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ANNUAL REPORT
2014- 2015

ALL INDIA COORDINATED RESEARCH PROJECT (ICAR)

ON

POST HARVEST ENGINEERING AND TECHNOLOGY

JUNAGADH CENTRE

Presented at the

31st Annual Workshop to be held at
Tamil Nadu Agricultural University
Coimbatore(Tamil Nadu)

January 4 - 6, 2016

AICRP on Post Harvest Engineering and Technology
Department of Processing and Food Engineering
College of Agricultural Engineering & Technology
Junagadh Agricultural University
JUNAGADH – 362001

FOREWORD

Post-harvest engineering and technology is an application of engineering principles for development of post harvest machinery for various post harvest operations. It also comprises practices of various operations to serve food to the countrymen after harvesting. This multi-disciplinary "Science, Engineering and Technology" applied to farm produce after harvest to protect, conserve, process, package, distribute, market, and utilize for the food and alimentary chucks of the society in relation to their desires. It has to develop in consonance with the needs of society to kindle agricultural production; avert post-harvest losses, improve nutrition and add value to the products. In this process, it must be able to generate employment, prevent migration from rural to urban areas, reduce poverty and stimulate growth of other related economic sectors. The process of developing of post harvest technology and its purposeful use needs an inter-disciplinary and multi-dimensional approach.

The Junagadh centre contributed successfully by establishing agro processing centres, enzyme and pectin production from agro industrial waste, extruded product from underutilized grains, popularization of cumin cleaner cum grader and fruit grader for small farmers, etc. In view of the shortage of capital, an arrangement of custom hiring service facility was provided to the farmers in meeting the requirements. The centre has brought fruitful findings on the storage of oil seeds, cereals and spice crops. These findings of research work became useful to farmers, industries and entrepreneurs.

Looking to the requirements of this region, the centre has worked continuously and developed technologies related to feed block making machine, solar dryer cum green house, peanut butter, coriander dhal milling process, vacuum packaging of mangoes, storage technique for coriander and wheat (seed), onion storage structures, sapota cleaner, pectin extraction, enzyme extraction etc. for the benefit of farmers and processing industries. However, in view of the recent trends, still much remains to be done. This centre has space for laboratory work, office room, analytical facilities, etc., but due do continuous expansion and with a view to impart training and accommodate precious and sensitive instruments / equipments purchased so far, this centre need a separate building / space for better sitting and laboratory arrangements, for which necessary efforts are being made to fulfill the same at university level.

The financial assistance provided by the ICAR under the AICRP on Post Harvest Technology is gratefully acknowledged. I am sure the Junagadh centre will contribute significantly towards need of the agro industries and the life prosperous of the farmers of the region.

December 23, 2015
Junagadh

(N. K. Gontia)
Principal & Dean
College of Agril.Engg.& Technology
JAU, Junagadh

ACKNOWLEDGEMENT

The All India Coordinated Research Project on Post Harvest Engineering and Technology staff wish to communicate their frank gratitude to Dr. A. H. Pathak, Vice-Chancellor, Junagadh Agricultural University, Junagadh and Dr. N. K. Gontiya, Principal & Dean, College of Agricultural Engineering & Technology, Junagadh for their caring direction, thought provocative annotations and keen interest shown in the activities of the scheme. We hereby express our earnest thanks to Dr. A. Y. Desai, Director of Research, for dexterous directing of the scheme work and Sh. S. K. Jethani, Comptroller Junagadh Agricultural University, Junagadh for resolving financial matters speedily.

The staff members of the scheme gratefully acknowledge the financial assistance received by ICAR to run the scheme smoothly. The positive attitude and constructive criticism of Dr. K. Alagusundaram, Deputy Director General (Engineering) and Dr. Kanchan K. Singh, Assistant Director General (PE) ICAR, New Delhi are thankfully acknowledged. We express our most sincere thanks to Dr. S. N. Jha, Project Coordinator, AICRP on Post Harvest Engineering and Technology, Central Institute of Post Harvest Engineering & Technology, Ludhiana for their inspiring guidance, coordination as well as their keen interest in the activities of the scheme.

We are also thankful to all the staff members of the Department of Processing and Food Engineering especially Prof. D. M. Vyas, Professor and Head, for their support and taking due interest in the activities of the scheme work. The staff members of the scheme also appreciate and thankfully acknowledges the cooperation rendered by agro processing centres for promoting nearby farmers and taking interest, post harvest industries for providing details during visits in connection with input for research work and more who helped directly or indirectly for this scheme.

December 23, 2015
Junagadh

(M. N. Dabhi)
Research Engineer
for Scheme Staff

C O N T E N T S

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ALL INDIA CO-ORDINATED RESEARCH PROJECT (ICAR)

ON

POST HARVEST ENGINEERING AND TECHNOLOGY SCHEME

JUNAGADH AGRICULTURAL UNIVERSITY

JUNAGADH CENTRE

GENERAL INFORMATION

1.	**Title of the scheme**	:	All India Co-ordinated Research Project (ICAR) on Post Harvest Engineering and Technology
2.	**ICAR sanction No. & Date**	**:**	1(41)/PHT/2006/XI Plan/1010998, dtd. 21.3.2009 (PC letter No.)
3.	**Date of commencement**	**:**	April, 1980
4.	**Date of completion**	:	The scheme is sanctioned for the 12th Five Year Plan
5.	**Sanctioned grant forthe Year 2014-2015 for which this report is presented**		Rs**.** 87,30,000.00 (ICAR+State)

6. Staff position in the scheme

Sr. No.	Designation	No. of posts			Name of the incumbent	Present Scale of pay	Date of joining / Vacant
		S	F	V			
*1.	Research Engineer (37400-67000)	1	-	1	Vacant	37400-67000	Withdrawn from 01.04.2014
2.	Asstt. Bio-Chemist (15600-39100)	1	-	1	Vacant	15600-39100	Abeyance from 01.04.2014
** 3.	Asstt. Entomologist (15600-39100)	1	1	-	Prof. R.D.Dhudashia	37400-67000	01.06.1997
4.	Asstt. Food Microbiologist (15600-39100)	1	1	-	Prof. A.M. Joshi	15600-39100	18.02.2009
5.	Asstt. Res. Engineer (ASPE) (15600-39100)	1	1	-	Prof. P. R.Davara	15600-39100	01.01.2011
+6.	Asstt. Process Engr. (Testing & Eva.) (15600-39100)	1	-	1	Dr. S. P. Cholera	15600-39100	01.04.2015
7.	Senior Tech. Asstt. (5500-9000)	1	1	-	Er. H. R. Sojaliya	10000 (fixed)	14.02.2012
8.	Investigator (5500-9000)	1	1	-	Er. P. P. Vora	10000 (fixed)	16.03.2012
9.	Draftman (Mech.) (5000-8000)	1	1	-	Shri D.M. Pethani	9300-34800	04.08.1987
10.	Craftman-I	1	-	1	Shri V. S. Kava	5200-	01.11.2014

	(Welder)					20200	
11.	Craftman-II (Fitter)	1	1	-	Shri N.V. Vora	5200-20200	28.12.2008
12.	Craftman-III (Tinsmith)	1	1	-	Shri N.M. Sidhapura	5200-20200	13.07.1982
13.	Jr. Lab. Asstt.	1	1	-	Shri J.K. Makwana	5200-20200	13.07.1982
14.	Sr. Clerk/ Stenotypist	1	1	-	Shri J. M. Kalyani	5200-20200	08.02.2013
15.	Driver	1	1	-	Shri M.B. Jadeja	5200-20200	06.07.2001
16.	Mate – I	1	-	1	Vacant	4440-7440	17.04.2012
17.	Mate - II	1	-	1	Vacant	4440-7440	30.06.2012

Note :

* The post of Research Engineer is withdrawn by Government of Gujarat vide Notification No. JKV-122013-2700-K.2 Dated 18/09/2014 and endorsed by Director of Research, Junagadh Agricultural University vide letter No. JAU/DR/Plan/11194-203/14. Dated 23/09/2014.

** Post mentioned above is getting higher pay scales as per university rules.

7. Expenditure Statement for the year 2014-2015 (Upto March, 2015)

S.N.	Budget Head	Opening* Balance as on (01.04.2014) Rs.	Fund received during the year 2014-15 Rs.	Revalidated ** Fund of unspent balance of last year-2013-14, Rs.	Receipts during the year 2014-15 Rs.	Total Fund Rs. (3+4+5+6)	Expenditure incurred for the councils share during the year 2014-15 Rs.	Unspent balances during the year 2014-15 Rs. (7-8)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	Pay and Allowances	-4,12,881.00	78,00,000.00	-	-	73,87,119.00	49,55,409.00	24,31,710.00
3	Travelling Allowance	3,25,576.00	1,30,000.00	71,287.00	-	4,55,576.00	78,910.00	3,76,666.00
2	Recurring Contingencies (Including HRD)	3,55,625.00	5,00,000.00	51,128.00	-	8,55,625.00	5,33,191.00	3,22,434.00
4	Non recurring contingencies	22,70,907.00	3,00,000.00	-	-	25,70,907.00	2,88,689.00	22,82,218.00
5	Receipt during the year 2014-15	-	-	-	23,664.00	23,664.00	-	23,664.00

6	Receipt during the year 2011-12	7,500.00	-	-	-	7,500.00	-	7,500.00
7	Receipt during the year 2010-11	26,601.00	-	-	-	26,601.00	-	26,601.00
	Total	**25,73,328.00**	**87,30,000.00**	**1,22,415.00**	**23,664.00**	**1,13,26,992.00**	**58,56,199.00**	**54,70,793.00**

* Opening balance includes the unspent balance of the previous five year plan i.e. 2007-2012 which is proposed to be surrendered to ICAR.

** **As revalidated fund of the preveious years (Col. 5) has already included in the Opening balance as on 01-04-2014 (Col. 3), it has not been**consideredagain in the calculation of total fund (col. 7).

8. Technical Programme

Sr.No.	Code No.	Title
1	PH/JU/85/1	Establishment of Agro Processing Centre training and demonstration of technologies (Operational research project on Agro Processing Centres)
2	PH/JU/2011/02	Extraction of pectin from *Kesar* mango peel by resins
3	PH/JU/2013/02	Post Harvest Management of Sapota.

Investigation No. : 1

1.1 Scheme code No. : **PH/JU/85/1**

1.2 Title of Investigation: Establishment of Agro Processing Centre training and demonstration of technologies (Operational research project on Agro Processing Centres)

1.3 Name of Investigators:
1. Dr. M. N. Dabhi
2. Prof. P. R. Davara
3. Prof. D. M. Vyas
4. Er. P. P. Vora

1.4 Objectives

1. Survey of selected villages to identify the available agro-processing equipment.
2. To transfer the developed and improved agro-processing equipment to the selected village to give value added product.
3. To evaluate the techno-economic feasibility of the agro-processing centre.

1.5 Justification

Migration from the village to the cities not only disturbs the rural based economy but also causes a saturated and explosive urban population growth. The dire need of the hour is to prevent this migratory trend from villages to cities, so as to increase the activities concerned with farming thereby increase food production. This could be prevented by stabilizing industries in the proximity of the source of raw materials or near the vicinity of consumption catchment's area to avoid higher transportation cost. This will help the village to become self sufficient in production, processing and consumption of raw materials produce by them. More job opportunities would also be created, resulting in more income generation.

1.6 Date of start: April - 2012

1.7 Date of completion: Continue

1.8 Past Work done

Major equipment installed at agro processing centres were used for their operational work. In this period, oil milling, spice milling, groundnut decorticating, cleaning and grading of wheat were taken up. The detailed operational performance data and expenditure incurred, income obtained along with profit / loss were determined.

1.9 Progress of work

At TadkaPipaliyacentre they have processed groundnut for oil milling and marketed 325 tin with the processing charge of Rs. 75 per tin. At Loejcentre, 11100 kg groundnut processed for oil milling with Rs. 4 per kg processing charge. Similarly, Virol

centre has also processed 20300 kg groundnut for oil milling with Rs. 4 per kg processing charge. The grader is converted into thresher cum grader for TadkaPipaliya, Loej and Virol processing cenres.

The above detailed operational performance data and expenditure incurred, income obtained along with profit / loss were determined and presented in Table: 1.1.

Table 1.1 : Operational performance and income from the processed products

S. N.	Activities	Raw material processed (kg)	Finished material produced (kg)	Expenditure incurred (Rs.)	Income (Rs.)	Profit / loss (Rs.)
	Tadaka Pipaliya Agro Processing Centre					
1	Oil milling (groundnut)	10200	4080 (272 tin of 15 kg each) @ Rs. 80 per tin	9160	21760	12600
2	Flour milling (wheat, bajra, jowar etc.)	15700	-	15700	39250	23550
3	Cleaning and grading of wheat,	4500	-	-	4500	4500
4	Groundnut decortication (manually)	-	_	_	2500 (@ 20Rs/day x 2 nos.)	2000
	Vitthalpur Khambhaliya Agro Processing Centre					
1	Cleaning and grading of wheat,	-	-	-	-	-

	Loej Agro Processing Centre					
1	Oil milling (groundnut)	10738	-	21476	42952	21476
2	Cleaning and grading of wheat,	1000	-	-	3300	3300
	Ramdevji Agro Processing Centre, Virol Agro Processing Centre					
1	Oil milling (groundnut)	61718	-	123436	246872	123436
2	Cleaning and grading of wheat,	9500	-	-	9500	9500
3.	Spice milling	821 kg	-	-	-	12135

1.10 Conclusion:

Based upon the requirement, the existing centre at Virolwas strengthened by installing spice mill. A new Agro Processing Centre was started at Vadala, Ta. Talala, Dist. GirSomnath under Tribal Sub Plan Project. Survey work for establishment of new APC was carried out at Chotila, Dist. Rajkot by a committee constituted by Principal and Dean, CAET, JAU, Junagadh.

1.11 Future plan of work

The experiment will be continued.

Investigation No. : 2

(Scheme code No. : PH/JU/2011/02)

2.1 Title of Investigation: Extraction of pectin from *Kesar* mango peel by resin.

2.2 Objectives :

1. To study the processing parameters on the recovery and quality of mango peel pectin by using cation exchange resin at laboratory scale.
2. To study the process parameters on pilot scale.
3. To study the cost economy of pectin extraction.

2.3Name of Investigators **:** 1. Er. P. R. Davara
2. Dr. P. J. Rathod
3. Dr. M. N. Dabhi
4. Dr. A. K. Varshney

2.4 Year of commencement : 2011-12

2.5 Crop and variety **:** Mango, Variety : *Kesar*

2.6 Experimental detail

Experimental work at laboratory level has already been completed and submitted. The following work was carried out to study the process parameters on pilot scale for extraction o pectin from *Kesar* mango peel.

❖ **Collection and drying of mango peels**

- About 50 kg of dried mango peels was prepared. The required quantity of peel was collected from the Mango Canning plant of JAU, Junagadh as well as from the Lion Foods Pvt. Ltd., Madhupur. The peel was washed and dried in cabinet dryer as well as under sun light. The relevant photographs are shown in Plate 1 to Plate 3.

Kesar mango peel waste

Washing of mango peels

Plate 2.1 Washing of mango peel with water.

Loading of clened mango peels into cabinet dryer

Trays loaded with mango peels

Turning of mango peels during drying

Drying of mango peels under sun light

Plate 2.2 Drying of cleaned mango peels.



Plate 2.3 Dried mango peels stored in polyethylene bag.

❖ **Extraction of pectin from dried mango peels**

- Extraction of pectin was carried out on large scale with the existing facilities available at Mango Canning plant of Junagadh Agril. Univerisity, Junagadh.
- The procedure as given in the Fig. 1 was followed to extract the pectin from *Kesar*mango peel.
- Details of the experiment for pectin extraction on large scale is given as under:

Input parameters

- Quantity of dried mango peels = 4 kg
- Extracting medium = Cation exchange resin
- Peels and extracting medium ratio = 1:4
- Extraction temperature = 80 °C ± 5 °C
- Extraction time = 60 min
- pH of extracting medium = 2.56
- Number of extraction = 2
- Precipitation method = Alcohol precipitation (0.05N, 95% IPROME)

Output parameters

- Quantity of pectin extract collected in first extraction = 28 lit
- Quantity of pectin extracted in first extraction = 467 g
- Yield of pectin in first extraction = 11.68 %(DWB)

- The photographs of pectin extraction are shown in Plate 4 to Plate 6.

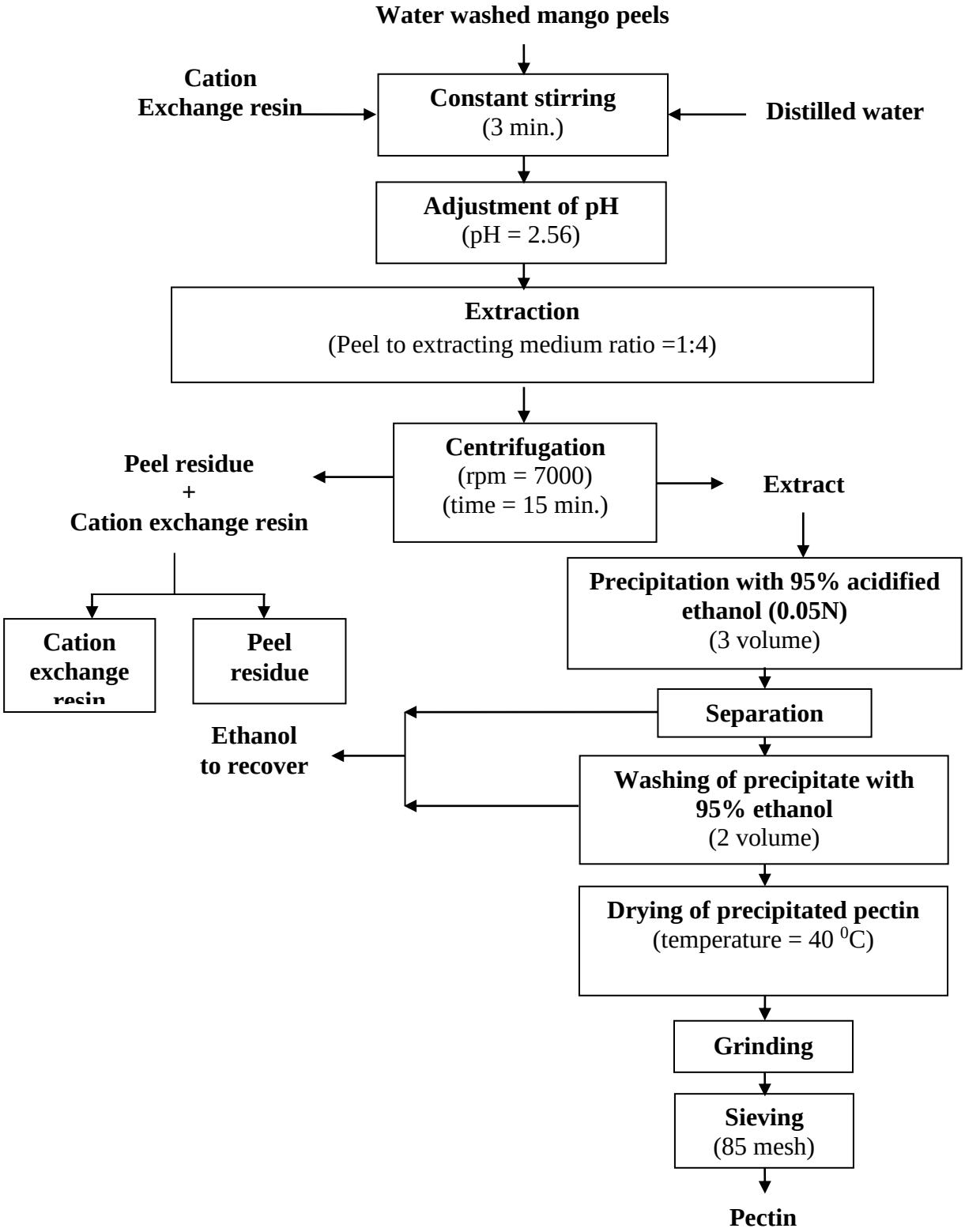

Fig. 2.1 Modified experimental flow chart for extraction of pectin by cation exchange resin (Mayer and Rouse (1943), Huang (1973), Patil and Mishra (2004).

Grinding of mango peel

Weighing of mango peel

Mango peel collected in steam jacketed kettle

Addition of cation exchange resin

Boiling of mixture of mango peel and resin

Measurement of temperature and pH during boiling

Plate 2.4 Grinding and boiling of mango peel.

Boiled mixture of mango peel and resin

Separation of pectin extract using basket centrifuge

Pectin extract

Mixture of peel and resin after extraction

Plate 2.5 Separation of pectin extract after boiling.

Precipitation of pectin using alcohol

Isolated pectin

Washing of isolated pectin with alcohol

Washed pectin

Pectin powder

Plate 2.6 Isolation of pectin from pectin extract.

RESEARCH PROJECT PROFORMA FOR UPSCALE OF RESEARCH OUTPUT TO THE END USER (RPP- IV)

1. Institute Project Code : PH/JU/2011/02
2. Project Title : Extraction of pectin from *Kesar* mango peel by resins
3. (a) Name of the Lead Institute : College of Agril. Engg. & Technology

   (b) Name of Division/ Regional Center/ Section : AICRP on PHT, Junagadh
4. (a) Name of the Collaborating Institute(s) : --

   (b) Name of Division/ Regional Center/ Section of Collaborating Institute(s) : --
5. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time spent)

S. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)
1.	Prof. P. R. Davara, Asstt. Research Engineer, AICRP on PHT, Dept. of Processing & Food Engineering, College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	PI
2.	Dr. P. J. Rathod, Asstt. Biochemist, AICRP on PHT, Dept. of Processing & Food Engineering, College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	Co-PI
3.	Dr. M. N. Dabhi, Research Engineer, AICRP on PHT, Dept. of Processing & Food Engineering, College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	Co-PI
4.	Dr. A. K. Varshney, Professor and Head (Rtd.), Dept. of Processing & Food Engineering, College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	Co-PI

5. Details of Research Outputs

   a. Details of research output (Product, Process, Technology, Methods, Tools, Software etc.) developed (Crop-based; Animal-based, including vaccines;

Biological – biofertilizer, biopesticide, etc; IT based – database, software; Any other – please specify)

- Process technology has been developed for the extraction of pectin from mango peel using cation exchange resin (crop-based)

b. Intellectual Property Generated
   i. Patents - filed/obtained; Nil
   ii. Copyrights- filed/obtained; Nil
   iii. Designs- filed/obtained; Nil
   iv. Registration details of variety/germplasm/accession, if any : Nil

c. Publications
   i. Research Papers : Preparation is under progress
   ii. Reports/Manuals : Prepared
   iii. Working and Concept Papers : Nil
   iv. Popular Articles : Nil
   v. Books/Book Chapters : Nil
   vi. Extension Bulletins : Preparation is under progress

6. Efforts made for commercialization of Research Output/ Technology transfer (with reference to item 15 of RPP - III)

   Enumerate the efforts made for commercialization of research output/ technology transfer. The list of the activities executed like organization of awareness programmes may also be given.

Sr. No.	Details of the research output	Expected end users	Efforts made for transfer of research output to clientele	Outcome of the efforts
1.	Process technology has been developed for the extraction of pectin from mango peel	Mango processors / Fruit processors	The output as obtained from the project will be commercialized by establishment of pilot plant.	It is expected that through establishment of pilot plant we may be able to provide the hands on training to the end users/processors for the extraction of pectin from mango peel. Further, the suggested process technology may be useful for the utilization of mango waste for the production of good quality pectin.

7. Economic Benefits and Impact (with reference to those identified under item 14 of RPP - I and item 16 of RPP - III)

   - The technology developed will be the best alternate for extraction of quality pectin from mango peel with excellent jelly grade properties.

8. Research work undertaken on the problems identified as future line of research work :
9. Signature of PI, CC-PI(s), all Co-PIs

P. R. Davara	P. J. Rathod	M. N. Dabhi	A. K. Varshney
Principal Investigator	Co-PI	Co-PI	Co-PI

10. Signature of Head of Division
11. Observations of PME Cell
12. Signature of JD (R)/ Director

ANNEXURE - VIII
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
(For Guidelines Refer ANNEXURE – XI(H))

PROFORMA FOR RESEARCH PERFORMANCE EVALUATION OF INDIVIDUAL SCIENTIST

1. Institute Project Code * : PH/JU/2011/02

2. Evaluation by PI on the contribution of the team in the project including self

S. No.	Name	Status in the project (PI/CC-PI/Co-PI)	*Rating in the scale of 1 to 10
1.	P. R. Davara	PI	9
	Dr. P. J. Rathod	Co-PI	8
	Dr. M. N. Dabhi	Co-PI	8
	Dr. A. K. Varshney,	Co-PI	7

3. Signature of PI

* Individual scientists participating in the project would be assessed for their performance through an appraisal system in a scale of 1 to 10 for each of the following attributes:

S. No.	**Criteria**	**Marks**
1.	Percentage of the assigned activity completed	**40**
2.	Quality of the completed activity	**10**
3.	Authenticity/reliability of the data generated	**10**
4.	Enthusiasm and sincerity to work	**10**
5.	Inferences made	**10**
6.	Collaboration and cooperation demonstrated in performing the task at hand	**10**
7.	Amenability to scientific/academic/laboratory discipline	**10**
	Total Score	**100**

ANNEXURE - IX

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

(For Guidelines Refer ANNEXURE – XI(I))

PROFORMA FOR EVALUATION OF A RESEARCH PROJECT AFTER COMPLETION BY PI

1. Institute Project Code : PH/JU/2011/02

2. Evaluation research project after completion by PI

S. No.	Criteria	Methodology	Marks (output)	Self Evaluation by PI
1.	Achievements Against approved and stipulated outputs under project	**Qualitative and quantitative assessment of objectives and stipulated outputs under the project will be carried out** a) Activity Input /Projected Output/ Output Achieved b) Extent to which standard design methodology, experimental designs, test procedures, analytical methods followed c) Does the data justify the conclusions? d) Innovativeness and creating of new knowledge e) Additional outputs over those stipulated under the project f) Creation of linkages for commercialization of technology developed under the project g) Is scientific input commensurate to output (manpower, financial input and time duration)?	**75** 35 10 05 10 05 05 05	**59** a) 30 b) 10 c) 05 d) 10 e) 00 f) 02 g) 02
2.	Publication/ awards	Assessment will be done in respect of: Research papers; Reports/Manuals; Working and Concept Papers; Books/Book Chapters/Bulletins. Quality of publication (s) and Awards /Scientific recognitions received	**10**	**05**
3.	Additional facilities created	Facilities created in terms of laboratory. Research set-up, instrumentation, software, hardware etc. during the project.	**05**	**02**
4.	Human Resource Development (Scientific and Technical)	Scientist trained in different areas	**05**	**00**
5.	Revenue generated under the	Resources and revenues generated	**05**	**00**

	project/ avenues created for revenue generation			
6.	Product/ Process/Technology/ IPR/New Models/ Methods/Databases/ / Concept/ Tools/Technique /commercial value of the technology developed	Details to be provided on a) Product b) Process c) Technology d) IPR e) Registration of the varieties f) New Models g) Methods h) Tools i) Databases j) Concepts k) Techniques	**10**	**09**
7.	Quality of available documents of the project duly authenticated	Research Project Files, Data, Reports etc.	**05**	**05**
Total Marks			**115**	**80**
8.	Timelines of execution of the project	Marks will be deducted if extension sought over the approved project duration beyond recorded and officially granted extension with recorded reasons	Marks to be deducted	
		Up to 5%	01	
		Up to 10%	02	
		Up to 30 %	03	
		Beyond 30 %	05	
Net Score: Score obtained to be counted out of 100 to compensate for activities not relevant to the project			**100**	**70**

3. Signature of PI

Investigation No. : 3

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CHECKLIST FOR SUBMISSION OF FINAL RESEARCH PROJECT REPORT (RPP-III)

1. Institute Project Code : **PH/JU/2013/02**
2. Title of Investigation : Post Harvest Management of Sapota
3. Investigators as approved in RPP-I, If any change attach IRC proceedings:

Principal Investigator	CC-PI	Co-PI
Dr. M. N. Dabhi	-	Prof. P. R. Davara

4. Any change in objectives and activities ~~Yes~~/No
   (If yes, attach IRC proceedings)

5. Date of Start & Date of Completion (Actual). If any extension granted enclose IRC proceedings — ~~Yes~~ / No

6. Whether all objectives met — Yes / ~~No~~

7. All activities completed — Yes / ~~No~~

8. Salient achievements/major recommendations included — Yes / ~~No~~

9. Annual Progress Reports (RPP-II) submitted
   - 1st Year — Yes / ~~No~~
   - 2nd Year — Yes / ~~No~~

10. Reprint of each of publication attached — ~~Yes~~ / No

11. Action for further pursuit of obtained results indicated — Yes / ~~No~~

12. Report presented in Divisional seminar (enclose proceedings & action taken report) — Yes / ~~No~~

13. Report presented in Institute seminar (enclose proceedings & action taken report) — Yes / ~~No~~

14. IRC number in which the project was adopted — IRC No:

15. Any other Information

16. Signature:

Project Leader Co-PI Co-PI Co-PI

HOD/PD/I/c.

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

FINAL RESEARCH PROJECT REPORT (RPP- III)

PROJECT REPORT (RPP- III)

1. Institute Project Code **PH/JU/2013/02**

2. Project Title : Post Harvest Management of Sapota

3. Key Words : Cleaning, Grading, Packaging, Sapota

4. (a) Name of the Lead Institute : Junagadh Agricultural University

(b) Name of Division/ Regional Center/ Section - Nil

5. (a) Name of the Collaborating Institute(s) - Nil

(b) Name of Division/ Regional Center/ Section of Collaborating Institute(s) - Nil

6. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time spent)

S. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)	Time spent (%)	Work components assigned to individual scientist
1	Dr. M. N. Dabhi	PI	70	Design, development, performance evaluation and report writing
2	Prof. P. R. Davara	Co-PI	30	Help in fabrication and performance evaluation of machine.

7. Priority Area : Cleaning, grading and packaging of sapota fruits.

8. Project Duration: Date of Start : 2013 Date of Completion : 2015

9. a. Objectives

i. To design a continuous sapota cleaner.

ii. To develop a continuous sapota cleaning unit.

iii. To evaluate the performance of Sapota cleaning unit.

iv. To synchronize the post harvest operations, viz. cleaning, grading and packaging of sapota.

b. **Practical utility** :

Cleaning of sapota is an important unit operation to be carried out after harvesting. Presently the harvested fruits are cleaned by rubbing with cloth to make them more attractive and also for the removal of latex and scurf from the skin of sapota. This process of cleaning is a laborious as well as time consuming and required lot of time in clearing operation and makes them more attractive. A manual type sapota cleaner is developed which is batch operated. A continuous type sapota cleaner is needful for large farmers as well as at cooperative level. Looking to the above it was thought to develop a continuous machine which can be useful to the farmers.

10. Final Report on the Project (materials and methods used, results and discussion, objective wise achievements and conclusions)

10.1 Experiment Detail

(a) Design : CRD

(b) Variables

1. Cleaner speed : 25, 30, 35 rpm
2. Abrasive material type : Jute cloth
3. Slope of the drum : 2, 4, 6 degree

(c) Measuring parameters:

1. Grading efficiency
2. Damage percentage
3. Output capacity

(d) Replications: 4

(e) Sample size for each test run: 10 kg fruits

10.2 Methodology:

The sapota cleaner was designed and developed during the previous year. During this year performance evaluation of designed sapota cleaner was carried out. Freshly harvested sapota were purchased from the farmers' field.

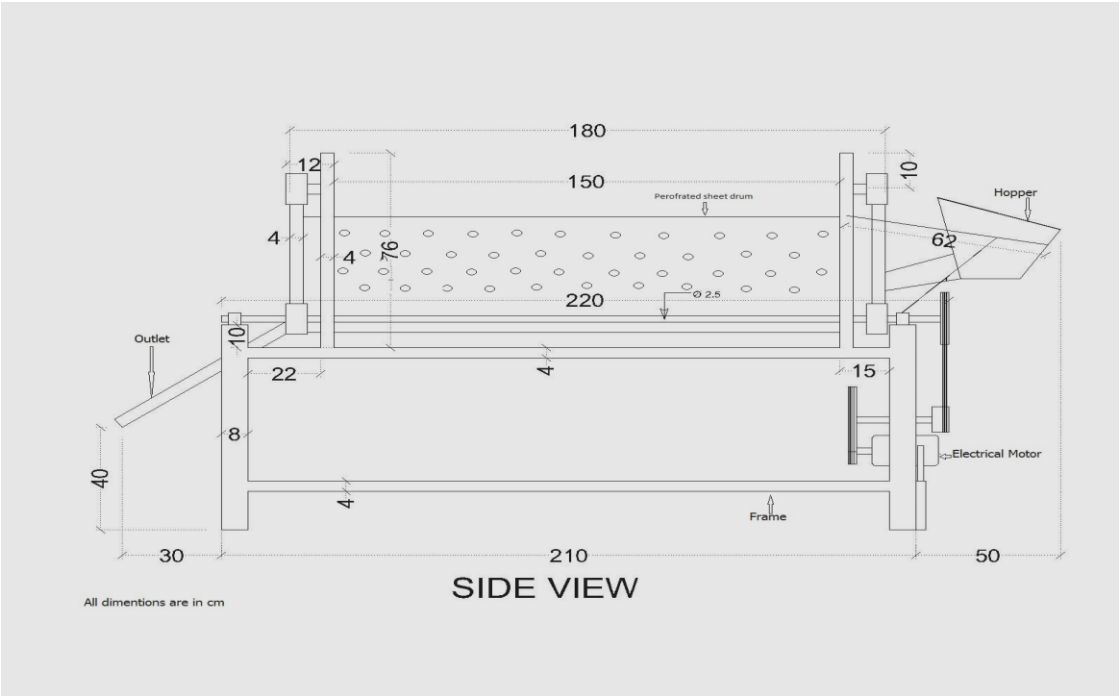

Fig. 3.1 : Drawing of Sapota cleaner

The performance of the developed electric motor operated continuous type sapota cleaner was evaluated in terms of cleaning efficiency, output capacity and damage percentage as function of operating speed and slope of the drum. The cleaning efficiency was analyzed on the basis of average mass of the actual fruits cleaned.

The cleaner was tested for sapota fruits as per procedure given below.

1. 10.2.1.1 Sample Preparation:

The performance of the developed cleaner was evaluated by taking 25, 30, and 35 rpm at 2, 4 and 6 degree angle of drum. Freshly harvested batches of sapota fruits from farmers' field were used for each decided rpm and angle of drum. While during the replications under the individual rpm and according angle of drum, the fresh lot of fruits were used. The cleaning efficiency for each run was estimated visually out of total feed material.

2. 10.2.1.2 Cleaning Efficiency:

Cleaning efficiency of the developed cleaner was estimated on the basis of known feed composition for each decided rpm.

Under known feed composition test, the uncleaned freshly harvested sapota fruits were selected. After completion of cleaning, the fruits were observed visually and matched to the sapota cleaned manually. The cleaning efficiency was estimated as,

$$Cleaning\ efficiency, \% = \frac{Weight\ of\ cleaned\ sapota}{Total\ weight\ of\ fed\ sapota}$$

10.2.1.3 Damage Percentage:

The damage percentage during cleaning at each rpm was determined by visual observation. The cleaned fruits were sorted in respect of damage due to abrasion and brushing and the weight of total damage fruits collected at each collection unit was noted. Thereafter, the damage percentage was estimated using following relation.

$$Percent\ damage, \% = \frac{Weight\ of\ damaged\ sapota}{Total\ weight\ of\ fed\ sapota}$$

10.2.1.4 Output Capacity:

Output capacity was determined by noting the time required to clean fed sapota at different rpm and angle of drum. Thereafter, the output capacity of the cleaner at different rpm was estimated using equation,

$$Output\ capacity, \frac{kg}{hr} = \frac{Fed\ material}{Time\ required\ to\ clean}$$

10.3 RESULTS AND DISCUSSIONS

10.3.1Cleaning Efficiency

10.3.1.1 Effect of rotating speed of drum at different degree angle of drum on cleaning efficiency.

Table 3.1 : Cleaning efficiency at different rotating speed of drum with respect to different angle of drum

Angle	**2**	**4**	**6**
RPM	Time taken (Sec)		
25	96.46	87.68	67.51
30	97.68	87.88	70.01

35	99.13	90.46	80.16
SEM	1.52	1.32	1.82
CD	NS	NS	5.81
CV	3.13	3.01	5.04

i. Efficiency at 25 rpm :

The freshly harvested sapota was cleaned in cleaner at 2, 4 and 6 degree angle of rotating drum and 25 rpm rotating speed. Highest cleaning efficiency was found significantly at 2 degree angle of drum. The average cleaning efficiency was found 96.46, 87.68 and 67.51 percent at 2, 4 and 6 degree angle of drum respectively.

ii. Efficiency at 30 rpm:

The freshly harvested sapota was cleaned in cleaner at 2, 4 and 6 degree angle of rotating drum and 30 rpm rotating speed. Highest cleaning efficiency was found significantly at 2 degree angle of drum. The average cleaning efficiency was found 97.68, 87.88 and 70.01 percent at 2, 4 and 6 degree angle of drum respectively.

iii. Efficiency at 35 rpm:

The freshly harvested sapota was cleaned in cleaner at 2, 4 and 6 degree angle of rotating drum and 35 rpm rotating speed. Highest cleaning efficiency was found significantly at 2 degree angle of drum. The average cleaning efficiency was found 99.13, 90.46 and 80.16 percent at 2, 4 and 6 degree angle of drum respectively.

10.3.1.2 Effect of angle of drum at different rotating speed of drum on cleaning efficiency

Table 3.2 : Cleaning efficiency at different angle of drum with respect to different rotating speed of drum

RPM	**25**	**30**	**35**
Angle	Time taken (Sec)		
2	96.46	97.68	99.13
4	87.68	87.88	90.46
6	67.51	70.01	80.16
SEM	1.72	1.81	1.39

CD	5.51	5.79	4.46
CV	4.11	4.25	3.10

i. Efficiency at 2 degree angle :

The freshly harvested sapota was cleaned in cleaner at 25, 30 and 35 rpm rotating speed of drum and at 2 degree angle of drum. Highest cleaning efficiency was found non-significantly at 35 rpm rotating speed of drum. It was at par with 25 and 30 rpm rotating speed of drum. The average cleaning efficiency was found 96.46, 97.68 and 100 percent at 2, 4 and 6 degree angle of drum respectively.

ii. Efficiency at 4 degree angle:

The freshly harvested sapota was cleaned in cleaner at 25, 30 and 35 rpm rotating speed of drum and at 4 degree angle of drum. Highest cleaning efficiency was found non-significantly at 35 rpm rotating speed of drum. It was at par with 25 and 30 rpm rotating speed of drum.The average cleaning efficiency was found 87.68, 87.88 and 90.46 percent at 2, 4 and 6 degree angle of drum respectively.

iii. Efficiency at 6 degree angle:

The freshly harvested sapota was cleaned in cleaner at 25, 30 and 35 rpm rotating speed of drum and at 6 degree angle of drum. Highest cleaning efficiency was found significantly at 35 rpm rotating speed of drum. The average cleaning efficiency was found 67.51, 70.01 and 80.16 percent at 2, 4 and 6 degree angle of drum respectively.

10.3.2 DAMAGE PERCENTAGE

During the cleaning at different combination of speed and angle of rotating drum, there was no damage to any sapota fruit. Hence, there was 0% damage of sapota. This was due to continuous operation hence no impact of fruit to each other. It was observed during batch type manual sapota cleaner that large amount and high speed of drum caused damage to sapota fruits.

10.3.3 Output Capacity:

Output capacity was carried out as per the time taken to clean the sapota. It was observed that small amount of sapota reduced the capacity, as initial period of sapota takes times. Once the feeding of sapota started continuously, the time taken for cleaning reduced and hence output capacity increased. In terms of time taken for 10 kg sapota and there by conveting into capacity, following inferences were found.

Table 3.3 : Cleaning time requirement at different rotating speed of drum with respect to different angle of drum

Angle	2	4	6
RPM	Time taken (Sec)		
25	110.00	145.00	163.00
30	117.00	134.75	119.50
35	62.50	85.50	88.75
SEM	3.37	2.07	1.53
CD	10.77	6.61	4.91
CV	4.83	3.34	3.89

Based on rotating speed of drum it was found that at 25 rpm, 2 degree angle of drum resulted significantly lesser time to clean the sapota and hence increased the capacity as compared to 4 and 6 degree angle of drum. Similarly, for 30 and 35 rpm rotating speed same results were observed.

Table 3.4 : Cleaning time requirement at different angle of drum with respect to different rotating speed of drum

RPM	25	30	35
Angle	Time taken (Sec)		
2	110.00	117.00	62.50
4	145.00	134.75	85.50
6	163.00	119.50	88.75
SEM	1.41	1.53	1.96
CD	NS	NS	6.28
CV	2.89	3.44	5.41

Based on angle of rotating drum it was observed that at 2 degree angle of drum, 35 rpm of rotating drum speed resulted significantly highest capacity and same observations were found for 4 and 6 degree angle of drum.

Overall it was reported that combination of 2 degree angle of drum and 35 rpm rotating speed of drum resulted lessen time requirement i.e. 62.50 sec for 10 kg of sapota fruits which resulted 576 kg/hr cleaning capacity of freshly harvested sapota fruits.

10.3.4 Cost Economics:

The cost economics was calculated based on the cost of developed cleaner and labour requirement. It was also compared with cost of manual cleaning.

Table 3.5 : Cost of cleaner

ITEMS	SPECIFITION	QUANTITY	RATE	TOTAL COST(Rs)
Square pipe	40 x 40 x 2 mm	33.5kg	47/kg	1574.5
	80 x 40 x 3 mm	32 kg	47/kg	1504
L-Profile	20 x 20 x 2 mm	8.11 kg	38/kg	308.18
	50 x 50 x 6 mm	4.4 kg	38/kg	167.2
Shaft	25 mm	18.1 kg	50/kg	905
Sq. Solid	25 x 38 mm	24 kg	42/kg	1008
Pulley	20 cm. Dia	2 Nos	200	400
	12 cm. Dia	6 Nos	150	900
	24 cm. Dia	1 No	220	220
	10 cm. Dia	1 No	150	150
Pedestal	2 inch. Dia	6 Nos	150	900
Motor	1 HP	1 No	2000	2000
Bearing		4 Nos	125	500
Perforated sheet	10 gauge	31 sq.ft	55	1705
v belt	B66,B53	2+1 Nos	80	240
Iron strip	20 x 3 mm	0.9 kg	42/kg	37.8
Bolt	M12 x 1"	1.2 kg	80/kg	96
	M13 x 1"	0.62 kg	80/kg	49.6
	M15 x 1"	0.71 kg	80/kg	56.8
	M18 x 1"	0.24 kg	80/kg	19.2
	M20 x 1"	0.2 kg	80/kg	16
Metal sheet	2mm thickness	2 kg	51/kg	102
Gunny bag				140
Labour charge				5000
Total cost				17999.28

Assumptions:

1) Life of machine in year : 10

2) Total working days/year : 200
3) Total working hours/day :8
4) Depreciation cost of cleaner : @10% of initial cost/year
5) Rate of interest on capital investment : @ 12% of initial cost/year
6) Housing, insurance and other expenditures :@ 1% of initial cost/year
7) Repair and maintenance cost : @5% of initial cost/year

Labour charges : 200 /- per day

Electric charge : 5rs/kwh

10.3.4.1 Fixed Costs

1) Depreciation cost of cleaner in Rs./ hr, (D)

$$= \frac{\text{Initial cost} - \text{final cost}}{\text{Life of cleaner} \times \text{Working} \frac{\text{hr}}{\text{yr}}} = \frac{18000 - 1800}{10 \times 1600}$$

= Rs. 1.01/hr

2) Interest on the machine cost in Rs./ hr,(I)

$$= \frac{\text{Average cost of machine} \times \text{rate of interest}}{\text{Working} \frac{\text{hr}}{\text{yr}}} = \frac{(18000 + 1800) \times 0.12}{2 \times 1600}$$

=Rs. 0.74/hr

3) Housing, insurance and other costs, Rs./hr (H)

$$= \frac{\text{Initial cost} \times 0.01}{\text{Working hour/year}} = \frac{18000 \times 0.01}{1600}$$

=Rs. 0.11 /hr

TOTAL FIXED COST = D + I + H =1.01 + 0.74 + 0.11 = Rs. 1.86/hr

10.3.4.2 Variable Costs

1) R =repair and maintenance cost, `/hr

$$= \frac{\text{Initial cost} \times 0.05}{\text{Working} \frac{\text{hr}}{\text{yr}}} = \frac{18000 \times 0.05}{1600}$$

=Rs. 0.56 /hr

2) W=Wages(Rs/hr)

$$= \frac{\text{Labour charge per day}}{\text{Working hour/day}} = \frac{200}{8}$$

= Rs. 25 /hr

3) E=Electric charge

1hp=750watts
working hour/day=8
electricity used=750watts x 8hr/1000 =6kwh/day
electric charge = 6 x 5 = Rs. 30/day = Rs. 3.75/hr. (= 1kwh=5rs)
Total Variable Cost= R+W +E = 0.56 + 25 + 3.75 = Rs. **29.31**/hr

Total Cleaning Cost= Total fixed cost + Total variable cost

= 1.86 + 29.31
=Rs. 31.17/hr

Cleaning cost /kg

$$= \frac{\text{Total cleaning cost}}{\text{Cleaning capacity}} = \frac{31.17}{576} = \text{Rs .0.05/kg}$$

10.3.4.3 Cost of manual cleaning:

Capacity of cleaning = 800 kg/day for two labour
Labour wages = Rs. 200 /day
Cleaning cost = 200/800= Rs. 0.25/kg
Saving of cost = 0.25 - 0.05 = Rs. 0.20/kg

Conclusion:

(1) The cleaning efficiency, for jute surface at different rpm was found maximum at 35 rpm for 2 degree angle of rotating drum, which was of the order of 99.13 %.
(2) There were no damage of sapota fruit at any rotating speed and angle of rotating angle of drum, hence damage paercentage was 0%.
(3) The maximum capacity of the machine was 576 kg/hr, at obtained at 35 rpm for 2 degree angle of rotating drum.
(4) Cost savings of about Rs. 0.20/kg or 80.00 %.

POST HARVEST MANAGEMENT OF SAPOTA

Post harvest operation for sapota crop involves cleaning, grading and packging. These operation wise machinery and technology are developed by Junagadh Centre.

CLEANING :

Manual operated sapota cleaner:

Manual operated batch type sapota cleaner for small farmers was developed by Junagadh Centre. It optimized at 70 rpm rotating speed of drum with 20kg sapota fruit per batch and resulted 99.50% cleaning efficiency with 2% damage of sapota fruits. It can be operated by one operator with 210 kg/hr capacity. The cost of machine is Rs. 7000/-.

Plate 3.1 : Manual operated sapota cleaner

Continuous type electrical motor operated sapota cleaner :

Another continuous type electrical motor operated sapota cleaner is developed by Junagadh Centre. It is optimized at 35 rpm rotating speed of drum with 2 degree angle of drum. This can be operated by two operators with 550 kg/hr capacity with 100% cleaning efficiency and without damage of sapota. The cost of machine is Rs. 18000/-.

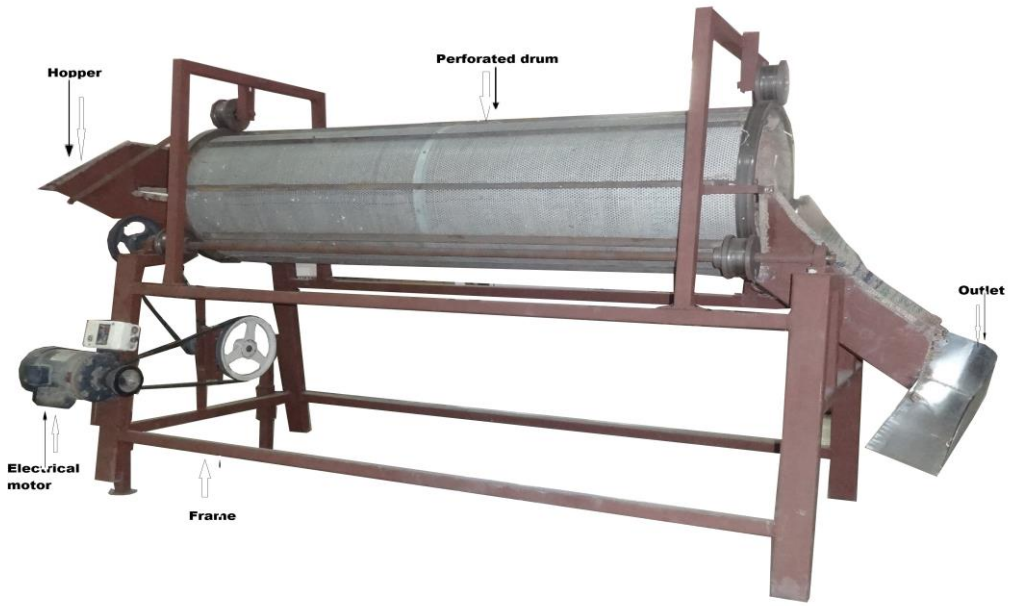

Plate 3.2 : Continuous type electrical motor operated sapota cleaner

GRADING:

Flapper type grader:

Flapper type grader was developed by Junagadh Centre. It was optimized that grading of sapota fruits can be carried out with 400 kg/hr capacity and 80 to 90% grading efficiency. The cost of grader machine is about Rs. 50000/-.

Plate 3.3 : Flapper type grader

PACKAGING:

MINIMIZING TRANSPORTATION LOSSES FOR SAPOTA

Design and development of container:

A foldable transportation container of 10 kg capacity was designed and developed to minimize transportation losses of sapota fruit. The container was made from 3.5 mm thick poly propylene sheet of 650 g/m^2 with weight of 1.40 kg. It is enclosed condition for protecting produce from adverse climate and micro-organisms. Velcro mechanism is stretched on container to erect and fold the container. The adjustable and removable cells are made to enhance the safety of fruits. Size of cells was made on the basis of size of fruits. Additional slots are offered on cell strips for different size of fruits. Separation sheets are provided to nullify impact damage at upper layer of fruits. Perforation is created for proper respiration to the produce. Reinforcement is provided at all four corners of the container. Corrugated plastic sheets are used to absorb the shocks. The container is completely foldable and reusable.

Freshly harvested uniformly matured healthy sapota (Kalipatti) was graded and sorted out manually. The experiment was mainly consisting of seven types of containers or bags with 10 kg capacity stacking in six layers (replication) for sapota viz.; gunny bag, gunny bag lined with bubble sheet, foldable plastic container, perforated poly propylene bag, corrugated fiber board (CFB) carton, egg tray in CFB carton and plastic crate. The fruits in different containers were transported from Junagadh to Jamnagar and return from Jamnagar to Junagadh by road requiring 12 h to cover approximately 350 km in goods rickshaw.

Maximum hardness (24.51 kg/cm2), firmness (12.35 kgf), bioyield point (88.88 kgf) and rupture force (96.76 kgf), marketable fruits (97.72%), sensory score (8.5) of sapota fruit were recorded in foldable plastic container. Minimum weight loss (0.70%), deformation (11.33 mm) and total soluble solids (17.44 ^{o}Brix), ripening (2.28%) and total losses (2.28%) were observed in foldable plastic container. Bruising, cracking and impact damage and decay were not observed in foldable plastic container. Transportation

losses were minimized 13.17% by using foldable plastic container as compared to gunny bag. Foldable plastic container was found the cheapest container for sapota transportation (**total cost 2167 Rs./t**) amongst all the containers and also quality of the fruits retained in the container.

Plate 3.4 : Packaging of Sapota

DEVELOPMENT OF MODIFIED ATMOSPHERE PACKAGING (MAP) FOR SAPOTA

Plate 3.5 : Modified atmospheric packaging (MAP) of Sapota

Uniformly matured fresh sapota fruits were precooled at 10°C for 1 h and pretreated with 200 ppm benomyl for 5 min. The fruits were packed in 25 µm and 40 µm LDPE bags with 5 % O_2 +5 % CO_2 and 5 % O_2 +10 % CO_2 gas concentration and stored at 6 ± 1°C and 11 ± 1°C temperature. Results revealed that sapota fruit was stored up to 35 days at 110C in 25 µm LDPE bags and fruits ripened within the package during storage.

It was optimized to pack sapota fruit in 25 micron LDPE bags with 5% Oxygen and 10% Carbon dioxide gas concentration at 6 degree centigrade temperature. It increase the shelf life of sapota fruit upto 49 days without change in physical, biochemical and sensory characteristics. The total cost of packaging of sapota fruit was estimated Rs. 4.25/kg.

11. Financial Implications (` in Lakhs)

11.1 Expenditure on

(a) Manpower : 16.05

(b) Research/Recurring Contingencies : Rs. 0.18 lakh

(c) Non-Recurring Cost (Including cost of equipment) : Rs. 0.03 lakh

(d) Any Other Expenditure Incurred : - Nil -

11.2 Total Expenditure : Rs. 16.26 lakh

12. Cumulative Output : -Nil-

a. Special attainments/innovations
b. List of Publications (one copy each to be submitted if not already submitted)
    i. Research papers
    ii. Reports/Manuals
    iii. Working and Concept Papers
    iv. Popular articles
    v. Books/Book Chapters
    vi. Extension Bulletins
c. Intellectual Property Generation
   (Patents - filed/obtained; Copyrights- filed/obtained; Designs-filed/obtained; Registration details of variety/germplasm/accession if any)
d. Presentation in Workshop/Seminars/Symposia/Conferences
   (relevant to the project in which scientists have participated)
e. Details of technology developed
   (Crop-based; Animal-based, including vaccines; Biological – biofertilizer, biopesticide, etc; IT based – database, software; Any other – please specify)
f. Trainings/demonstrations organized
g. Training received
h. Any other relevant information

13. (a) Extent of achievement of objectives and outputs earmarked as per RPP-I

Objective wise	Activity	Envisaged output of monitorable target(s)	Output achieved	Extent of Achievement (%)
1.	To design a continuous sapota cleaner.	Designing of machine	Designing is completed	100%
2.	To develop a continuous sapota cleaning unit.	Machine development as per desing	Development is completed	100%
3.	To evaluate the performance of Sapota cleaning unit.	Performance on the basis of cleaning efficiency to be completed	Cleaning efficiency, damage percentage, and output capacity is completed	100%
4.	To synchronize the post harvest operations, viz. cleaning, grading and packaging of sapota.	It should match with capacity of developed sapota grader	The capacity of machine is attained according to grader and hence, complete post harvest operations like cleaning, grading and packaging of sapota can be carried out.	100%

(b) Reasons of shortfall, if any

14. Efforts made for commercialization/technology transfer : After recommendation, the technology will be demonstrated to the users.

15. (a) How the output is proposed to be utilized? : The machines can be utilized by the cooperative or large farmers to clean, grade and package their sapota fruits in market in time.

(b) How it will help in knowledge creation? Traditional methods of cleaning, grading and packaging is laborious and losses sapota fruits during transportation due to packaging. This knowledge will help to farmers for saving labour and fruits.

16. Expected benefits and economic impact(if any) : This is labour saving technology as well economy due to saving labour cost and timed marketing of cleaned, graded and well packaged fruits.

17. Specify whether the project requires submission of RPP-IV for up scaling of research output. : -No-

18. Future line of research work/other identifiable problems : -NA-

19. Details on the research data (registers and records) generated out of the project deposited with the institute for future use : Details are given in point 10.

20. Signature of PI, CC-PI(s), all Co-PIs

21. Signature of Head of Division

22. Observations of PME Cell based on Evaluation of Research Project after Completion

23. Signature (with comments if any along with rating of the project in the scale of 1 to 10on the overall quality of the work) of JD (R)/ Director

ANNEXURE - VIII

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

(For Guidelines Refer ANNEXURE – XI(H))

PROFORMA FOR RESEARCH PERFORMANCE EVALUATION OF INDIVIDUAL SCIENTIST

1. Institute Project Code *

2. Evaluation by PI on the contribution of the team in the project including self

S. No.	Name	Status in the project (PI/CC-PI/Co-PI)	Rating in the scale of 1 to 10
1	Dr. M. N. Dabhi	PI	9

3. Signature of PI

ANNEXURE - VIII

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

(For Guidelines Refer ANNEXURE – XI(H))

PROFORMA FOR RESEARCH PERFORMANCE EVALUATION OF INDIVIDUAL SCIENTIST

1. Institute Project Code *

2. Evaluation by PI on the contribution of the team in the project including self

S. No.	Name	Status in the project (PI/CC-PI/Co-PI)	Rating in the scale of 1 to 10
1	Prof. P. R. Davara	Co-PI	9

3. Signature of PI

SUMMARY OF PROGRESS REPORT

1. PH/JU/85/1.Operational research project on Agro- processing center.

At TadkaPipliya agro processing center, flour milling and oil milling operations were carried out. About 19 ton groundnut was processed and 325 tins oil were filled. The VithalpurKhambhaliya has also graded of about 1.5 tons of wheat for the farmers.

At Agro Processing Centre, Virol, about 20 tons of groundnuts were processed for the farmers. About 6 ton of wheat grains were graded for the farmers at the centre.

At Agro Processing Centre, Loej, about 11 tons of groundnuts were processed for the farmers. About 1 ton of wheat grains were graded for the farmers at the centre.

A new Agro Processing Centre, was established under TSP project at Vadala, Ta. Talala, Dist. GirSomnath.

2. PH/JU/2011/02 Extraction of pectin from Kesar mango peel by resins.

The research component of the project was completed. The pilot plant for pectin extraction with limited sources of equipment was carried out.

3. PH/JU/2013/02Post Harvest Management of Sapota

For complete package of post harvest package of sapota, grader was already developed by Junagadh Centre. Packaging of sapota for transportation was also developed by AICRP on Plasticulture Engineering and Technology, Junagadh Centre. Hence it was necessary to develop continuous type sapota cleaner to complete post harvest operations. Manual operated and continuous type sapota cleaner are developed by this centre. Thus complete line of post harvest management of sapota is prepared for post harvest operations, viz., cleaning, grading and packaging of sapota.

Tentative Technical Programme for the year 2015-2016

Sr. No.	Code No.	Title
1.	PH/JU/85/1	Operational research project on Agro-processing center.
2.	Ongoing Project	ICAR-FCI project - Study on Determining Storage Losses of Food Grains in FCI and CWC Warehouses
3.	New Project	Design and development of on farm solar assisted dryer for drying of ground nut pods for longer storage.
4.	New Project	To study the effect of different packing materials against Groundnut Bruchid (Caryedon serratus Olivier) during storage.
5.	New Project	Design and development of banana bunch harvesting tool.
6.	New Project	Extraction of Citric acid from banana peels using Aspergillus niger fungi.

Action taken report of Proceeding of 30th Biennial Workshop held at UAS, Bangalore during 6-9, January, 2015

and

Proceeding of the Expert Committee Meeting held at ICAR, New Delhi during 20 & 21 Janunary, 2015

Sr. No.	Experiment	Comments 30th Workshop	Action	Comments Expert committee	
1	Extraction of pectin from *Kesar* mango peel	Establishment of pilot plant for pectin extraction.	Pectin extraction was carried out in quantity. For pilot plant special grant is required to purchase special equipment. RPP IV was filled and sent to PC office.	-	-
2	Post harvest management of sapota	Complete the project by March 2015	Performance of continuous type sapota cleaner is evaluated and it can be used for continuous operation of post harvest management of sapotaalongwithsapota grader and packaging. Complete line of post harvestsapota management is carried out for cleaning, grading and packaging of sapota.	-	-
3.	Application of natural and artificial antimicrobial agents for inactivation of microbes presents on surface of lemons and custard apples fruits.	The decision was deferred for separate meeting	-	Project was not approved	The project was dropped as per comments of expert committee.

4.	Shelf life enhancement of lime	The decision was deferred for separate meeting	-	-	-
5.	To study the effect of sun drying on groundnut for the control of Groundnut Bruchid (Caryedonserratus Olivier.) during storage	-	-	Project was not approved	The project was dropped as per comments of expert committee.

NEW INVESTIGATION – I

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
PROFORMA FOR PREPARATION OF STATUS REPORT
FOR PROPOSAL OF A NEW RESEARCH PROJECT
(Refer for Guidelines ANNEXURE-XI(A))

1. Institute Name : Junagadh Agricultural University, Junagadh.

2. Title of the project : Design and development of on farm solar assisted dryer for drying of ground nut pods for longer storage.

3. Type of research project: Basic/Applied/Extension/Farmer Participatory/Other (specify) : Applied

4. Genesis and rationale of the project

India produces 8-10 million tons of groundnut with an average yield of 1200 kg/ha. About 80 per cent of total production is used for oil extraction, 11 per cent as seed, 8 per cent direct food uses and 1 per cent for export as HPS Kernel. Gujarat cultivates about 18.51 lakh hectare which is almost 40.21 per cent of the total groundnut area in India. Saurashtra region contributes to 85 per cent and 81per cent of area and production respectively (Chavda, 2010). Cultivation area under groundnut crop during 2013-14 in Gujarat was 1842 thousand hectares produced 5445 thousand metric tons with a productivity of 2956 kg/ha (Anonymous, 2014).

In Gujarat, groundnut farming involves two cropping seasons. One is generally harvested at the peak of the rainy season. At digging time, groundnuts generally contain about 35 to 45 % (wb) moisture, Without reducing moisture content to about 7 to 8 % (wb), the produce is quite susceptible to contamination by moulds, especially at the warm temperatures and high humidities in the tropics. This condition leads to decrease the shelling efficiency and milling quality and also development of aflatoxins when spoilage occurs. Several researchers recommended storing the unshelled ground nut rather than kernel. It becomes necessary to reduce the initial moisture content of ground pods to 5 % (wb) or less and that of ground nut kernel to 7-8 % (wb) or less for safe storage. Most of the farmers have poor drying and storage facilities. If such moisture levels are maintained, unshelled groundnuts can be stored without significant loss in quality for long storage period. Groundnut drying systems and aflatoxin contamination have been the main constraints in improving peanut quality to meet industrial market standards. There is high demand for toxin free produce in the international market.

Presently, farmers of Saurashtra region followed the traditional open air sun drying method for drying of groundnut pods. Over the last two decades, open air drying has gradually become more and more limited because of the requirement for a large area, limitation of time, the possibilities of quality degradation, high level of dust and atmospheric pollution from the air, cloudiness and rain, intrusion from animals and man, infestation caused by birds and insects and inherent difficulties in controlling the drying process. In addition to this, open air drying of ground nut, i.e., peg drying, windrow drying methods will also reduce the time for preparation of land for the next crop. Under these conditions the seed loses its quality and viability in storage rapidly. Smallholder farmers store groundnut as pods, in earthen pots, mud

bins, bamboo baskets or in other types of receptacles. Such containers are often plastered with mud and cow dung with little or no use of pesticides.

In view of above constraints, there is a need to develop economic drying system operated by renewable energy sources in order to reduce the post harvest losses, to improve the overall qualities of ground kernel, to increase the storage life and to inhibit the attacks of moulds, afflatoxin, bruchid, etc.

5. Knowledge/Technology gaps and justification for taking up the present project including the questions to be answered

Post-harvest losses in Groundnut occur at different stages at curing, drying, storages, threshing, cleaning, winnowing, packaging, transportation, processing and marketing. It has been estimated that post-harvest pod losses in harvesting varies from 16 to 47 percent, whereas, in curing / drying 5 to 50 percent. The losses during storage are mainly due to driage loss and through damage by rodents and pests. Damage also occurs due to dampness which develops the moulds, leading to contamination with Aflatoxin. This might be attributed to lack of knowledge of post harvest operations, lack of drying / storage facilities, adoption of traditional post harvest methods as well as financial limitations of small scale farmers.

The traditional open air sun drying methods for groundnut, viz., drying of plant with pods, windrows methods leads the post harvest losses due to its several drawbacks. The final product obtained by these traditional methods is of inferior in quality, discoloured, non-uniform dried and poor in storability. In addition to this, these traditional drying methods take longer period (10 to 15 days) for the desired moisture content of groundnut pods, prolong exposure to direct sun rays results in deterioration of the quality. Also, it requires large place and reduces the attention of the farmer for the next crop.

So, there is a need to design an on farm level solar assisted hybrid drying system for groundnut pods on the basis of local cultivar of groundnut grown in the Saurashtra region. The developed drying system could be able to dry the groundnut pods uniformly in 14 to 15 hours (i.e., 2 days) to safe moisture content (7-8 % (wb)) with least drying cost as well as minimizes the post harvest losses occurs during drying and gives better storability of groundnut pods during storage.

6. Critical review of present status of the technology at national and international levels along with complete references

Chavda (2010) studied the aspirations of the farmers for scientific post harvest techniques in groundnut crop for 10 villages of South Saurashtra Agro-climatic Zone, Gujarat. There is no information available on aspirations of farmers toward scientific post harvest techniques of groundnut crop. It was concluded that the majority of the groundnut growers had aspiration to increase their production and to increase their land in next three year. Majority of the groundnut growers were expected to purchase of pod plucking machine and to reducing the losses of groundnut production during the post harvest practices of grading of pods, marketing place for better price, storage method, advanced drying method, cleaning and winnowing of pod.

Post-harvest losses during storage are among the major problems of the tropical environment, where high relative humidity and temperature are prevalent. As a consequence, mould growth in groundnut seed contributes considerable to bio-deterioration. Groundnut being an oilseed crop is more prone to mould attack than starchy seeds. Lipid peroxidation results in the formation of aldehydes, ketones and other low molecular weight compounds, which may cause off-flavours and odours in stored groundnut seed. Further, these react with proteins, amino acids and vitamins to decrease the seed quality (FAO, 2002).

It is best to store groundnuts in their shell. Good drying of the pods to 7-8% moisture content will help to ensure that the seeds remain in good condition during storage. Never bag groundnuts for storage when the pods are still dump. Before storing, poor, damaged shriveled, rotten, or fungus-infected pods should be removed. Whatever the storage container, it is important to ensure that the store is dry and that there is good ventilation so that the pods/seeds do not increase in moisture content, which would encourage fungal growth. Ideally the store should be cool as this is prolonged the storage life of the pods (http://www.teca.fao.org).

The correct drying or curing of the harvested groundnuts is very important as poor curing can help induce fungal growth (producing aflatoxin contamination) and reduce seed quality for consumption, marketing and germination for the following seasons planting. For good storage and germination, the moisture content of the pods should be reduced to 6-8%. There are different ways of drying the pods, some of which are better than other. It is particularly important to note that if the pods are exposed to the sun for too long the seed quality can deteriorate considerably and germination can be affected. Mada et al. (2014) reported 30 % post harvest loss of ground during various post harvest operations, viz., drying, storage, threshing, transportation, packaging and marketing.

Irtwange and Adebayo (2009) developed and evaluated a laboratory-scale passive solar grain dryer using 10 kg of freshly harvested maize at 32.8%wb. The performance evaluation results obtained showed that the mean drying rate of the dryer was 0.7 kg/day per every 10 kg of corn whereas sun-drying rate was 0.3125 kg/day comparatively. The solar dryer has considerable advantages over the traditional sun drying method in terms of faster drying rate, less fear of spoilage by micro-organisms when crop is harvested at high moisture content and handling convenience. Savings in time was achieved by using the solar grain dryer as against the traditional sun drying. It took 4-days to dry the corn to moisture content of 13.1%wb using the passive solar dryer while it took 8-days to dry to 13.4%wb under sun drying. Commercial sizes of the solar dryer can be amplified and produced for community level cooperative use and for prospective investors to fast track agricultural development in the rural areas.

Drew (2011) designed and evaluated a natural-convection solar dryer capable of producing dried mango slices in rural communities of Haiti. Evaluation of the solar dryer in Gainesville, Florida found temperatures inside the cabinet significantly elevated compared to environmental air with temperature increases of up to 32.4°C and 40.0°C depending on airflow and loading. Loading tests conducted with an average of 9.80kg of fresh mango slices resulted in effective drying within two days from a moisture content of 84% (wb) down to approximately 9.4% (wb) and 11.1% (wb) for batch and continuous modes of operation,

respectively. The collector efficiency, drying efficiency and system efficiency were 29.5%, 10.8% and 33.9%, respectively. These results indicated sufficient drying and preservation of mango slices within two full days of sunlight. The quality of solar-dried product was competitive with commercially-available mango slices.

Bukola et al. (2008) designed and evaluated performance of a mixed-mode solar dryer for food preservation. In the dryer, the heated air from a separate solar collector passed through a grain bed, and at the same time, the drying cabinet absorbs solar energy directly through the transparent walls and roof. The results obtained during the test period revealed that the temperatures inside the dryer and solar collector were much higher than the ambient temperature during most hours of the day-light. The temperature rise inside the drying cabinet was up to 74% for about three hours immediately after 12.00h (noon). The drying rate and system efficiency were 0.62 kg/h and 57.5% respectively. The rapid rate of drying in the dryer reveals its ability to dry food items reasonably rapidly to a safe moisture level.

A conceptual prototype solar dryer for drying sea cucumber was designed which has its advantages over the traditional open sun drying methods such as reducing the loss due to damage caused by insects, birds, rodents and adverse climatic conditions. The drying period using the conceptual solar dryer is 1 -2 days whereas it takes 4 -14 days in the traditional open sun drying methods(Vaipulu, 2009).

Solar drying is a good alternative to sun drying, especially for farmers in developing countries. In comparison with sun drying, solar dryers can generate higher air temperatures and consequently lower air relative humidity, both of which are conducive to improved drying rates and lower final moisture contents of the dried product. This advantage reduces the risk of spoilage both during the actual drying process and in storage. The higher temperatures attainable are also a deterrent to insect and microbial infestation, and protection against dust, insects, and animals is enhanced by drying in an enclosed structure (Bassey and Schmidt, 1986).

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7. Expertise available with the investigating group/Institute :

Microbiologist, post harvest engineer, renewable energy engineer, biochemist and entomologist are available in the institute.

8. Brief note on Proprietary/Patent Perspective (for projects related to technology development)/Ethics/Animal Welfare/Bio Safety Issues

Technology based on renewable energy will be available.

9. (a) Expected output

i. Reduction in post harvest losses occurs during drying and storage of groundnut pods.

ii. Farmers of Saurashtra region benefited in terms of drying time, qualitative and quantitative losses of groundnut, preparation of land for next crop as well as hazards of various diseases (afflatoxin, bruchid, etc).

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(b) Clientele/Stake holders (including economic and socio aspects)

i. It also provides a unique guide for the concerned stakeholders on how best to use the solar energy for drying of groundnut pods with minimization of drying cost.

ii. It also provides an opportunity to farmers, concerned entrepreneurs and stake holders to cost comparison for the use of solar energy as a fuel with the traditional drying methods and power operated industrial level drying systems.

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10. Signatures

[Project Leader] [Co-PIs] ……

11. Comments and signature

[Head of Division]

ANNEXURE- II

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

RESEARCH PROJECT PROFORMA FOR INITIATION OF A RESEARCH PROJECT (RPP - I)

(Refer for Guidelines ANNEXURE-XI (B))

1. **Institute Project Code (to be provided by PME Cell)**
2. **Project Title** : Design and development of on farm solar assisted dryer for drying of ground nut pods for longer storage.
3. **Key Words** : Drying, groundnut, solar, on farm
4. **(a) Name of the Lead Institute** :
   Junagadh Agricultural University, JUNAGADH – 362 001
   (b) Name of Division/ Regional Center/Section :
   AICRP on Post Harvest Technology,
   Department of Processing and Food Engineering,
   College of Agricultural Engineering & Technology,
   Junagadh Agricultural University, JUNAGADH – 362 001
5. **(a) Name of the Collaborating Institute(s), if any** : No
   (b) Name of Division/ Regional Center/ Section of Collaborating Institute(s) : NA
6. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time proposed to be spent)

Sr. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)	Time to be spent (%)	Work components to be assigned to individual scientist
1.	Dr. S. P. Cholera	PI	50 %	Design, fabrication, testing and performance evaluation of developed dryer
2.	Prof. R. D. Dhudeshiya	Co-PI	10 %	Entomological analysis
3.	Prof. A. M. Joshi	Co-PI	10 %	Microbiological analysis
4.	Dr. P. N. Sarsavadia	Co-PI	10 %	Designing of dryer
5.	Dr. M. N. Dabhi	Co-PI	10 %	Monitoring and helping in Design, fabrication, testing and performance evaluation of developed dryer
6.	Dr. P. J. Rathod	Co-PI	10 %	Food safety

7. **Priority Area to which the project belongs** : Food quality, food safety, innovative product, output and resource efficiency
   (If not already in the priority area, give justification)
8. **Project Duration**: **Date of Start** : February, 2016
   LikelyDate of Completion :December, 2018

9. (a) Objectives

(1) Design and development of on farm solar assisted dryer for drying of groundnut Pods
(2) To study drying characteristics of groundnut pods using developed dryer
(3) To evaluate the quality of the dried groundnut pods during storage period period.
(4) To evaluate the performance of the developed dryer.
(5) To study the economic feasibility of the developed dryer

(b) Practical utility :

Traditional methods of direct sun drying and storage is not suited for groundnut pods, farmers of Saurashtra region may need to develop a new kind of solar assisted groundnut pod dryer to reduce long drying time, post harvest losses and quality deterioration. These traditional methods leads to 20 to 30 % post harvest losses of groundnut. Solar assisted groundnut pod dryer enable the farmer to avoid field drying by permitting adequate drying of groundnut with a starting moisture content of around 15 to 17 %. The farmers of Saurashtra region will also benefited in terms of drying time, qualitative and quantitative losses of groundnut, preparation of land for next crop as well as hazards of various diseases (afflatoxin, bruchid, etc). The earning of farmers will also increase by producing good quality final product, as it could be able to meet the levels qualities desired by industrialists, exporters or processors.

10. Activities and outputs details

Objective wise	Activity	Month & Year of		Output monitorable target(s)	% to be carried out in different years			Scientist(s) responsible
		Start	Comp-letion		1	2	3	
1.	Planning, designing, fabricating the dryer and purchasing the relevant materials	February - 2016	November - 2017	Design and fabrication of dryer	√			Dr. S. P. Cholera Dr. P. N. Sarsavadiya
2.	Drying of groundnut pods, quality evaluation of dried product during storage,etc	November - 2017	June - 2018	Drying and quality evaluation of dried product during storage		√		Dr. S. P. Cholera Dr. P. J. Rathod Prof. A.M. Joshi Prof. R.D. Dhudishiya

3.	Performance evaluation, economic feasibility, etc	June - 2018	Dece mber-2018	Performance evaluation in terms of temperature raising & thermal efficiency of developed dryer			√	Dr. S. P. Cholera Dr. M. N. Dabhi

11. Technical Programme (brief)

- Designing of hybrid dryer.
- Purchase of the relevant materials.
- Fabrication of the designed dryer.
- Drying of groundnut pods
- Performance evaluation, economic feasibility, etc
- Quality evaluation of dried product
- Storage of dried pods
- Quality evaluation of stored pods.

12. Financial Implications (` in Lakhs)

13.

(A) Financed by the institute

12.1 Manpower (Salaries / Wages)

S. No.	Staff Category	Man months	Cost
1.	Scientific	22	1512000
2.	Technical	6	24000
3.	Supporting	6	24000
4.	SRFs/RAs	--	--
5.	Contractual	--	--
	Total	34	1560000

12.2 Research/Recurring Contingency

S. No.	Item	Year(1)	Year (2)	Year (3)…	Total
1.	Consumables	250000	50000	50000	350000
2.	Travel	3000	2000	--	5000
3.	Field Preparation/ Planting/ Harvesting (Man-days/costs)	--	--	--	--
4.	Inter-cultivation & Dressing (Man-days/costs)	--	--	--	--
5.	Animal/Green house/Computer Systems/Machinery Maintenance	--	--	--	--
6.	Miscellaneous(Other costs)	5000	5000	5000	15000
	Total(Recurring)	208000	57000	55000	320000

Justification : For purchase of raw material for construction of dryer, drying material, chemicals, etc.

12.3 Non-recurring (Equipment)

S. No.	Item	Year (1)	Year (2)	Year (3)…	Total
1.	Blower (2 hp)	30000			30000
2.	Pyranometer	250000			250000
.3.	Hot wire anemometer	100000			100000
4.	Orifice meter	100000			100000
	Total (Non-recurring)	480000			480000

Justification : Integral part and analytical instruments required for developed dryer.

12.4 Any Other Special Facility required (including cost)

12.5 Grand Total (12.1 to 12.4)

Item	Year (1)	Year (2)	Year (3)…	Total
Grand Total	1208000	577000	575000	2360000

(B) Financed by an organization other than the Institute (if applicable) - **NA**

(i) Name of Financing Organization
(ii) Total Budget of the Project
(iii) Budget details

No.	Item	Year(1)	Year(2)	Year (3)…	Total
	Recurring Contingency				
	Travelling Allowance				
	Workshops				
	Contractual Services/ Salaries				
	Operational Cost				
	Consumables				
	Non - Recurring Contingency				
	Equipment				
	Furniture				
	Vehicle				
	Others (Miscellaneous)				
	HRD Component				
	Training				
	Consultancy				
	Works (i) New (ii) Renovation				
	Institutional Charges				

7. Expected Output : Renewable energy will be used for drying of groundnut pods. Dried groundnut pod will be useful for further use. This will be safe against bruchid and aflatoxin.

8. Expected Benefits and Economic Impact : Export of bruchid and aflatoxin will give more revenue to producer.
9. Risk Analysis
10. Signature

Project Leader Co-PI-I Co-PI-II Co-PI–n

11. Signature of HoD

12. Signature of JD (R)/ Director

ANNEXURE - III

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CHECKLIST FOR SUBMISSION OF RPP-I

(Refer for Guidelines ANNEXURE-XI(C))

1. Project Title : Design and development of on farm solar assisted dryer for drying of ground nut pods for longer storage.

2. Date of Start & Duration : February 2016 to December 2018

3. Institute Project ☐ or Externally Funded ☐

4. Estimated Cost of the Project : Rs. 2360000/-

5. Project Presented in the Divisional/Institutional Seminar? ~~Yes~~ / No

6. Have suggested modifications incorporated? ~~Yes~~ / No

7. Status Report enclosed Yes ~~/ No~~

8. Details of work load of investigators in approved ongoing projects:

Project Leader				Co-PI – I				Co-PI – II…
Proj. Code.	% Time spent	Date of start	Date of compl -etion	Proj. Code.	% Time spent	Date of start	Date of completion	……
				PH/JU/ 2013/ 02	70%	2014	2016	

9. Work Plan/Activity Chart enclosed Yes / ~~No~~

10. Included in Institute Plan Activity Yes / ~~No~~

11. Any previous Institute/Adhoc/Foreign aided projects on similar lines? ~~Yes~~ / No

12. New equipment required for the project Yes / ~~No~~

13. Funds available for new equipment ~~Yes~~ / No

14. Signatures

Project Leader Co-PI-I Co-PI-II Co-PI–n

HOD/PD/I/c

ANNEXURE - IV

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

APPRAISAL BY THE PMECELL OF RPP-I

(Refer for Guidelines ANNEXURE-XI (D))

1. Institute Name
2. Project Title
3. On scale 1-10 give score to (a) to (j)

(a)	Relevance of research questions	☐
(b)	Addressing priority of the institute and/or National priority	☐
(c)	New innovativeness expected in the study	☐
(d)	Appropriateness of design/techniques for the questions to be answered	☐
(e)	Elements of bias addressed in the study	☐
(f)	Adequacy of scientist(s) time allocation	☐
(g)	Extent of system review and meta analysis	☐
(h)	Effective control to experiments	☐
(i)	Economic evaluation and cost efficiency analysis	☐
(j)	How appropriately the expected output answers the questions being addressed in the specific subject matter/area (Basic/Applied/Translational/Others)?	☐
	***Total Score out of 100**	

* The score obtained is suggestive of the overall quality ranking of the project

4. Was there any other project carried in the past in the same area/topic?

   Yes ☐ No ☐

   If yes, list the project numbers.

5. Signature of PME Cell Incharge

NEW INVESTIGATION – II

ANNEXURE - I
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
PROFORMA FOR PREPARATION OF STATUS REPORT
FOR PROPOSAL OF A NEWRESEARCH PROJECT
(Refer for Guidelines ANNEXURE-XI(A))

1. Institute Name : Junagadh Agricultural University, Junagadh

2. Title of the project : To study the effect of different packing materials against Groundnut Bruchid (Caryedon serratus Olivier.) during storage

3. Type of research project: Basic/Applied/Extension/Farmer Participatory/Other (specify) : Applied

4. Genesis and rationale of the project :

   Groundnut is an important oilseed crop in India. In India, groundnut occupies 4.77million hectares area with total production of 4.75 million tonnes in year 2012-13.(anonymous 2015a). Groundnut when stored is often attacked by number of pests, viz. groundnut bruchid, rust red flour beetle, rice moth etc. In Gujarat, groundnut farming involves two cropping seasons. One is generally harvested at the peak of the rainy season. At digging time, groundnuts generally contain about 35 to 45 % (wb) moisture, Without reducing moisture content to about 7 to 8 % (wb), the produce is quite susceptible to contamination by moulds, especially at the warm temperatures and high humidities in the tropics. This condition leads to decrease the shelling efficiency and milling quality and also development of aflatoxins when spoilage occurs. The heat and moisture generated by a large insect population in storage also increase the risk of mould growth which indirectly spoils the quality of groundnut. Hence farmers have a problem for storing of groundnut.

5. Knowledge/Technology gaps and justification for taking up the present project including the questions to be answered :

   Generally plant protection scientists have worked on storage of groundnut seed. However, very little information is available on pest incidence in different packing materials during storage of groundnut pods. Thus it is necessary to find out the effective packing materials for safe storage of groundnut pods.

6. Critical review of present status of the technology at national and international levels along with complete references

   Groundnut bruchid (Caryedon serratus Olivier.) is one of the major and important storage insect species, causing more damage to groundnut (Dick, K. M. 1987a). 20% dry weight loss of kernals due to bruchid infestation in warehouse in AndraPradesh was reported by Dick K.M. (1987b). Bruchid infestation reduces

the market value and germination of seeds. Various scientists were tested different packing materials for minimizing storage losses of groundnut. The minimum loss due to bruchid on both count and weight basis was observed in groundnut stored in jute bags followed by that in polyethylene lined bags (Anonymous 1993). Basavegowda and Y. A. Nanjareddy (2008) reported that use of poly lined (300gauge) gunny bag+ silica gel 30gm/kg pod gave better germination than gunny bag. Sudini H. et al (2012) was tested PICS bag for groundnut storage and found less infestation of bruchid as compared to gunny bag. Alam M.M. et al (2013)reported that shelled groundnut seed could be stored safely from one rabi season to next if stored in polythene bags after drying 8% initial seed moisture content. Harish G. et al (2014) reported that super grain bags recorded minimum number of egg laid, less damage and minimum weight loss in pod and kernel in comparison to other storage bags. Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content less than 5% was reported by Tamilnadu Agricultural University, India.(anonymous 2015b).

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Harish G., Natrajan M V., Ajay B.C., Prassanna H., Savlia S.D. and Gedia M.V. (2014) Comparative efficacy of storage bags,storability and damage potential of bruchidbeetle.Journal of food science and Technogy,51(12);4047-4053.

Sudini H., C.L.L. Gowda, V.Mugam and L.L.Murdock (2012) Evaluating PICS for Groundnut. Purdue improved crop storge workshopApril,10-12,2012,Accra,Ghana

7. Expertise available with the investigating group/Institute :

   Entomologist, Microbiologist and Post harvest engineers are available.

8. Brief note on Proprietary/Patent Perspective (for projects related to technology development)/Ethics/Animal Welfare/Bio Safety Issues

9. (a) Expected output

i. The outcome of this project will help to the farmers and processors in reduction of post harvest losses occur during storage of groundnut pods. Same time they may also get without chemically treated groundnut and safe to human being.
ii. The technology is safe to environment and reduce weight loss during storage. Farmer and traders can stored groundnut pods longer period and get more market price.

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a. Clientele/Stake holders (including economic and socio aspects)
    i. Farmers can store their product for market at right price.
    ii. Traders, oil millers can store groundnut pod to use at right time.

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10. Signatures

[Project Leader] [Co-PIs] ……

11. Comments and signature

[Head of Division]

ANNEXURE- II
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
RESEARCH PROJECT PROFORMA FOR INITIATION OF A RESEARCH PROJECT (RPP - I)
(Refer for Guidelines ANNEXURE-XI (B))

13. Institute Project Code (to be provided by PME Cell)
14. Project Title : To study the effect of different packing materials against Groundnut Bruchid (*Caryedon serratus* Olivier.) during storage
15. Key Words : Groundnut Storage, Bruchid beetle, Packing materials
16. (a) Name of the Lead Institute : College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh
    (b) Name of Division/ Regional Center/ Section : AICRP on PHET, Junagadh centre
17. (a) Name of the Collaborating Institute(s) :
    (b) Name of Division/ Regional Center/ Section of Collaborating Institute(s) :
18. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time proposed to be spent)

S. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)	Time to be spent (%)	Work components to be assigned to individual scientist
1.	R.D.Dhudashia Assistant Entomologist, AICRP on PHET, Dept. of Processing and Food Engg., College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	PI	60%	planning, data collection, statistical analysis and final report Writing
2.	A.M.Joshi, Assistant Moicrobiologist, AICRP on PHET, Dept. of Processing and Food Engg., College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	Co-PI	20%	Helping in analysis and data collection
3.	Dr. M. N. Dabhi, Research Engineer, AICRP on PHET, Dept. of Processing and Food Engg., College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	Co-PI	20%	Supervision and Co-ordination

19. Priority Area to which the project belongs : Post Harvest Technology
(If not already in the priority area, give justification)

20. Project Duration: Date of Start: March-2016
LikelyDate of Completion **:** Feb-2018

21. (a) Objectives

1. To study insect infestation and its damage to pods in different packing materials in stored groundnut
2. To evaluate the effect of packing materials on germination of seeds of groundnut during storage.
3. To study on moisture content and aflatoxin level in different packing materials for safe storage of groundnut

(b) Practical utility

- For safe storage of groundnut, effective storage bag against bruchid infestation will be find out.
- Losses during storage will be reduced
- Farmer will get more market price
- Farmers will store groundnut without using any hazardous chemicals
- This technology is safe to environment.

10. Activities and outputs details

Objective wise	Activity	Month & Year of		Output monitorable target(s)	% to be carried out in different years			Scientist(s) responsible
		Start	Comp-letion		1	2	..	
1.	Planning the experi-ment	March 2016	March 2016	Purchasing the materials and storage of groundnut in different bags.	--	--	--	R.D.Dhudashia M.N.Dabhi
2.	Data collection	April 2016	Janu-ary 2017	Experiment critically examine and collection of observation data for different parameter.	--	--	--	R.D.Dhudashia A.M.joshi
3.	Statistical analysis and Report writing	Feb-2017	Feb-2017	Analysis the data and preparation of report.	--	--	--	R.D.Dhudashia

11.Technical Programme (brief):

Justification :

Groundnut is an important oilseed crop in India. In India, groundnut occupies 4.77million hectares area with total production of 4.75 million tonnes in year 2012-13.(anonymous 2015a). Groundnut when stored is often attacked by number of pests, viz. groundnut bruchid, rust red flour beetle, rice moth etc. Among this, groundnut bruchid (*Caryedon serratus* Olivier.) is one of the major and important storage insect species, causing more damage to groundnut (Dick, K. M. 1987a).

20% dry weight loss of kernals due to bruchid infestation in warehouse in Andra Pradesh was reported by Dick K.M. (1987b). Bruchid infestation reduces the market value and germination of seeds. The heat and moisture generated by a large insect population in storage also increase the risk of mould growth which indirectly spoils the quality of groundnut. Hence farmers have a problem for storing of groundnut. Various scientists were tested different packing materials for minimizing storage losses of groundnut. The minimum loss due to bruchid on both count and weight basis was observed in groundnut stored in jute bags followed by that in polyethylene lined bags (Anonymous 1993). Basavegowda and Y. A. Nanjareddy (2008) reported that use of poly lined (300gauge) gunny bag+ silica gel 30gm/kg pod gave better germination than gunny bag. Sudini H. *et al* (2012) was tested PICS bag for groundnut storage and found less infestation of bruchid as compared to gunny bag.Alam M.M. *et al* (2013)reported that shelled groundnut seed could be stored safely from one rabi season to next if stored in polythene bags after drying 8% initial seed moisture content. Harish G. *et al* (2014) reported that super grain bags recorded minimum number of egg laid, less damage and minimum weight loss in pod and kernel in comparison to other storage bags. Store the seeds in 700 gauge polythene bag for long term storage (more than15 months) with seed moisture content less than 5% was reported by Tamilnadu Agricultural University, India.(anonymous 2015b).Generally plant protection scientists have worked on storage of groundnut seed. However, Very little information is available on pest incidence in different packing materials during storage of groundnut pods. Thus it is necessary to find out the effective packing materials for safe storage of groundnut pods.

Objectives:

1. **To study insect infestation and its damage to pods in differentpacking materials in stored groundnut pods.**
2. **To evaluate the effect of packing materials on germination of seeds of groundnut during storage.**
3. To study on moisture content and aflatoxin level in different packing materialsfor safe storage of groundnut pods.

Technical programme:

(a) Design: CRD
(b) Replication: 3
(c) Treatments: 8

1. Jute bags
2. Fertilizer bags
3. Inner polyethylene lined jute bags
4. Inner polyethylene lined Fertilizer bags
5. Polythene (700 gauge) bag
6. PICS bags
7. Closely woven net bags
8. Cloth bags

Observation to be recorded:

(A) Entomological Parameters:
   i. Pest population
   ii. Percent pods damage on number and weight base

(B) Physical parameters
   i. Germination percentage
   ii Moisture content percentage

(C) Microbial parameters

i Aflatoxinpercentage

Possible outputs :

1. The outcome of this project will help to the farmers and processors in reduction of post harvest losses occur during storage of groundnut pods. Same time they may also get without chemically treated groundnut and safe to human being.
2. The technology is safe to environment and reduce weight loss during storage. Farmer and traders can stored groundnut pods longer period and get more market price.

References :

Alam M.M.,Rehman M.M.,AsharafR.,andraheman M.M.(2013) Effect of storage container and initial seed moisture content on quality of shelled groundnut seed.J.Agrofor.Environ.7(1):23-26

Anonymous (1993) Studies on groundnut bruchid (Caryedon serratus Oliver)in Gujarat Annual report 1993,AICRP on PHT, Junagadh Agricultural University, Junagadh,Gujarat

Anonymous,(2015a) All India Area, production and yield status of major crops during 2012- 13 and 2011-12.Diractorate of economics and statistics, Ministry of agriculture, Govt. of India.WWW.krishjagran.com

Anonymous,(2015b) Seed:Oilseed: Groundnut www.agritech.tnau.in/seed certification/seed groundnut.

Basavegowda and Y.A. Nanja Reddy (2008) storage of rabi or summer groundnut with desiccant to prolong seed viability and seedling vigour. Karnataka J.Agri.Sci.21(3): 353-356

Dick, K.M.(1987a). Pest Management in stored groundnuts. Information bulletin No.22.,Pantancheru, A.P.502324.ICRISAT

Dick K.M.(1987b) Losses caused by insect to groundnut stored in warehouse inIndia.Tropical Sci.27(2):65-75.

Harish G., Natrajan M V., Ajay B.C., Prassanna H., Savlia S.D. and Gedia M.V. (2014) Comparative efficacy of storage bags,storability and damage potential of bruchidbeetle.Journal of food science and Technogy,51(12);4047-4053.

Sudini H., C.L.L. Gowda, V.Mugam and L.L.Murdock (2012) Evaluating PICS for Groundnut.Purdue improved crop storge workshop. April,10-12,2012,Accra,Ghana

12.Financial Implications (` in Lakhs) : Rs. 21.21 lakhs

(A) Financed by the institute

12.1 Manpower (Salaries / Wages)

S. No.	Staff Category	Man months	Cost
1.	Scientific	24	2100000
2.	Technical	-	-
3.	Supporting	-	-
4.	SRFs/RAs	--	--
5.	Contractual	--	--
	Total	24	2100000

12.2 Research/Recurring Contingency

S. No.	Item	Year(1)	Year (2)	Year (3)	Total
22.	Consumables	10000	11000	--	21000
23.	Travel	---	--	--	---
24.	Field Preparation/ Planting/ Harvesting (Man-days/costs)	--	--	--	--
25.	Inter-cultivation & Dressing (Man-days/costs)	--	--	--	--
26.	Animal/Green house/Computer Systems/Machinery Maintenance		--	--	
27.	Miscellaneous(Other costs)		--	--	
	Total(Recurring)	10000	11000	--	21000

Justification : ----------

12.3 Non-recurring (Equipment)

S. No.	Item	Year (1)	Year (2)	Year (3)…	Total
1.		--	--	--	--
2.		--	--	--	--
.		--	--	--	--
	Total (Non-recurring)	--	--	--	--

Justification : ----------

12.4 Any Other Special Facility required (including cost)

12.5 Grand Total (12.1 to 12.4)

Item	Year (1)	Year (2)	Year (3)	Total
Grand Total	10,10000	1111000	--	2121000

(B) Financed by an organization other than the Institute (if applicable) : No

(iv) Name of Financing Organization : NA

(v) Total Budget of the Project :

(vi) Budget details

Sr. No.	Item	Year(1)	Year(2)	Year (3)…	Total
1	Recurring Contingency				
	Travelling Allowance	--	--	--	--
	Workshops	--	--	--	--
	Contractual Services/ Salaries	--	--	--	--
	Operational Cost	--	--	--	--
	Consumables	--	--	--	--
2	Non - Recurring Contingency				
	Equipment	--	--	--	--
	Furniture	--	--	--	--
	Vehicle	--	--	--	--
	Others (Miscellaneous)	--	--	--	--
3	HRD Component				
	Training	--	--	--	--
	Consultancy	--	--	--	--
4	Works (i) New (ii) Renovation	--	--	--	--
5	Institutional Charges				

13.Expected Output :

1.Benefited to farmer for safe storage of groundnut against bruchid beetle attack.

2. It is more convenient, safer and alternative methods to minimize the losses on groundnut.

3. Reduction in storage losses in groundnut due to bruchid beetle without using any hazardous chemicals.

14.Expected Benefits and Economic Impact

15.Risk Analysis

16.Signature

Project Leader Co-PI-I Co-PI-II

17.Signature of HoD

18.Signature of JD (R)/ Director

ANNEXURE - III

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CHECKLIST FOR SUBMISSION OF RPP-I

(Refer for Guidelines ANNEXURE-XI(C))

1.Project Title **: To study the effect of different packing materials against Groundnut Bruchid (*Caryedon serratus* Olivier.) during storage**

2. Date of Start & Duration : Date of Start: 01-03-2016

Likely Date of Completion : 28-02-2018

3. Institute Project [√] or Externally Funded [ ]

4. Estimated Cost of the Project : 21.21 lakh

5. Project Presented in the Divisional/Institutional Seminar? ~~Yes~~ / No

6. Have suggested modifications incorporated? ~~Yes~~ / No

7. Status Report enclosed Yes / ~~No~~

8. Details of work load of investigators in approved ongoing projects:

Project Leader				Co-PI – I				Co-PI – II…
Proj. Code.	% Time spent	Date of start	Date of completion	Proj. Code.	% Time spent	Date of start	Date of completion	……
FCI project	70%	2014	2017					

9. Work Plan/Activity Chart enclosed Yes / ~~No~~

10. Included in Institute Plan Activity Yes / ~~No~~

11. Any previous Institute/Adhoc/Foreign aided projects on similar lines? Yes / ~~No~~

12. New equipment required for the project ~~Yes~~ / No

13. Funds available for new equipment Yes / ~~No~~

14. Signatures

Project Leader Co-PI-I Co-PI-II Co-PI–n

HOD/PD/I/c

ANNEXURE - IV

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

APPRAISAL BY THE PMECELL OF RPP-I

(Refer for Guidelines ANNEXURE-XI (D))

1. Institute Name
2. Project Title
3. On scale 1-10 give score to (a) to (j)

(k)	Relevance of research questions	☐
(l)	Addressing priority of the institute and/or National priority	☐
(m)	New innovativeness expected in the study	☐
(n)	Appropriateness of design/techniques for the questions to be answered	☐
(o)	Elements of bias addressed in the study	☐
(p)	Adequacy of scientist(s) time allocation	☐
(q)	Extent of system review and meta analysis	☐
(r)	Effective control to experiments	☐
(s)	Economic evaluation and cost efficiency analysis	☐
(t)	How appropriately the expected output answers the questions being addressed in the specific subject matter/area (Basic/Applied/Translational/Others)?	☐
	***Total Score out of 100**	

* The score obtained is suggestive of the overall quality ranking of the project

4. Was there any other project carried in the past in the same area/topic?

   Yes ☐ No ☐

   If yes, list the project numbers.

5. Signature of PME Cell Incharge

NEW INVESTIGATION – III
ANNEXURE - I
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
PROFORMA FOR PREPARATION OF STATUS REPORT
FOR PROPOSAL OF A NEWRESEARCH PROJECT
(Refer for Guidelines ANNEXURE-XI(A))

1. Institute Name : Junagadh Agricultural University, Junagadh

2. Title of the project : Design and development of banana bunch harvesting tool.

3. Type of research project: Basic/Applied/Extension/Farmer Participatory/Other (specify) : Applied

4. Genesis and rationale of the project :

Banana is one of the most important major fruit crops grown in India. Also, banana is the fourth most important food crop in the world after rice, wheat and corn. (Singhal, 2003). India ranks first in production of banana with share of 17% of world production. India is the largest producer of banana in the world with a production of 16.82 million tonnes from an area of 0.49 million ha The major banana producing states of India are Tamilnadu, Maharashtra, Karnataka, Andhra Pradesh, Assam, Gujarat, Bihar, Madhya Pradesh and West Bengal (Sonawane*et al*., 2011).

The fruits of banana grow in clusters known as bunch hanging from the top of the plant. The average bunch weight with 6-7 hands and with about 13 fruits per hand is about 15-25 kg. Average diameter of banana bunch stalk is 90 mm (Mohapatra*et al*., 2010). Banana fruits are harvested when the ridges on the surface of the skin changed from angular to round, i.e., after the attainment of 3/4 full stage. Dwarf bananas are ready for harvest in 11 to 14 months after planting while tall varieties takes about 14 to 16 months to harvest (Kotecha and Desai, 1995). The maturity of banana is also indicated by drying of top leaves, change in colour of fruits from dark green to light green and tendency of the floral end of the fruit to fall by slightest touch by hand. Bananas are harvested raw and ripened artificially.

The method of harvesting depends on the height of the plant. Mostly two methods are used by the farmers for harvesting. In first method, the plants having lower height are harvested by cutting the banana bunch stalk keeping about 30-35 cm bunch stalk above the top hand. While in case of, taller plants, the pseudostem of the plant was partly cut to bring the bunch down within the persons reach and then the bunch stalk or peduncle was cut through. The first method was most prominent method used by the farmers, as the dwarf varieties grown in Gujarat.

5. Knowledge/Technology gaps and justification for taking up the present project including the questions to be answered

At present, harvesting of banana bunch is carried out by specially curved knife which requires 2-3 labours for cutting of one bunch. Moreover, this method is very tedious, time consuming and also having chances of injury to the person

as well as banana fruit. Looking to this fact, it was felt that there is high need of special harvesting tool for cutting of banana bunch. Keeping this thing in mind, the project was undertaken for design and development of banana bunch harvesting tool to improve the harvesting efficiency of banana bunch and to reduce the losses of banana during harvesting.

6. Critical review of present status of the technology at national and international levels along with complete references

Anonymous (1989) reported that two persons were necessary for harvesting the bunches for tall plants. The banana bunch was cut 12 to 25 cm above the first hand by means of a sickle. The pseudostem was then cut to half and left standing on the field for drying and removed. The partial removal of pseudostem called mattocking. Generally, the parent plant left undisturbed after harvesting the bunches. Cutting the pseudostem up to ground level is generally not preferable.

Yekutieli (1994) developed a harvesting device which was connected to the three-point hinge system of a tractor. The device included a telescoping arm with a knife and a banana-neck catcher. A train of small wagons with special bars for hanging the harvested branches was pulled behind the tractor. The experiments showed that the net harvesting rate was not lower than the hand-harvesting rate, but several improvements were needed in the hanging bars of the small wagons. The physical work was completely eliminated. There was no more need to carry heavy bunches from the plant to the transport vehicle. Bunches from tall plants were also harvested with no special problems. The results suggested that the bunch density (no. of bunches to be harvested per unit area unit in one harvest) had considerable influence on the harvesting rate: the higher the density the higher the harvest rate.

References :

Singhal, V. (2003). Banana. In : Indian Agriculture-2003. Published by Indian Economic Data Research Centre, New Delhi, pp. 230-234.

Sonawane, S. P., Sharma, G. P. and Pandya, A. C. (2011). Design and development of power operated banana slicer for small scale food processing industries. Res. Agr. Eng., 57 : 144–152.

Mohapatra, D., Mishra, S., and Sutar, N. (2010). “Banana and its by-product utilization: An overview,” J. Sci. Ind. Res.,69 (5) : 323-329.

Kotecha, P. M. and Desai, B. B. (1995). Banana. In : Handbook of Fruit Science and Technology : production, composition, storage and processing (D. K. Salunkhe and S. S. Kadam, eds.), Marcel Dekker, Inc., New York. pp. 67-90.

Anonymous (1989b). Harvest and yield. In :Banana in India - Production, Preservation and Processing, Industrial Monograph Series, Published by Central Food Technological Research Institute, Mysore, p. 12.

Yekutieli, O. (1994). Mechanical harvesting of banana bunches. Hassadeh (Israel), 74(7) : 760-765, 783.

7. Expertise available with the investigating group/Institute :
   Experts are available within Institute.

8. Brief note on Proprietary/Patent Perspective (for projects related to technology development)/Ethics/Animal Welfare/Bio Safety Issues : NA

9. (a) Expected output

   i. Special tool for harvesting of banana bunch will be developed
   ii. Efficiency of banana bunch harvesting will be improved
   iii. Losses during harvesting will be reduced
   iv. Harvesting cost for banana will be reduced

   .

   a. Clientele/Stake holders (including economic and socio aspects)
      i. Farmer

10. Signatures

[Project Leader] [Co-PIs] ……

11. Comments and signature

[Head of Division]

ANNEXURE- II
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
RESEARCH PROJECT PROFORMA FOR INITIATION OF A RESEARCH PROJECT (RPP - I)
(Refer for Guidelines ANNEXURE-XI (B))

28. Institute Project Code (to be provided by PME Cell)
29. Project Title : Design and development of banana bunch harvesting tool.
30. Key Words : Banana, Harvesting
31. (a) Name of the Lead Institute : College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh
    (b) Name of Division/ Regional Center/ Section : AICRP on PHET, Junagadh centre
32. (a) Name of the Collaborating Institute(s) : NavsariAgril. University, Navsari
    (b) Name of Division/ Regional Center/ Section of Collaborating Institute(s) : Centre of Excellence on Post Harvest Tech., NAU, Navsari
33. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time proposed to be spent)

S. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)	Time to be spent (%)	Work components to be assigned to individual scientist
1.	Er. P. R. Davara, Assistant Research Engineer, AICRP on PHET, Dept. of Processing and Food Engg., College of Agril. Engg. & Tech., Junagadh Agril. University, Junagadh	PI	50%	1. Designing of tool 2. Development and fabrication of tool 3. Field level experiments 4. Modifications in the tool 5. Data collection and its analysis 6. Report writing
2.	Er. P. S. Pandit, Assistant Professor, Dept. of Post Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agril. University, Navsari	Co-PI	30%	To assist the PI in designing, development and data collection aspects
3.	Dr. M. N. Dabhi, Research Engineer, AICRP on PHET, Dept. of Processing and Food Engg., College of Agril. Engg. &Tech., Junagadh Agril. University, Junagadh	Co-PI	20%	To assist the PI in all above aspects

34. Priority Area to which the project belongs : Post Harvest Technology
(If not already in the priority area, give justification)

35. Project Duration: Date of Start: 01-02-2016 LikelyDate of Completion **:** 28-02-2017

36. (a) Objectives

1. To study the morphological parameters for banana plant and banana bunch.
2. To design and develop hand-held banana bunch harvesting tool.
3. To evaluate the performance of the banana bunch harvesting tool.

(b) Practical utility

- Special tool for harvesting of banana bunch will be developed
- Efficiency of banana bunch harvesting of banana will be improved
- Losses during harvesting will be reduced
- Harvesting cost for banana will be reduced

37. Activities and outputs details

Objective wise	Activity	Month & Year of		Output monitorable target(s)	% to be carried out in different years			Scientist(s) responsible
		Start	Comp-letion		1	2	..	
1.	1. Review collection	Feb-16	March-16	To collect the data on morphological characteristics of banana bunch grown in Gujarat/India	--	--	--	Er. P. R. Davara
	2. Measurement of some morphological parameters of banana bunch	Aug-16	Oct-16	To assess the morphological characteristics of banana bunch grown in Gujarat	--	--	--	Er. P. R. Davara, Er. P. S. Pandit,
2.	1. Review collection	Feb-16	March-16	To study the work done in the past	--	--	--	Er. P. R. Davara
	2. Designing of tool	April-16	May-16	Conceptual designs will be prepared	20%	--	--	Er. P. R. Davara, Er. P. S. Pandit, Dr. M. N. Dabhi,
	3. Fabrication of tool	June-16	July-16	Banana bunch harvesting tool	--	--	--	Er. P. R. Davara,

				will be fabricated				Dr. M. N. Dabhi
3.	1. Field experiments and data collection	Aug-16	Oct-16	Testing of the tool will be done and performance will be evaluated based on the data collected	--	--	--	Er. P. R. Davara, Er. P. S. Pandit, Dr. M. N. Dabhi
	2. Report writing	Nov-16	Jan-16	Compilation of collected data and preparation of report	--	--	--	Er. P. R. Davara, Dr. M. N. Dabhi

38. Technical Programme (brief)

Status (review) :

Objectives

a. To study the morphological parameters for banana plant and banana bunch.
b. To design and develop hand-held banana bunch harvesting tool.
c. To evaluate the performance of the banana bunch harvesting tool.

Technical programme

- **Experimental Design :** CRD (Complete Randomized Design)
- **Treatment Details :**
  - **Factor-1:** Grip height (Three levels)
    H_1=30 mm
    H_2=40 mm
    H_3=50 mm
  - **Factor-2:** Types of blades (Four levels)
    B_1 : Both the blades are plain and sharp
    B_2 : One blade plain & sharp and another blade flat
    B_3 : Both the blades are toothed and sharp
    B_4 : One blade is toothed & sharp and another blade flat
- **Treatment Combinations:**

No.	Treatment combination	No.	Treatment combination
1	H_1 B_1	8	H_2 B_4
2	H_1 B_2	9	H_3 B_1
3	H_1 B_3	10	H_3 B_2
4	H_1 B_4	11	H_3 B_3
5	H_2 B_1	12	H_3 B_4
6	H_2 B_2	13	Control (By sickle)
7	H_2 B_3		

- **Number of replications : 3**

- **Observations to be recorded:**

I. Banana Plant (Variety : Grand Naine**) :**

a. Plant height (cm)
b. Raw to raw and plant to plant spacing (cm)

II. Banana Bunch:

a. Height of basal part of banana bunch from ground (cm)
b. Length of bunch (cm)
c. Weight of bunch (kg)
d. Diameter of bunch stalk (mm)

III. Banana Bunch Harvesting Tools

a. Physical dimension of various components of tools
b. Counter force require to carry the banana bunch on body of worker (kg)

IV. Observation during harvesting & handling

a. Time required for harvesting the bunches (No. of bunches/hr)
b. Losses during harvesting due to damages (%)
c. Losses during transportation of bunches from filed to stacking place (%)
d. Labour requirement (Number of labour required for harvesting of one banana bunch)

Possible outputs :

- Special tool for harvesting of banana bunch will be developed
- Efficiency of banana bunch harvesting will be improved
- Losses during harvesting will be reduced
- Harvesting cost for banana will be reduced

39. Financial Implications (in Lakhs) : Rs. 10.17 lakhs

(A) Financed by the institute

12.1 Manpower (Salaries / Wages)

S. No.	Staff Category	Man months	Cost
1.	Scientific	12	8,00,000
2.	Technical	5	2,00,000
3.	Supporting		
4.	SRFs/RAs	--	--
5.	Contractual	--	--
	Total	17	10,00,000

12.2 Research/Recurring Contingency

S. No.	Item	Year(1)	Year (2)	Year (3)…	Total
40.	Consumables	5000	--	--	5000
41.	Travel	5000	--	--	5000
42.	Field Preparation/ Planting/ Harvesting (Man-days/costs)	--	--	--	--
43.	Inter-cultivation & Dressing (Man-days/costs)	--	--	--	--
44.	Animal/Green house/Computer Systems/Machinery Maintenance	2000	--	--	2000
45.	Miscellaneous(Other costs)	5000	--	--	5000
	Total(Recurring)	17000	--	--	17000

Justification : ----------

12.3 Non-recurring (Equipment)

S. No.	Item	Year (1)	Year (2)	Year (3)…	Total
1.		--	--	--	--
2.		--	--	--	--
.		--	--	--	--
	Total (Non-recurring)	--	--	--	--

Justification : ----------

12.4 Any Other Special Facility required (including cost)

12.5 Grand Total (12.1 to 12.4)

Item	Year (1)	Year (2)	Year (3)	Total
Grand Total	10,17,000	--	--	10,17,000

(B) Financed by an organization other than the Institute (if applicable) : No

(vii) Name of Financing Organization : NA

(viii) Total Budget of the Project :

(ix) Budget details

S. No.	Item	Year(1)	Year(2)	Year (3)…	Total
1	Recurring Contingency				
	Travelling Allowance	--	--	--	--
	Workshops	--	--	--	--
	Contractual Services/ Salaries	--	--	--	--
	Operational Cost	--	--	--	--
	Consumables	--	--	--	--
2	Non - Recurring Contingency				
	Equipment	--	--	--	--

	Furniture	--	--	--	--
	Vehicle	--	--	--	--
	Others (Miscellaneous)	--	--	--	--
3	HRD Component				
	Training	--	--	--	--
	Consultancy	--	--	--	--
4	Works (i) New (ii) Renovation	--	--	--	--
5	Institutional Charges				

13. Expected Output : New tool for harvesting of banana bunch will be developed.

14. Expected Benefits and Economic Impact
    - Efficiency of banana bunch harvesting will be improved
    - Losses during harvesting of banana will be reduced
    - Harvesting cost for banana will be reduced

15. Risk Analysis
16. Signature

Project Leader Co-PI-I Co-PI-II

17. Signature of HoD

18. Signature of JD (R)/ Director

ANNEXURE - III

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CHECKLIST FOR SUBMISSION OF RPP-I

(Refer for Guidelines ANNEXURE-XI(C))

1. Project Title : Design and development of banana bunch harvesting tool.
2. Date of Start & Duration : Date of Start: 01-02-2016 Likely Date of Completion : 28-02-2017
3. Institute Project [√] or Externally Funded [ ]
4. Estimated Cost of the Project : 10.17 lakh
5. Project Presented in the Divisional/Institutional Seminar? ~~Yes~~ / No
6. Have suggested modifications incorporated? ~~Yes~~ / No
7. Status Report enclosed Yes / ~~No~~
8. Details of work load of investigators in approved ongoing projects:

Project Leader				Co-PI – I				Co-PI – II…
Proj. Code.	% Time spent	Date of start	Date of completion	Proj. Code.	% Time spent	Date of start	Date of completion	……
Pilot scale pectin production	50%	2015	2016	Post harvest management of sapota	50%	2014	2015	

9. Work Plan/Activity Chart enclosed Yes / ~~No~~
10. Included in Institute Plan Activity Yes / ~~No~~
11. Any previous Institute/Adhoc/Foreign aided projects on similar lines? Yes / ~~No~~
12. New equipment required for the project ~~Yes~~ / No
13. Funds available for new equipment Yes / ~~No~~
14. Signatures

Project Leader Co-PI-I Co-PI-II Co-PI–n

HOD/PD/I/c

ANNEXURE - IV

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

APPRAISAL BY THE PMECELL OF RPP-I

(Refer for Guidelines ANNEXURE-XI (D))

1. Institute Name
2. Project Title
3. On scale 1-10 give score to (a) to (j)

(u)	Relevance of research questions	☐
(v)	Addressing priority of the institute and/or National priority	☐
(w)	New innovativeness expected in the study	☐
(x)	Appropriateness of design/techniques for the questions to be answered	☐
(y)	Elements of bias addressed in the study	☐
(z)	Adequacy of scientist(s) time allocation	☐
(aa)	Extent of system review and meta analysis	☐
(bb)	Effective control to experiments	☐
(cc)	Economic evaluation and cost efficiency analysis	☐
(dd)	How appropriately the expected output answers the questions being addressed in the specific subject matter/area (Basic/Applied/Translational/Others)?	☐
	***Total Score out of 100**	

* The score obtained is suggestive of the overall quality ranking of the project

4. Was there any other project carried in the past in the same area/topic?

Yes ☐ No ☐

If yes, list the project numbers.

5. Signature of PME Cell Incharge

NEW INVESTIGATION – IV

INDIAN COUNCIL OF AGRICULTURAL RESEARCH
PROFORMA FOR PREPARATION OF STATUS REPORT
FOR PROPOSAL OF A NEW RESEARCH PROJECT
(Refer for Guidelines ANNEXURE-XI(A))

1. Institute Name : Junagadh Agricultural University, Junagadh-362 001
2. Title of the project : Extraction of Citric acid from banana peels using *Aspergillus niger* fungi.
3. Type of research project : ~~Basic~~/Applied/~~Extension/Farmer Participatory/Other~~ (specify)

4. Genesis and rationale of the project :

One of the food industries in Junagadh, Gujarat named Sagar Foods & Namkeen was visited by PHET scheme members and observe that there was a great problem of environmental pollution after processing of bananas by producing a byproduct, banana peel. After that an idea was generated to do something on banana peel which is helpful for society & environment.

5. Knowledge/Technology gaps and justification for taking up the present project including the questions to be answered :

(1) How to utilize the bio-waste (banana peel) of food Industries?

Banana peel is a great source of carbohydrate and fiber. Microbes make a great action on this and obtain nutrition from peels and extraction of useful products can make possible by this way.

(2) Can be utilize the bio-waste for production of citric acid ?.

Yes. Utilization of bio-waste is possible by a fungal strain – *Aspergillus niger.*

6. Critical review of present status of the technology at national and international levels along with complete references :

Presently citric acid was produced at industrial level by chemical way i.e. ultimately make environmental pollution and end users also pay more money for the citric acid product. So, a technology regarding waste utilization that might be useful for society.

7. Expertise available with the investigating group/Institute :

Department of Biochemistry / Biotechnology, Junagadh Agril. University, Junagadh.

8. Brief note on Proprietary/Patent Perspective (for projects related to technology development)/Ethics/Animal Welfare/Bio Safety Issues :

Patent might be obtained as per the rules of patent issuing authority.

9. (a) Expected output

i. Environmental Pollution might be reduced due to such kind of practises.

ii. It might be possible to produce citric acid by this technique.

.

b. Clientele/Stake holders (including economic and socio aspects)

The developed technology will be useful for the processors, entrepreneurs and end users.

10. Signatures

[Project Leader] [Co-PIs] ……

11. Comments and signature

Such kind of project works is necessary for today's era where biological aspects increase their height as compare to chemical science. The ended technology will provide a useful information and sufficient data to the entrepreneurs, processors and they might be doing something new for society and end users. Such kind of project work also carries the departmental research activities at a new direction.

[Head of Division]

ANNEXURE- II

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

RESEARCH PROJECT PROFORMA FOR INITIATION OF A RESEARCH PROJECT (RPP - I)

(Refer for Guidelines ANNEXURE-XI (B)

1. Institute Project Code (to be provided by PME Cell)
2. Project Title : Extraction of Citric acid from banana peels using Aspergillus niger fungi.
3. Key Words : Banana Peel, Fungal strain : *Aspergillus niger*, Citric acid

(a) Name of the Lead Institute : AICRP on Post Harvest Engg. & Tech., Dept. of Processing & Food Engineering, College of Agril. Engg. & Technology, Junagadh Agricultural University, Junagadh

(b) Name of Division/ Regional Center/ Section : Junagadh-362 001

4. (a) Name of the Collaborating Institute(s), if any : - Nil -

(b) Name of Division/ Regional Center/ Section of Collaborating Institute(s) : - Nil -

5. Project Team(Name(s) and designation of PI, CC-PI and all project Co-PIs, with time proposed to be spent)

Sr. No.	Name, designation and institute	Status in the project (PI/CC-PI/ Co-PI)	Time to be spent (%)	Work components to be assigned to individual scientist
1.	Prof. A. M. Joshi	P.I.	80%	Survey, Collection and Full Fledge Experimental work.
2.	Dr. M. N. Dabhi	Co – P.I.	20%	Overall Inspection, Helping in purchase of chemicals and other important items which is necessary for project works, Guidance where necessary & Performance Evaluation work.

6. Priority Area to which the project belongs

(If not already in the priority area, give justification)

7. Project Duration: Date of Start : **February-2016**

Likely Date of Completion**: December-2017**

8. (a) Objectives :

(i) To study the growth habit of fungi on standard media.

(ii) To standardize the conditions for growth of microbes using banana peel.

(iii) To measure the citric acid production after a good growth of fungi on banana peels.

(b) Practical utility : (i) Processor will be the immediate beneficiary.

(ii) Pollution free environment to the public Industries.

(iii) End users might be obtained cheap product.

9. Activities and outputs details

Objective wise	**Activity**	**Month & Year of**		**Output monitorable target(s)**	**% to be carried out in different years**		**Scientist(s) responsible**
		Start	**Comp-letion**		1	2	
1.To study the growth habit of fungi on standard media.	1. Obtain standard culture from Microbial Type Culture Collection Center (MTCC).	**1st year**		Output will be obtained with best of knowledge and efforts for 2 years. So, a strong database & technology obtained will be successfully transferred to the society.	50 %	50 %	1. Prof. A. M. Joshi 2. Dr. M. N. Dabhi
		Februar y - 2016	April – 2016				
		2nd Year					
	2. Make a good growth on standard culture media for fungi.	October – 2016	Decembe r - 2016				
	3. Check the purity of culture.						
2. To standardize the conditions for growth of microbes using banana peel.	1. Checking the good growth of fungi in respect to pH, Temperature and Growth Media containing banana peel.	**1st year**					
		May – 2016	July - 2016				
		2nd Year					
		January – 2017	March - 2017				
3. To measure the citric acid production	Citric acid was determined titrimetrically by using 0.1	**1st year**					
		August – 2016	Septemb er – 2016				
		2nd Year					

after a good growth of fungi on banana peels.	NaOH and phenolphthalein as indicator and calculated as per the standard formula.	April – 2017	May - 2017				
4. Data Analysis & Report Writing	2 years research work needed pooled work of data analysis. So, a valuable note regarding technology development will be created.	June – 2017	Decembe r - 2017				

10. Technical Programme (brief)

(a) Material : **Chemicals, Growth media for fungal cultures, Standard fungal cultures from MTCC, Miscelleneous Laboratory items.**

(b) Techniques/Methodology :

1. Growth of fungal cultures on Potato Dextrose Agar (PDA) media, Banana Peel agar media.
2. After a good growth of fungi on media plates, inoculate the fungal cultures in a sterile banana peel broth + other essential nutrients.
3. Growth of fungi was carried out in incubator shaker by fermentation technique.
4. After a sufficient growth citric acid measurement was carried out through a titration method.
5. Same method was carried out for 2nd year. And Analyse the data.

(c) Instrumentation : Laminara Air Flow, Incubator Shaker, Vortex Stirrer, Burner, Autoclave etc.

(d) Special material : -Nil-

(e) Analytical tools : Microscope, Simple Titrable acidity measuring tools.

11. Financial Implications (` in Lakhs)

(A) Financed by the institute

12.1 Manpower (Salaries / Wages)

S. No.	Staff Category	Man months	Cost
1.	Scientific	(19+5=) 24	(9.12+3.50=) 12,62,000
2.	Technical	23	5,75,000
3.	Supporting	10	1,00,000
4.	SRFs/RAs	--	--
5.	Contractual	--	--
	Total	57	19,37,000

12.2 Research / Recurring Contingency

S. No.	Item	Year(1)	Year (2)	Year (3)…	Total
19.	Consumables	25000	25000	--	50000
12.	Travel	5000	5000	--	10000
13.	Field Preparation/ Planting/ Harvesting (Man-days/costs)	--	--	--	--
14.	Inter-cultivation & Dressing (Man-days/costs)	--	--	--	--
15.	Animal/Green house/Computer Systems/Machinery Maintenance	--	--	--	--
16.	Miscellaneous(Other costs)	5000	5000	--	10000
	Total(Recurring)	35000	35000	--	70000

Justification : Chemicals and Fungal growth media are very necessary for citric acid production as well standard culture is very necessary which is obtained from culture collection bank, Chandigarh.

12.3 Non-recurring (Equipment)

S. No.	Item	Year (1)	Year (2)	Year (3)…	Total
1.	--	--	--	--	--
2.	--	--	--	--	--
	Total (Non-recurring)	--	--	--	--

Justification : ----------

12.4 Any Other Special Facility required (including cost) : Special Chamber for Laminar Air Flow is to be made by wall panelling with Air Conditioner.

S. No.	Item	Year (1)	Year (2)	Total	Remarks
1.	Separate Chamber of Laminar Air Flow instrument.	1,00,000	--	1,00,000	This facility is useful for many years. And such kind of facility is very much needed due to elimination of contamination and A.C. is required because of the Fast cooling of media Plates & easier to handle microbes by a person who seat in front of heat.
2.	Air Conditioner	40,000	--	40,000	
	Total	1,40,000	--	1,40,000	

12.5 Grand Total (12.1 to 12.4)

Item	Year (1)	Year (2)	Year (3)	Total
Grand Total	11,43,500	10,03,500	--	21,47,000

(B) Financed by an organization other than the Institute (if applicable) : - Nil -

(i) Name of Financing Organization

(ii) Total Budget of the Project

(iii) Budget details

S. No.	Item	Year(1)	Year(2)	Year (3)…	Total
1	Recurring Contingency				
	Travelling Allowance	--	--	--	--
	Workshops	--	--	--	--
	Contractual Services/ Salaries	--	--	--	--
	Operational Cost	--	--	--	--
	Consumables	--	--	--	--
2	Non - Recurring Contingency				
	Equipment	--	--	--	--
	Furniture	--	--	--	--
	Vehicle	--	--	--	--
	Others (Miscellaneous)	--	--	--	--
3	HRD Component				
	Training	--	--	--	--
	Consultancy	--	--	--	--
4	Works (i) New (ii) Renovation	--	--	--	--
5	Institutional Charges	--	--	--	--

13. Expected Output : The developed technology will be useful for the processors / entrepreneurs and end users.

14. Expected Benefits and Economic Impact :

(i) Pollution will be minimised due to consumption of banana waste, so food industry can't spend extra money to dispose the waste materials.

(ii) End user must get a cheap product i.e. citric acid which is produced a biological way.

(iii) Chemical production of citric acid is harmful for the environment. So, it is necessary to identify another way for the production of such thing.

17. Risk Analysis : Microbial culture is involved here. So, a qualified person is necessary to handle this live thing.

18. Signature :

Project Leader Co-PI-I Co-PI-II Co-PI–n

19. Signature of HoD

20. Signature of JD (R)/ Director

ANNEXURE - III
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
CHECKLIST FOR SUBMISSION OF RPP-I
(Refer for Guidelines ANNEXURE-XI(C)

1. Project Title : Extraction of Citric acid from banana peels using *Aspergillus niger* fungi.
2. Date of Start & Duration : February – 2016 to December - 2017
3. Institute Project [√] or Externally Funded [ ]
4. Estimated Cost of the Project : 21,47,000/-
5. Project Presented in the Divisional/Institutional Seminar? ~~Yes~~ / No [√]
6. Have suggested modifications incorporated? ~~Yes~~ / No [√]
7. Status Report enclosed Yes / No
8. Details of work load of investigators in approved ongoing projects:

Project Leader				Co-PI – I				Co-PI – II…
Proj. Code.	% Time spent	Date of start	Date of compl-etion	Proj. Code.	% Time spent	Date of start	Date of completion	……
- Nil -								

9. Work Plan/Activity Chart enclosed [√] Yes / ~~No~~ [√]
10. Included in Institute Plan Activity Yes / ~~No~~ [√]
11. Any previous Institute/Adhoc/Foreign aided projects on similar lines? ~~Yes~~ / No [√]
12. New equipment required for the project Yes / ~~No~~ (A.C. & Separate Laminar Air Flow chamber) [√]
13. Funds available for new equipment Yes / ~~No~~
14. Signatures

Project Leader Co-PI-I Co-PI-II Co-PI–n

HOD/PD/I/c

ANNEXURE - IV
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
APPRAISAL BY THE PMECELL OF RPP-I
(Refer for Guidelines ANNEXURE-XI (D)

4. Institute Name :
5. Project Title :
6. On scale 1-10 give score to (a) to (j)

(ee)	Relevance of research questions	
(ff)	Addressing priority of the institute and/or National priority	
(gg)	New innovativeness expected in the study	
(hh)	Appropriateness of design/techniques for the questions to be answered	
(ii)	Elements of bias addressed in the study	
(jj)	Adequacy of scientist(s) time allocation	
(kk)	Extent of system review and meta analysis	
(ll)	Effective control to experiments	
(mm	Economic evaluation and cost efficiency analysis	
(nn)	How appropriately the expected output answers the questions being addressed in the specific subject matter/area (Basic/Applied/Translational/Others)?	
	***Total Score out of 100**	

* The score obtained is suggestive of the overall quality ranking of the project

4. Was there any other project carried in the past in the same area/topic?

Yes ☐ No ☐

If yes, list the project numbers.

5. Signature of PME Cell Incharge

BRIEF REPORT ON ICAR- FCI PROJECT

1. Scheme code No :

2 Title of the Investigation : Study on Determining Storage Losses of Food Grains in FCI and CWC Warehouses and to Recommend Norms for Storage Losses in Efficient Warehouse Management.

3. Name of Investigator : (1) Prof. R. D. Dhudashia

(2) Dr. M.N.Dabhi

(3) Prof. D.M. Vyas

4. Objectives

1. To identify the extent of losses commodity wise i.e. separately wheat and rice.
2. To identify the factors responsible for losses in storage.
3. To arrive at storage loss norms in different agro-climatic regions/state with respect to various factors.
4. To suggest ways and means to reduce the extent of storage losses in different unit operations.

5. Justification

This work aims to identify Study on Determining Storage Losses of Food Grains in FCI and CWC Warehouses and to Recommend Norms for Storage Losses in Efficient Warehouse Management. The work will be conducted by 20 AICRP on PHT Centers throughout the country nominated by the Project Coordinator, AICRP on PHT, Ludhiana.

6. Date of start: September-2013

7. Date of completion: September-2017

8. Past work done: Recruitment of field investigator and SRF were completed. Regularly visited FSD Ghanteshwar-Rajkot, CWC-Bhavnagar and FSD Sabarmati-Ahmedabad.Selection of compartment / chambers was completed at FSD Ghanteshwar, FSD Sabarmati-Ahmedabad and CWC Bhavnagar.24 stacks of Rice were prepared at FSD Ghanteshwer-Rajkot and 24 stacks of wheat were prepared at CWC-Bhavnagar in August 2014.24 stacks of wheat and 24 stacks of rice in warehouse as well as 8 stacks of wheat in CAP were prepared at FSD Sabarmati. Observations were started as per datasheet prepared by PC office.

9. Progress under the project:

List of selected warehouses in Gujarat

Sr. No.	State	District selected	Storage Type (Warehouse/ CAP)	Grains to be studied
1.	Gujarat	FSD Sabarmati Gandhinagar	Warehouse	Wheat & Rice
		FSD Sabarmati Gandhinagar	CAP	Wheat
		CWC Bhavnagar	Warehouse	Wheat
		FSD Ghanteshwar Rajkot	Warehouse	Rice

Work has been started as per the ICAR guidelines as under.

Progress under the project:

1. Senior Research Fellow has been regularly posted forco-ordination of all the godowns and individually handling of FSD Ghanteshwar-Rajkot,Twoinvestigatorshave been posted for CWC-Bhavnagar andFSD Sabarmati-Ahmedabad. They have been recorded observation as per datasheet prepared by PC office.
2. Twenty fifth fortnightly observations and fifth quarterly of rice in warehouse at FSD Ghanteshwer-Rajkot were recorded as per datasheet prepared. Two stack of wheat was liquidated on fifth quarter during second week of December 2015.
3. Twenty fifth fortnightly and fifth quarterly observations of wheat in warehouse at CWC-Bhavnagar were recorded as per datasheet prepared. Two stack of wheat was liquidated on fifth quarter during first week of December 2015
4. Thirty fifth fortnightly and six quarterly observations of wheat in warehouse were recorded as per datasheet prepared. Two stack of wheat in warehouse was liquidated on sixth quarter.
5. Thirty two fortnightly and six quarterly and observations of Rice in warehouse were recorded at FSD Sabarmati. Two stack of rice was liquidated on sixth quarter
6. Twenty fortnightly and fourthquarterly observations of wheat in CAP were recorded at FSD Sabarmati. Two stack of wheat in CAP was liquidated on fourth quarterduring February 2015 and thus the work on CAP was completed.

Brief progress of work is as under (Upto December 2015):

Sr. No.	State	District selected	Storage Type (Warehouse/ CAP)	Grains to be studied	Godown No.	No. of stack	No. of liquidated stack
1.	Gujarat	FSD Sabarmati	Warehouse	Wheat	16A&16B	24	12
		FSD Sabarmati	Warehouse	Rice	15A,15B &15C	24	12
		FSD Sabarmati	CAP	Wheat	PlinthNo.5 &8	8	8
		CWC Bhavnagar	Warehouse	Wheat	II and IA	24	10
		FSD Ghantesh war Rajkot	Warehouse	Rice	1A and 1B	24	8

BRIEF REPORT OF TSP PROJECT

Under Tribal Sub Plan (TSP) Project the training programme was arranged in February 2015 at Dahod (Tribal area of Gujarat) regarding awareness about processing of their crops. During this training 7 (seven) young educated were interested for training on soyabean processing. Keeing this in mind another training for soyabean processing was arranged at Junagadh in March 2015. Seven participants have got training and they are planning to start soya milk production.

Based on training to tribals of Gir Somnath District at Junagadh and Vadala, they were ready to start spice mill processing at Vadala under Ekta Mahila Munch (A cooperative society of tribal women). Hence, a new Agro Processing Centre was started at Vadala, Ta. Talala, Dist. GirSomnath with cumin grainder, turmeric grinder and chilly grinder.

Achievements under TSP for the year 2014-15
Centre : Junagadh

Name of scheme	Budget allocation, Rs.Lakh	Month & Year	Trainings, no.	FLDs, no.	Exhibitions, no.	Exposure visits, no.	Beneficiaries, no.	Supply of inputs (Type with units)	Asset created (Type & no.)	Any other
Tribal Sub-plan Project (TSP)	3.50	Feb-2015	1	1	1	32	32	Spice processing unit	1. Cumin grinder (No. 1) 2. Chilly/ turmeric grinder (No. 1 each)	--
		March-2015	1	1	1	7	7	--	--	--

PUBLICATION, TRAINING AND DEMONSTRATION

Publications:

Research papers:

1. RajendraDhudashia and Mukesh Dabhi. 2014. "Storability of wheat harvested by different methods" in Agricultural Engineering. 39(2):1-6.
2. V P Sangani, N C Patel and P R Davara (2014). Physical Properties of Pigeon Pea Grains (BDN 2) as a Function of Moisture Content. Agricultural Engineering Today. 38(4)
3. V. P. Sangani, N. C. Patel, V. M. Bhatt, P. R. Davara, D. K. Antala (2014). Optimization of enzymatic hydrolysis of pigeon pea for cooking quality of dhal. Int J Agric&Biol Eng. 7(5) : 123-132.
4. A. M. Joshi, M. N. Dabhi and RavalKashyap. 2015. "Extraction of Enzymes from Potato Peels Substrate using Bacillus subtilis" in International Journal of Current Microbiology and Applied Sciences. 4(8): 451-458.

Books:

1. N. K. Dhamsaniya and M. N. Dabhi. "Agricultural Process Engineering (Numerical Problems)". Published by Agrotech Publishing Academy, Udaipur. 2015 (2nd ed.).

Trainings:

Training attended.

1. Dr. M. N. Dabhi attended the one day training seminar on MahitiAdhikarAdhiniyam – 2005 organized by Junagadh Agricultural University, Junagadh on 23/06/2015.
2. Prof. P. R. Davara attended the summer school on Numerical techniques and its application to agril. and food engg. problems at FPT & BE, AnandAgricutlural University, Anand during 17/6/2015 to 7/7/2015.

Training organized under TSP project.

1. Processing and value addition of Soyabean, pigeon pea and cereals,at KVK, Dahod on 11/02/2015.
2. Soyabean processing and value addition, at CAET, JAU, Junagdh during 10/03/2015 to 12/03/2015.

Demonstration conducted :

1. One demonstration mela was orgaznised on 23/3/2015 at CAET. JAU, Junagadh.
2. Sapota cleaner cum grader was demonstrated at Arena on 18/4/2015
3. Sapota cleaner cum grader was demonstrated at MotaKajaliyara on 8/5/2015
4. Sapota cleaner cum grader was demonstrated at Kukasvada on 27/11/2015
5. Sapota cleaner cum grader was demonstrated at Mangrol on 19/12/2015