

**Final Completion Report (27.5.2014 to 26.5.2017)**

**QUALITY IMPROVEMENT OF A TRADITIONAL PROBIOTIC  
BEVERAGE OF NORTH-EAST INDIA AS COMBAT FOOD**

**Submitted to**



**Directorate of Extramural Research & Intellectual Property Rights  
(ER&IPR)  
Defence Research & Development Organization (DRDO)  
Ministry of Defence, Govt of India**

**Submitted by**



**Prof. S. C. Deka  
Principal Investigator  
Department of Food Engineering and Technology  
Tezpur University (A Central University)  
Napaam, Assam**

S. No	Item	Particulars
1.	Title of the Project	Quality improvement of a traditional probiotic beverage of North-East India as combat food
2.	Name of PI	Prof. Sankar Chandra Deka
3.	Address, Phone (office & mobile), E-mail	Professor, Department of Food Engineering and Technology, Tezpur University, Napaam-784028, Tezpur, Assam, India. 03712-275703 (O); 094354-08396 (M) sankar@tezu.ernet.in
4.	Name of Co-PI with address, phone & e-mail	Dr. Raj Kumar Duary, Assistant Professor, Department of Food Engineering and Technology, Tezpur University, Napaam-784028, Tezpur, Assam, India. 03712-275709 (O); 099576-69564 (M) duary@tezu.ernet.in
5.	DRDO Sanction letter No. and Date	Letter No. ERIP/ER/1203059/M/01/1511, Dated 28 <sup>th</sup> January 2014 & Corrigendum ERIP/ER/1203059/M/01/1511, Dated 9 <sup>th</sup> November 2015
6.	Date of start of the project (receipt of first grant by PI)	27.05.2014
7.	Duration of the project & extension, if any	3 years (Extension: Nil)
8.	Total Approved cost	₹ 21.07392 Lakhs
9.	Total Funds received by PI	₹ 21.07392 Lakhs
10.	Unspent balance	₹. 0.98554 Lakhs
11.	Project objectives	Attached separately (Annexure-I)
12.	Summary of Achievements (not more than half page)	Attached separately (Annexure-II)
13.	List of papers published, in journals/conference proceedings	Attached separately (Annexure-III)
14.	Patents filed, if any	N/A
15.	Manpower trained (M.Tech./Ph.D.)	N/A
16.	Facilities created/ Equipment procured**	Attached separately (Annexure-IV)
17.	Detailed Technical Project Report***	Attached Separately (Annexure-V)
18.	Future Scope for research	Attached separately (Annexure-VI)


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## Acknowledgments

The Principal Investigator and other Investigators would like to extend their sincere thanks to the DRDO (Defence Research and Development Organization) Ministry of Defence, Govt of India, New Delhi for funding the project.

We would also like to thank Tezpur University, Assam for giving the permission to carry out the research work and for availing all facilities needed to complete the research work.

  
20.6.2017  
(Sankar Chandra Deka)

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Department of Food Engineering and Technology,  
Tezpur University,  
Napaam-784028, Tezpur, Assam, India.

Professor  
Deptt. of Food Engineering & Technology  
Tezpur University, Napaam-784028  
Dist-Sonitpur (Assam)

### Objectives of the project (Annexure-I)

1. Collection of rice (*Oryza sativa*) beer and starter cultures from different regions of Assam and other parts of Northeast India and their biochemical and microbiological characterization.
2. Evaluation of the amylolytic and alcohol production properties of microbial isolates from starter cultures.
3. Identification of the isolates by phenotypic and genotypic methods.
4. Evaluation of antimicrobial and antioxidative activities of the extracts of different plants used in starter culture.
5. Evaluation of the antibiosis activities of the isolated strains and study of their probiotic properties.
6. Optimization of the rice beer and starter culture for quality improvement.
7. Suitable packaging and shelf life study.

## Summary of Achievements (Annexure-II)

Beer prepared using the different starter cake from various tribal communities of North East India has showed that the quality of beer get affected by the type of the quality of starter cake used due to the difference in the proportion and quality of rice and plant leaves used with difference in microbial consortium. Low moisture in starter culture extends the shelf life and presence of minerals, protein and fat in minimal making it a balanced nutritional drink. The high load of LAB bacteria both in starter cake and the rice beer may act as potential probiotic.

All the four species of the leaves used in rice beer in assam are potentially rich source of polyphenols and have high antioxidative properties, thereby capable to quench free radicals, act as reducing agents and chelate transition to suppress initiation of free radical formation. Photochemical from these species were also found to be rich in antimicrobial properties. Ethyl acetate fraction was found most effective among all identified phytochemical. All the extracts were more effective against *E. coli* compared to other pathogens. Among all the leaf species used *A. malaccensis* was close to establish antimicrobial agent and can be natural food preserver.

The experimental design and shelf life study of the probiotic rice beer using starchy substrate with specific ferment microbe helped to find the optimal condition for production and has broadened the prospect of production of good quality rice beer having techno-economic feasibility to promote the commercialization of the same.

### List of papers published, in journals/conference proceedings (Annexure-III)

1. Das, A. J., Khawas, P., Seth, D., Miyaji, T. and Deka, S. C. (2016). Optimization of the extraction of phenolic compounds from *Cyclosorus extensa* with solvents of varying polarities, Preparative Biochemistry and Biotechnology (DOI:10.1080/10826068.2015.1135457).
2. Das, A. J., Das, G., Miyaji, T. and Deka, S. C. (2016). *In vitro* antioxidant activities of polyphenols purified from four plant species used in rice beer preparation in Assam, India. International Journal of Food Properties 19(3):636-651 (DOI:10.1080/10942912.2015.1038835).
3. Das, A. J., Khawas, P., Miyaji, T. and Deka, S. C. (2015). Phytochemical constituents, ATR-FTIR analysis and antimicrobial activity of four plant leaves used for preparing rice beer in Assam, India. International Journal of Food Properties (DOI: 10.1080/10942912.2015.1104695).
4. Das A.J., Seth, D., Miyaji, T. and Deka, S.C. (2015). Fermentation optimization of probiotic rice beer and its application for cassava and plantain beer production. Journal of the Institute of Brewing. 121(2): 273-282.
5. Das, A. J., Khawas, P., Miyaji, T. and Deka, S. C. (2014). Effect of various microbial starters for amylolytic fermentation on some quality attributes of rice beer. International Food Research Journal 21(6):2443-2450.


### **Facilities created/ Equipment procured (Annexure-IV)**

- 1) **PCR Thermocycler** (Citizen, Master cycler nexus gradient 230 Volt, 50-60 Hz with heated flexlid). Memo No. TU/11-15(Pur)/FPT/2014/2451
- 2) **Ultrasonic Bath** (Model: CUB-15, sound waves 40 KHz high frequency, 15 ltr, power 220-240V, 50/60 Hz, 1.5 amp, heater 20-80°C , Timer and temperature monitor). Memo No. TU/11-15(Pur)/FPT/2014/2450
- 3) **Gel Electrophoresis Unit with Power Pack Vertical System** (Tarsons, Model: 7080, 7082, 7090, Dimension variable for small and large runs, casting base variable for small and large runs, No of parallel gel run 4 or more, Buffer volume 2500 ml min). Memo No. TU/11-15(Pur)/FPT/2014/2450



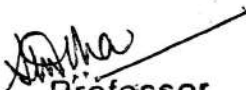
**UTILIZATION CERTIFICATE**  
FOR THE FINANCIAL YEAR 2016-2017 (From 1.04.2016 to 31.03.2017)

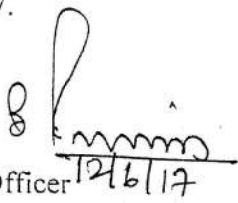
1.	Title of the Project/Scheme	Quality improvement of a traditional probiotic beverage of North-East India as combat food
2.	Name of the Institute	Tezpur University, Napaam,, Tezpur, Assam-784028
3.	Principal Investigator	Prof. Sankar Chandra Deka
4.	DRDO Letter No. and date of sanctioning the project	Letter No. ERIP/ER/1203059/M/01/1511, Dated 28 <sup>th</sup> January 2014 & Corrigendum ERIP/ER/1203059/M/01/1511, Dated 9 <sup>th</sup> November 2015
	Date of Start of the Project	27.05.2014
5.	Head of account as given in the original sanction letter	Major Head 2080 - Defence Services - Research & Development. Minor Head 004- Research/Research and Development. Sub- Head (C) - Extramural Research (EMIR) Code Head 852/06
6.	Amount brought forward from the previous financial year quoting DRDO letter No. & date in which the authority to carry forward the said amount was given	₹ 1.05324 Lakhs
7.	Amount received during the financial year (Please give No. & Date of DRDO sanction letter for the amount)	₹ 4.74704 Lakhs (Letter No. ERIP/ER/1203059/M/01/1511, Dated 25 <sup>th</sup> Jul 2016)
8.	Amount of interest earned, in any from the grants	-
9.	Total amount that was available for expenditure (excluding commitments) during the financial year (Sl. No 6+7)	₹ 5.80028 Lakhs
10.	Actual expenditure (excluding commitments) incurred during the financial year 2016-2017	₹ 4.34809 Lakhs
11.	Balance amount available at the end of the financial year	₹ 1.45219 Lakhs
12.	Unspent balance refunded, if any (Please give details of Cheque No. etc)	-
13.	Amount allowed to be carried forward to the next financial year 2016-2017	₹ 1.45219 Lakhs


 Professor  
Deptt. of Food Engineering & Technology  
Tezpur University, Napaam-784028  
Tezpur (Assam)

**UTILIZATION CERTIFICATE  
FOR THE FINANCIAL YEAR 2016-2017 (From 01.04.2016 to 31.03.2017)**

Certified that the sum of ₹ 4.74704 Lakhs sanctioned during the year 2016-2017 of grants-in-aid amount in favour of Tezpur University, Napaam, Tezpur, Assam, DRDO Letter No. ERIP/ER/1203059/M/01/1511, Dated 28<sup>th</sup> January 2014 & corrigendum ERIP/ER/1203059/M/01/1511, Dated 9<sup>th</sup> November 2015 and ₹ 4.74704 Lakhs is released vide letter No. Letter No.ERIP/ER/1203059/M/01/1511, Dated 25<sup>th</sup> Jul 2016 and amount of Rs NIL is an interest earned (if any) from grants during the year whereas ₹ 1.05324 Lakhs on account of unspent balance of the previous year, a sum ₹ 4.34809 Lakhs has been utilized for the purpose for which it was sanctioned and that the balance of ₹ 1.45219 Lakhs remaining unutilized at the end of the financial year (2016-17) will be adjusted towards the grants-in-aid payable or till the completion of project period 26.05.2017.

  
**Professor**  
 Principal Investigator  
 Deptt. of Food Engineering & Technology  
 Tezpur University, Napaam-784028  
 Dist-Sonitpur (Assam)

  
**Finance Officer**  
 Tezpur University

  
 Signature of Registrar  
 (with official seal)  
**Registrar**  
 Tezpur University

2. Certified that I have satisfied myself that the condition on which the grants were sanctioned have been fulfilled/are being fulfilled and that I have exercised the following checks to see that the money was actually utilized for the purpose for which it was sanctioned.

**Kinds of checks exercised**

1. Accounts audited by qualified Chartered Accountant appointed by this University as Internal Auditor.
2. The A. G. (Audit), Guwahati has already audited the account.
3. All the instrument (s), chemicals, consumables etc purchased from the grant are entered in the Log Book.

For SURAJIT CHAKRABORTY & CO.  
 CHARTERED ACCOUNTANTS

  
 CA, SURAJIT CHAKRABORTY  
 (Proprietor)

Membership No.- 305054

Signature of Audit Authority of Grantee Institute

**AUDITED STATEMENT OF EXPENDITURE ACCOUNTS**  
FOR THE FINANCIAL YEAR 2016-2017 (From 1.04.2016 to 31.03.2017)

- a) Title of the Project: **Quality improvement of a traditional probiotic beverage of North-East India as combat food**  
 b) Sanctioned letter No. & Date: **Letter No. ERIP/ER/1203059/M/01/1511, Dated 28<sup>th</sup> January 2014**  
 & **Corrigendum ERIP/ER/1203059/M/01/1511, Dated 9<sup>th</sup> November 2015**  
 c) Principal Investigator: **Prof. Sankar Chandra Deka**  
 d) Date of Start of the Project: **27.05.2014**  
 e) Total Sanctioned cost of the Project (Revised): **21.07392 Lakhs**  
 f) Grant received (Rs. Lakhs) in 1<sup>st</sup> Year ₹ 10.912 Lakhs, 2<sup>nd</sup> Year ₹ 5.41488 Lakhs, 3<sup>rd</sup> Year ₹ 4.74704 Lakhs  
 g) Total grant received so far: **₹ 21.07392 Lakhs (1<sup>st</sup> year + 2<sup>nd</sup> year + 3<sup>rd</sup> Year)**

Sl. No.	Sanctioned Heads	Funds sanctioned and released for 2015-2016 (₹ Lakhs) 2 <sup>nd</sup> year	Carried forward from 2015-2016 (₹ Lakhs)	Funds sanctioned and released for 2016-2017 (₹ Lakhs) 3 <sup>rd</sup> year	Funds available for 2016-2017 (₹ Lakhs) (iv+v)	Expenditure incurred during the FY 2016-2017 (₹ Lakhs) 3 <sup>rd</sup> year	Balance (vi-vii)	Commitments	Total expenditure (viii+ix)
i	ii	iii	iv	v	vi	vii	viii	ix	x
(a)	Staff	3.46807	0.46484	3.31549	3.78033	2.34641	1.43392	-	2.34641
(b)	Equipments	-	-	-	-	-	-	-	-
(c)	Operation & Maintenance	-	-	-	-	-	-	-	-
(d)	Expendables	1.00	(-) 0.00322	1.000	0.99678	1.000	(-) 0.00322	-	1.000
(e)	Travel	0.40	0.44254	-	0.44254	0.40212	0.04042	-	0.40212
(f)	Contingencies	0.20	(-) 0.00573	0.100	0.09427	0.11320	(-) 0.01893	-	0.11320
(g)	Research consultants	-	-	-	-	-	-	-	-
(h)	Procured service	-	-	-	-	-	-	-	-
(i)	Institutional over head	0.34681	0.15481	0.33155	0.48636	0.48636	0.00	-	0.48636
(j)	Interest earned, if any	-	-	-	-	-	-	-	-
	<b>TOTAL</b>	<b>5.41488</b>	<b>1.05324</b>	<b>4.74704</b>	<b>5.80028</b>	<b>4.34809</b>	<b>1.45219</b>	<b>-</b>	<b>4.34809</b>

Name & Signature  
of Principal Investigator  
Date

*[Signature]*

Name & Signature of  
Accounts Officer  
Date

*[Signature]*

Signature of Registrar  
Date

*[Signature]*

**Professor**  
Dept. of Food Engineering & Technology  
Tezpur University, Napaam-784028  
Dist.-Sonitpur (Assam)

**Finance Officer**  
Tezpur University

For SURAJIT CHAKRABORTY & CO.  
CHARTERED ACCOUNTANTS  
CA. SURAJIT CHAKRABORTY  
(Responsible)

**Registrar**  
Tezpur University

14/06/2015

**PROVISIONAL UTILIZATION CERTIFICATE  
FOR THE FINANCIAL YEAR 2017-2018 (From 01.04.2017 to 26.05.2017)**

1.	Title of the Project	Quality improvement of a traditional probiotic beverage of North-East India as combat food
2.	Name of the Institute	Tezpur University, Napaam, Tezpur, Assam-784028
3.	Principal Investigator	Prof. Sankar Chandra Deka
4.	DRDO Letter No. and date of sanctioning the project	Letter No. ERIP/ER/1203059/M/01/1511, Dated 28 <sup>th</sup> January 2014 & Corrigendum ERIP/ER/1203059/M/01/1511, Dated 9 <sup>th</sup> November 2015
	Date of Start of the Project	27.05.2014
5.	Head of account as given in the original sanction letter	Major Head 2080 – Defence Services – Research & Development, Minor Head 004- Research/Research and Development, Sub- Head (C) – Extramural Research (EMIR) Code Head 852/06
6.	Amount brought forward from the previous financial year (2016-17) quoting DRDO letter No. & date in which the authority to carry forward the said amount was given	₹ 1.45219 Lakhs
7.	Amount received during the financial year (2017-2018) (Please give No. & Date of DRDO sanction letter for the amount)	Nil
8.	Amount of interest earned, in any from the grants	₹0.09323 Lakhs
9.	Total amount that was available for expenditure (excluding commitments) during the financial year (Sl. No 6+7)	₹ 1.54542 Lakhs
10.	Actual expenditure (excluding commitments) incurred during the financial year (2017-2018) (From 1.04.2017 to 26.05.2017)	₹ 0.55988 Lakhs
11.	Balance amount available at the end of the financial year	₹ 0.98554 Lakhs
12.	Unspent balance refunded, if any (Please give details of Cheque No. etc)	₹ 0.98554 Lakhs
13.	Amount allowed to be carried forward to the next financial year	Nil

*B. Sankar Chandra Deka*

**PROVISIONAL UTILIZATION CERTIFICATE  
FOR THE FINANCIAL YEAR 2017-2018 (From 01.04.2017 to 26.05.2017)**

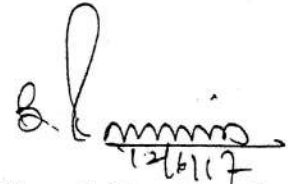
Certified that the sum of ₹ NIL sanctioned during the year 2017-2018 of grants-in-aid amount in favour of Tezpur University, Napaam, Tezpur, Assam DRDO Letter No. ERIP/ER/1203059/M/01/1511, Dated 28<sup>th</sup> January 2014 & corrigendum ERIP/ER/1203059/M/01/1511, Dated 9<sup>th</sup> November 2015 and ₹ NIL is released vide letter No. and amount of ₹ 0.09323 Lakhs is an interest earned (if any) from grants during the year whereas ₹ 1.45219 Lakhs on account of unspent balance of the previous year (2016-2017), a sum of ₹ 0.55988 Lakhs has been utilized (From 1.04.2017 to 26.05.2017) for the purpose for which it was sanctioned and that the balance of ₹ 0.98554 Lakhs, remaining unutilized at the end of the project period (26.5.2017) has been returned (during the F.Y. 2017-18).



Name & Signature  
of Principal Investigator  
Date & Seal

**Professor**

Deptt. of Food Engineering & Technology  
Tezpur University, Napaam-784028  
Dist-Sonitpur (Assam)



Name & Signature of  
Finance Officer  
Date & Seal

**Finance Officer**  
**Tezpur University**

For SURAJIT CHAKRABORTY  
CHARTERED ACCOUNTANTS



CA. SURAJIT CHAKRABORTY  
(Proprietor)

Membership No.- 305054

14/06/2017




**PROVISION STATEMENT OF EXPENDITURE ACCOUNTS  
FOR THE FINANCIAL YEAR 2017-2018 (wef 1.04.2017 to 26.05.2017)**

- a) Title of the Project: **Quality improvement of a traditional probiotic beverage of North-East India as combat food**  
 b) Sanctioned letter No. & Date: Letter No. ERIP/ER/1203059/M/01/1511, Dated 28<sup>th</sup> January 2014  
 & Corrigendum ERIP/ER/1203059/M/01/1511, Dated 9<sup>th</sup> November 2015  
 c) Principal Investigator: Prof. Sankar Chandra Deka  
 d) Date of Start of the Project: 27.05.2014  
 e) Total Sanctioned cost of the Project (After Revision): ₹ 21.07392 Lakhs  
 f) Grant received (Rs. Lakhs) in 1<sup>st</sup> Year ₹10.912 Lakhs, 2<sup>nd</sup> Year ₹ 5.41488 Lakhs, 3<sup>rd</sup> Year ₹ 4.74704 Lakhs  
 g) Total grant received so far: ₹ 21.07392 Lakhs (1<sup>st</sup> year + 2<sup>nd</sup> year + 3<sup>rd</sup> Year)


Sl. No.	Sanctioned Heads	Balance carried forward from 3 <sup>rd</sup> year i.e. F. Y. 2017-18 (₹ Lakhs)	Expenditure incurred from 01.04.2017 to 26.05.2017 (₹ Lakhs)	Balance (₹ Lakhs)
i	ii	iii	iv	iii-iv
(a)	Staff	1.43392	0.46667	0.96725
(b)	Equipments	-	-	-
I	Operation & Maintenance	-	-	-
(d)	Expendables	(-) 0.00322	0.00	(-) 0.00322
I	Travel	0.04042	0.00	0.04042
(f)	Contingencies	(-) 0.01893	0.09321	(-) 0.11214
(g)	Research consultants	-	-	-
(h)	Procured service	-	-	-
(i)	Institutional over head	0.00	0.00	0.00
Total	Interest earned, if any	1.45219		
(j)	Interest earned, if any	0.09323		0.09323
	<b>GRAND TOTAL</b>	<b>1.54542</b>	<b>0.55988</b>	<b>0.98554</b>

(Interest earned was expended under contingencies for the project activities only)

Name & Signature  
 of Principal Investigator  
 Date & Seal  
  
**Professor**

Dept. of Food Engineering & Technology  
 Tezpur University, Napaam-784028  
 Dist-Sonitpur (Assam)

For SURAJI CHAKRABORTY & CO.  
 CHARTERED ACCOUNTANTS  
 CA. SURAJI CHAKRABORTY  
 (Proprietor)  
 14/06/2018  
 Membership No. - 305054

Name & Signature of  
 Finance Officer  
 Date & Seal  
 Finance Officer  
  
 Tezpur University