$\mu$ g	Microgram
mm	Millimetre
$^{\circ}$ C	Degree celcius
$\mu$ m	Micrometre
g	Gram
w	Weight
h	Hour
v	Volume
%	Percentage
m	Minute
U	Unit
mM	Millimolar
M	Molar
<	Lesser than
>	Greater than
cm	Centimetre
nL	Nanolitre
s	Second
ms	Millisecond
ns	Nanosecond
/	Per
$\mu$	Micron
$\beta$	Beta
$\alpha$	Alpha
$\kappa$	Kappa