

UNIVERSITY GRANTS COMMISSION  
BAHADUR SHAH ZAFAR MARG  
NEW DELHI – 110 002

THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. Name and address of the Principal Investigator : **Dr. Poonam Mishra**
2. Name and address of the Institution: Department of Food Engineering and Technology Tezpur University, Napam Assam-784028
3. UGC approval no. and date : F.N.39-945/2010 (SR) dt.12.01.2011
4. Date of Implementation : 01/11/2012\*
5. Tenure of the Project : 2011-2012
6. Total grant allocated : Rs. 2,00,000
7. Total grant received : Rs 1,50,000
8. Final expenditure : Rs. 1,48,171
9. Title of the project : Value addition and popularization of under variety of Indian gooseberry with maximum possible retention of polyphenols and antioxidants and development of new Indiangooseberry products
10. Objectives of the project \* :
  - a. Compositional analysis of different varieties of Amla
  - b. Evaluation of varieties available locally for suitable product development
  - c. Development of export oriented Amla product
  - d. Study of storage stability of Amla products
  - e. Commercialization of Amla products
11. Whether objectives were achieved : Five objectives have been achieved but sixth and last objective could not be achieved. (details are given in Annexure-1)
12. Achievements from the project : One Ph.D produced
13. Summary of the findings : (given in Annexure-2)  
(In 500 Words )
14. Contribution to the society (Give Details): One paper communicated, one Phd produced, 3 paper presented in an International conference.
15. Whether any Ph.D. enrolled/produced : One Ph.D produced (Title "**Characterization of phenolics extracted from Amla (*Emblica officinalis*) and its processing waste and development of Amla-lemon based RTS drink**") out of the project
16. No. of publications out of the project : One paper accepted, One communicated Phd completed, 3 paper presented in an International conference  
(Please Attach Re-Prints) : details attached

• **Physicochemical analysis of different varieties of Amla**

The compositional analysis of different varieties of Amla was performed. *Krishna* and *Chakaiya* variety were found to be superior in terms of total phenolic contents. The Physicochemical properties of different varieties of amla are given in Table-1 and 2. Amla varieties differed in composition of nutrients.

**Table 2.1 Physical characteristics of different varieties of Amla genotype**

Varieties	Fruit height (cm)	Fruit width (cm)	Fruit weight (g)	No. of segments/fruit	Fruit shape
<i>Chakaiya</i>	3.4	4.1	42.7	6	Flattened, round
<i>Francis</i>	3.3	4.0	30.7	6	Flattened, oval
<i>Kanchan</i>	3.3	3.5	29.9	6-8	Flattened, oblong
<i>Krishna</i>	3.9	4.3	44.9	6-8	Triangular
<i>Narendra-7</i>	3.6	4.2	43.1	6	Flattened, oval

All observations are the average of 10 individual observations

**Table 2.2 Compositional analyses of different varieties of Amla**

Sample	<i>Francis</i>	<i>Chakaiya</i>	<i>Narendra-10</i>	<i>Narendra-7</i>	<i>Krishna</i>	<i>Kanchan</i>
Crude fiber (%) (fwb)	2.42±0.1 <sup>a</sup>	2.45±0.01 <sup>a</sup>	1.98±0.2 <sup>b</sup>	2.99±0.1 <sup>c</sup>	3.71±0.1 <sup>d</sup>	2.02±0.1 <sup>b</sup>
Moisture (%) (fwb)	83.12±0.8 <sup>a</sup>	83.81±0.9 <sup>a</sup>	80.12±0.8 <sup>b</sup>	80.03±0.9 <sup>b</sup>	79.56±1.0 <sup>b</sup>	81.18±1.0 <sup>b</sup>
Fat (%) (fwb)	0.03±0.01 <sup>a</sup>	0.05±0.01 <sup>a</sup>	0.04±0.01 <sup>a</sup>	0.05±0.02 <sup>a</sup>	0.05±0.01 <sup>a</sup>	0.03±0.01 <sup>a</sup>
Protein (%)	0.38±0.1 <sup>a</sup>	0.45±0.1 <sup>b</sup>	0.30±0.1 <sup>c</sup>	0.37±0.0 <sup>a</sup>	0.39±0.1 <sup>a</sup>	0.39±0.0 <sup>a</sup>
Carbohydrate (%) (fwb) (available)	13.69±0.2 <sup>a</sup>	12.75±0.4 <sup>b</sup>	17.01±0.4 <sup>c</sup>	15.84±0.3 <sup>d</sup>	15.75±0.3 <sup>d</sup>	15.95±0.4 <sup>d</sup>
Acidity (%)	3.20±0.1 <sup>a</sup>	3.31±0.1 <sup>a</sup>	3.77±0.2 <sup>b</sup>	2.81±0.1 <sup>c</sup>	3.22±0.1 <sup>a</sup>	2.42±0.2 <sup>d</sup>
Total phenols (g/100g) (db)	18.36±0.8 <sup>a</sup>	24.50±0.4 <sup>b</sup>	19.81±0.4 <sup>c</sup>	21.32±0.6 <sup>c</sup>	25.62±0.9 <sup>b</sup>	21.09±1.0 <sup>c</sup>
% Ash (fwb)	0.36±0.0	0.49±0.0	0.55±0.0	0.72±0.1	0.54±0.0	0.42±0.0
Vitamin C (mg/100g)	630.31±3.6 <sup>a</sup>	592.32±2.8 <sup>b</sup>	600.61±1.7 <sup>c</sup>	570.12±2.3 <sup>d</sup>	725.12±3.4 <sup>e</sup>	610±3.9 <sup>f</sup>

fwb means fresh weight basis; db is dry basis

Value = mean ± standard deviation

Different varieties of Amla were investigated for the product development and it was observed that being fibrous in nature the *Krishna* variety was not found suitable for the development of candy, slices, preserve etc. *Chakiya* variety being high total phenolic content and DPPH free radical scavenging activity next to *Krishna* variety were found suitable for further product development.

• **Process optimization for extraction of total phenolic content from Amla (*Emblica officinalis*) using response surface**

*Chakaiya* variety of amla was investigated for phenolic content. RSM (response surface methodology) was used to determine the optimum conditions for maximum recovery of total phenolic content from amla powder. ANOVA showed that the process variables i.e. temperature, ethanol concentration and pH were found to be statistically significant for recovery of TPC (total phenolic content) and % DPPH\* (2, 6 Diphenyl picryl hydrazil free radical) scavenging activity of the extract. Powder extracted under optimum conditions were further purified in using different solvents. The ethyl acetate fraction was purified by Sephadex column chromatography and was characterized by analytical HPLC and FTIR. Major polyphenols contained in ethyl acetate fraction were gallic acid, catechin, caffeic acid, vanillic acid and syringic acid. Fraction V showed the maximum DPPH\* scavenging activity.

• **Process optimization for extraction of total phenolic content from Amla seed coat powder (*Emblica officinalis*) using response surface**

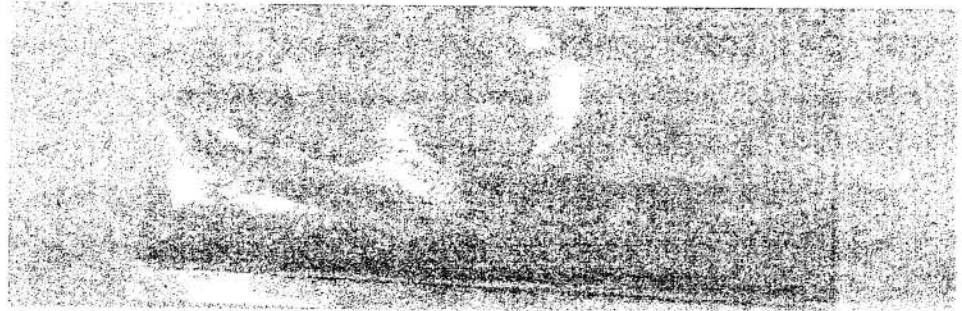
RSM was used to determine the optimum conditions for maximum recovery of phenolics from amla seed coat powder. At optimum conditions, TPC (total phenolic content) content and % DPPH free radical scavenging activity of extract were found to be 7.02 mg GAE / mL of extract and 42.69%, respectively. Phenolics were extracted in water, diethyl ether, butanol and ethyl acetate. % DPPH free radical scavenging (61.07%) activity was maximum in ethyl acetate fraction. The major phenolics in ethyl acetate extract were gallic, catechin, caffeic, quercetin, p-coumaric, vanillic and chlorogenic acids. Ethyl acetate extract was further fractionated with six fractions using methanol: water by column chromatography. Fraction V showed highest DPPH scavenging activity. The phenolics in different fractions of ethyl acetate extract were also estimated by GC-MS after derivatization. Caffeic, p-coumaric, hydroxy caffeic, vanillic, gallic and p-hydroxybenzoic acid were identified. Other components like tetracontane-1,40-diol and octadecanoic acid could also be identified.

• **Objective 3 and 4**

**Process standardization for development of spray dried amla powder**

Amla juice was spray dried with different maltodextrin concentrations at different inlet temperatures. The effect of spray drying on the physicochemical properties, total phenolic

content and DPPH\* scavenging activity of spray dried Amla powder were investigated in present investigations. The effect of spray drying conditions on physicochemical properties of Amla powder was evaluated. Maltodextrin concentration (5-9%) and drying temperature (125°C to 200°C) significantly affected moisture content, bulk density, hygroscopicity, color attributes, TPC and DPPH\* scavenging activity. However WSI was not significantly influenced by varying the concentration of maltodextrin or inlet temperature. The developed spray dried powder showed excellent water solubility that is essential for reconstitution. Amla juice powder dried at 175°C with 7% maltodextrin was adequately effective to produce powder with less hygroscopicity, acceptable color in terms of *L*, *a* and *b* and potent free radical scavenging activity. The image of spray dried Amla powder and scanning electron is shown in Fig 1 and 2 respectively.



**Fig 1 Image of spray dried Amla powder**

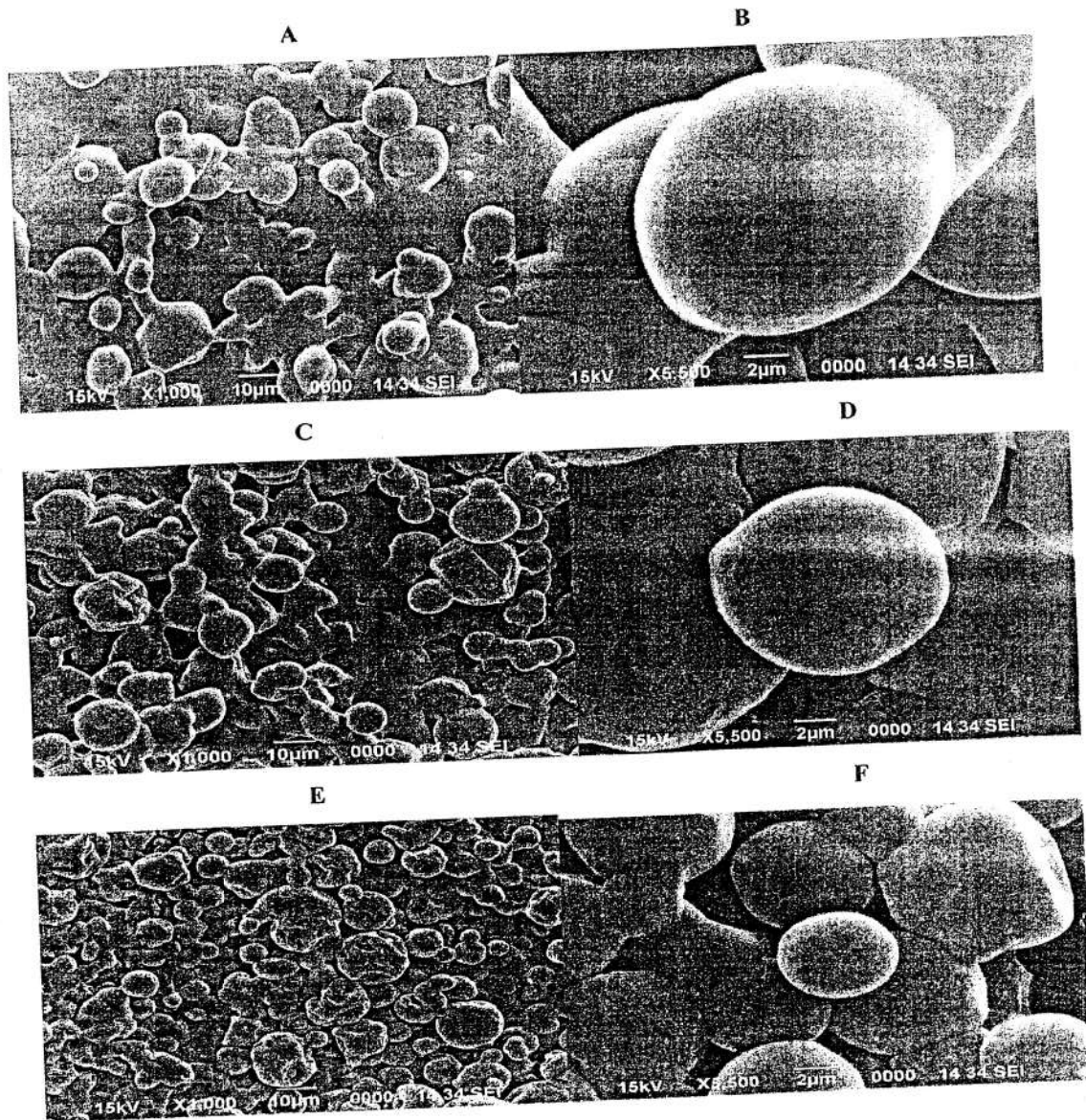


Fig 2 Micrographs of particles at different inlet temperature and constant maltodextrin level (9%) at magnifications of (a) 150°C, 1000 X, (b)150°C, 5500 X, (c) 175°C, 1000X, (d) 175°C, 5500 X, (e) 200°C, 1000X, and (f) 200°C, 5500 X.

• **Process standardization for development of spray dried lemon powder and optimization of amla-lemon based RTS by using response surface methodology**

Lemon juice powder was obtained from its juice under optimized conditions by spray drying with maltodextrin at 10%, 15% and 20 % level. The effect of inlet temperatures of 125, 150, 175 and 200°C and maltodextrin levels on the physicochemical properties, total phenolic content (TPC) and diphenyl picryl hydrazil (DPPH) scavenging activity of spray dried lemon juice powder was studied. Spray dried lemon juice powder was incorporated with spray dried

amla juice powder (processing conditions optimized in previous reported work) to develop a dry mix for ready to serve (RTS) drink along with citric acid and glucose. Spray dried lemon juice powder was used to enhance the acceptability and nutritive value of amla based RTS fruit drink. The amla-lemon based RTS had good nutritional quality and TPC. Refrigerated storage with nitrogen flushing prevented color change and reduced TPC and DPPH loss. The optimized product got good scores on sensory evaluation.

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**STATEMENT OF EXPENDITURE IN RESPECT OF MINOR RESEARCH**  
**PROJECT**

1. Name of Principal Investigator : Dr. Poonam Mishra  
2. Deptt. of University/College : Dept of Food Engineering and Technology,  
Tezpur University, Napaam, Tezpur- 784028,  
Assam, India  
3. UGC approval No. and Date : F.N.39-945/2010 (SR) dt.12.01.2011  
4. Title of the Research Project : **Value addition and popularization of under variety of Indian gooseberry with maximum possible retention of polyphenols and antioxidants and development of new Indiangooseberry products.**  
5. Effective date of starting the project : 01/11/2012  
6. a. Period of Expenditure: From **01/01/12 to 13/11/14**  
b. Details of Expenditure

S. No.	Items	Amount Received (in Rs)	2012-2013	2013-2014	01/01/14 to 13/11/14	TOTAL Expenditure incurred (in Rs)
			(Rs)	(Rs)	(Rs)	(in Rs)
1	Equipments	1,00,000	Nil	37,000	61,172	61,172
2	Chemicals & Glassware	25,000	25,000		Nil	25,000
3	Contingency	25,000	24,999			24,999
4	<b>Total</b>	<b>1,50,000</b>	49,999	37,000	61,172	<b>1,48,171</b>

**Total unspent amount: Rs. 1,829/- (Rs. One thousand eight hundred twenty nine only)**

7. Staff : Project Fellow : NA

1. It as a result of check or audit objective, some irregularly is noticed, later date, action will be taken to refund, adjust or regularize the objected amounts.
2. Payment @ revised rates shall be made with arrears on the availability of additional funds.
3. It is certified that an amount of **Rs. 1,48,171/-** (One lakh forty eight thousand one hundred seventy one only) out of the total grant of grant of Rs. **1,50,000/-** (Rupees One lacs fifty thousand only) received from the University Grants Commission under the scheme of support for Major Research Project entitled "Value addition and popularization of under variety of Indian gooseberry with maximum possible retention of polyphenols and antioxidants and development of new Indiangooseberry products" vide UGC letter No. F.N.39-945/2010 (SR) dt.12.01.2011 has been utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

*Poonam Mishra*  
(Principal Investigator)


*[Signature]*  
(Finance Officer)

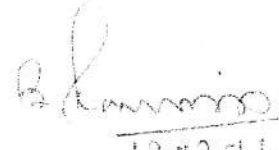
*[Signature]*  
(Registrar/Principal)

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**UTILIZATION CERTIFICATE**

Certified that an amount of **Rs. 1,48,171/-** (One lakh forty eight thousand one hundred seventy one only) out of the total grant of **Rs. 1,50,000/-** (Rupees One lacs fifty thousand only) received from the University Grants Commission under the scheme of support for Major Research Project entitled "Value addition and popularization of under variety of Indian gooseberry with maximum possible retention of polyphenols and antioxidants and development of new Indiangooseberry products" vide UGC letter No F.N.39-945/2010 (SR) dt.12.01.2011 has been utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission and the unspent amount of **Rs. 1,829/-** (Rs. One thousand eight hundred twenty nine only) is returned to UGC.

  
(Principal Investigator)

  
12-12-11  
(Finance Officer)

  
(Registrar/Principal)