Project Aashirwad

An initiation of
AFST I (Mumbai Chapter)
and FSSAI
In collaboration with
The Siddhivinayak Temple.

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Prasad Standardization @Siddhivinayak Temple

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INDEX

Aim:

Standardization of Process Parameters for the Production of BoondiLaddoo and Coconut Barfi and its Shelf Life Study.

Abstract: This study was conducted in order to understand the current process parameters for the Production of Boondi Laddoo and Coconut Barfi. The Information obtained was used to suggest improvements in the process parameters and to thereby control them in order to obtain a reproducible product at the end of each batch that has a longer shelf life.

Introduction

The city of Mumbai is a mute witness to places of worship and historical interest, which are not only popular but also of archaeological importance. Arguably themost popular and significant places of worship are the Shree SiddhivinayakGanapatiMandir situated at Prabhadevi. This temple was first consecrated on Thursday 19th November 1801, a fact that is noted in government records.(1)

Siddhivinayak Temple serves the devotees with Mahaprasad that contains one BoondiLaddoo (BoondiLadoo)and one Coconut Barfi (Naralwadi). This Mahaprasad is manufactured and packed by the Shree SiddhivinayakGanapati Temple Trust in the Temple premises.

Upto 1,00,000 devotees visit the Shree Siddhivinayak temple each day and take back the Prasad with them. Devotees consume this prasad with the faith that it is sacred and pure. It is thus important not only to safeguard public health but also to preserve public faith by ensuring that the Prasad is prepared hygienically and is free from contamination and is of the best quality. The Food Safety and Standards Authority of India (FSSAI) and Association of Food Scientists & Technologists of India (AFSTI) have joined hands with Siddhivinayak Temple to pilot the first-of-its-kind initiative in India. 'Project Ashirwad' aims at standardizing the process of preparing prasad at the temple's manufacturing unit and implement hygiene and safety practices that are in line with the FSSAI Act of 2011. With the successful implementation of this project, the FSSAI & AFSTI hope to implement it nationally at all pilgrim centers across faiths.(2)

The Association of Food Scientists and Technologists has been in existence since August 1957 and is registered under the Karnataka State Societies Act. This is one of the biggest Associations in the country reaching global platform through professional membership of scientists, technologists and engineers who are tomorrow's professionals. Today, its membership is around 3,000 food scientists and technologists around the globe. The main objective of AFST(I) is to strive for the advancement of all aspects of science and technology relating to the production, processing and distribution of food. In pursuit of this objective, AFST(I) seek to promote the rational and economic development of food science and technology in the country so as to ensure the best interest of the

community at large, to stimulate research, development and training in the science and technology of food. Along with this it also promotes among its members, a high standard of technical proficiency, professional expertise and personal integrity so as to elevate in turn the profession of food science and technology. This is achieved by collaborating with other organizations, national or international in activities relating to furtherance of the AFST(I) objectives.(3)

The Food Safety and Standards Authority of India (FSSAI)has been established under Food Safety and Standards Act, 2006 which consolidates various acts & orders that have hitherto handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.(4)

In the first phase of this project, the process of preparing the mahaprasad, theBoondiLaddoo and the Coconut Barfi was monitored and the process parameters were studied. Due to manual and traditional methods of preparation, there are variations in the process parameters and consequently in the products that have an effecton the characteristics and shelf life of the product. Hence, to overcome this and obtain a better product with a stable shelf life, modifications in the process and establishment of optimum process parameters is a necessity. To implement this, certain modern equipment and techniques to inculcate the necessary changes have been suggested.

Two post graduate students of Food Science and Technology, School of Biotechnology and Bioinformatics, D.Y.Patil University availed the opportunity to initiate this project as an Internship experience.

PROJECT PHASE I

OBJECTIVE

To Study the existing Process Parameters of BoondiLaddoo and Coconut Barfi Production and suggest modifications in order to increase Product Yield and Shelf Life.

Materials List

For BoondiLaddoo

Sr. No.	Materials	Quantity used (For one Batch)
1.	Besan flour	25 kg
2.	Water	60 kg
3.	Sugar (Crystal form)	50 kg
4.	Ghee	45 kg
5.	Cashew nuts	1 ½ kg
6.	Resins	1 ½ kg
7.	Cardamom Powder	250 gm
8.	Nutmeg Powder	250 gm
9.	Food color	250 gm

For Coconut Barfi

Sr. No.	Materials	Quantity used (For one Batch)
1.	Sugar Crystals	50 kg
2.	Water	10 kg
3.	Freshly grated Coconut	75 kg

Method

Process: BoondiLaddoo Production

Preparation of Boondi: Mixture ofBesan flour and water is prepared

Besan flour is weighed
Flour is sifted for fine powder
Water is added to the flour and mixed
Batter is strained to avoid lumps

Boondi are prepared by frying in hot Ghee
(Approx.1 min)

Fried Boondi are allowed to cool

Sugar syrup is prepared by heating sugar in water till dark brown syrup is ready
(Two batches are made having different ˚Brix)

Cashews, Resins, Cardamom powder, Nutmeg powder and Food grade colorare mixed in the first batch of Sugar syrup

Fried Boondis are added and mixed evenly

Second batch of sugar syrup is added to coat mixture

The mixture is then formed into round balls of uniform size and allowed to cool and dry

Packaged and Stored

Process: Coconut Barfi Production

Add sugar and water in the mixer and prepare Sugar Syrup

Add the Grated coconut

Heat the mixture while mixing

Spread mixture uniformly over trays

Cool and cut into squares

Packaging and Storage

Instruments used

1. **Refractometer**
   A Handheld Refractometer was used to measure the Total Solids present in the sugar syrup made for both BoondiLaddoo and Coconut Barfi and was denoted as º Brix.

2. **Infrared Moisture Analyzer**
   Traditional Infrared Moisture analyzer was used to measure the % Moisture of the samples taken during and after processing of the BoondiLaddoo and Coconut Barfi.

   - About 5gm of sample was used to measure the moisture content of Boondi batter heated between 80-85ºC for 30 min.
   - About 5gm of sample was used to measure the moisture content of fried Boondiheated at 90ºC for 20-25 min.
   - About 5gm of sample was used to measure the moisture content of final mixture for BoondiLaddooheated between 85-90ºC for 15-20 min.
   - About 5gm of sample was used to measure the moisture content of Final BoondiLaddooheated between 85-90ºC for 15-20 min.

   - About 5gm of sample was used to measure the moisture content of freshly grated coconutheated between 80-85ºC for 25 min.
   - About 5gm of sample was used to measure the moisture content of final Coconut Barfi mixture heated between 80-90ºC for 10-15 min.
   - About 5gm of sample was used to measure the moisture content of Final Coconut Barfi heated between 85-90ºC for 15 min.

3. **Infrared Thermometer**
   A Digital Thermometer gun was used to measure the various processing temperatures.

4. **Digital Weighing Balance machine**
   A Digital Weighing balance was used to weigh the raw materials and the final product.

Standardization of Process parameters for BoondiLaddoo Production

1. A) Weight of Besan Flour used for making Boondi
   B) Quantity of Water used to make mixture
   C) Moisture content of the mixture prepared for making Boondi

2. A) Quantity of ghee used for frying
   B) Temperature of Ghee before frying
   C) Temperature of Ghee after frying

3. Moisture content of Boondi after frying

4. A) Weight of Sugar for Sugar Syrup
   B) Weight of Water to make Syrup
   C) Brix of Sugar Syrup prepared(Made in two batches)

5. A)Moisture content of Laddoo mix
   B) Temperature of Laddoo mix when shaping into Laddoos

6. A)Moisture content of Final product (Laddoo)
   B) Weight of the Final product (Laddoo)

7. Time for Drying of Laddoos : A) Drying till Laddoo holds shape
   B)Complete Drying of Laddoo till Packaging

8. Total number of Laddoos prepared

Standardization of Process parameters for Coconut Barfi

1. A) Weight of Sugar for Sugar Syrup
   B) Volume of Water added in Syrup
   C) Brix of Sugar Syrup prepared

2. A) Weight of Grated coconut
   B) Moisture content of Grated coconut

3. A) Moisture content of mixture
   B) Temperature of mixture

4. A) Temperature of mixture after cooling
   B) Time for drying of mixture
   C) Quantity of mixture prepared

5. A) Moisture content of Final product (Barfi)
   B) Temperature before packaging

6. Number of Barfis prepared

Observations:

BoondiLaddoo Processing

[Data Recording Sheet]

Step No 1: Batter Preparation

Sr. No.	Date and Time of Reading		Besan Flour (Weight in kg)	Water (Weight in kg)	Boondi Batter (Weight in kg)	Moisture content of Boondi Batter (% Moisture)
1.	13/6/16	11:45 am	25	30.7	55	44
2.	17/6/16	9:00 am	25	31.0	56	45
3.	18/6/16	11:40 am	25	31.0	60	56
4.	18/6/16	12:30 pm	25	31.0	60	48
5.	20/6/16	9:00 am	25	31.0	60	54
6.	20/6/16	11:45 am	25	31.0	60	48
7.	22/6/16	10:00 am	25	31.0	60	56
8.	22/6/16	12:00pm	25	31.0	60	56
9.	24/6/16	9:00 am	25	31.0	60	56
10.	24/6/16	12:00 pm	25	31.0	60	56
11.	25/6/16	03:30 pm	25	31.0	60	58
12.	27/6/16	10:49 am	25	31.0	60	58
13.	27/6/16	12:20 pm	25	31.0	60	64
14.	04/07/16	10:00pm	25	31.0	60	56
15.	08/07/16	12:00pm	25	31.0	60	58

(Note: Weights taken from the third reading onward are approximate values)

Step No 2: Frying Boondi Batter

Sr. No.	Date and Time of Reading		Initial Amount of Ghee (Weight in kg)		Temperature of Ghee added (˚C)		Temperature of ghee during frying (˚C)		Moisture content of Boondi after frying (%)
			A	B	A	B	A	B	
1.	13/6/16	11:45 am	40	55	78.0		165.2		2
2.	17/6/16	9:00 am	40	55	75.0		165.0		2
3.	18/6/16	11:40 am	40	55	75.0		160.0		0
4.	18/6/16	12:30 pm	40	55	65.2		160.9		0
5.	20/6/16	9:00 am	40	55	68.0		173.0		0
6.	20/6/16	11:45 am	40	55	73.0		215.0		0
7.	22/6/16	10:00 am	40	55	90.0	98.9	175.0	160.0	0
8.	22/6/16	12:00 pm	40	55	101.3	105	171.7	137.4	2
9.	24/6/16	9:00 am	40	55	196.1	165.2	167.5	183.3	0
10.	24/6/16	9:00 am	40	55	105	156.2	169.8	128.9	4
11.	25/6/16	04:15 pm	40	55	75.0	80	166.0	169.0	2
12.	27/6/16	10:49 am	40	55	126	164	159.5	231.4	6
13.	27/6/16	12:20 pm	40	55	155	108	169.9	258.0	10
14.	04/7/16	10:00am	40	55	168	170	187.1	218	6
15.	08/7/16	12:00pm	40	55	168.3	176.5	187.5	216.5	6

Step No 3: Sugar Syrup Preparation

Sr. No.	Date and Time of Reading		*Sugar (Weight in kg)	*Water (Weight in kg)	Time of Preparation of Sugar Syrup (minutes)		Total Solids in Sugar Syrup (°Brix)		Temperature of processing sugar syrup (°C)	
							A	B	A	B
1.	13/6/16	11:45 am	25	15	25	20	75	71	60.2	98.1
2.	17/6/16	9:00 am	25	15	25	20	73	75	75.0	101
3.	18/6/16	11:40 am	25	15	25	20	75	72	70.9	99.7
4.	18/6/16	12:30pm	25	15	25	20	75	73	78.0	95.0
5.	20/6/16	9:00 am	25	15	25	20	75	73	88.0	90.0
6.	20/6/16	11:45 am	25	15	25	20	75	73	79.9	89.1
7.	22/6/16	10:00 am	25	15	25	20	75	71	80.0	103.7
8.	22/6/16	12:00pm	25	15	25	20	70	68	78.0	101.7
9.	24/6/16	9:00 am	25	15	25	20	76	71	89.2	96.1
10.	24/6/16	9:00 am	25	15	25	20	76	74	97.1	96.8
11.	25/6/16	4:20 pm	25	15	25	20	76	71	84.1	89.0
12.	27/6/16	10:49 am	25	15	25	20	75	74	89.0	95.9
13.	27/6/16	12:20pm	25	15	25	20	77	75	96.6	96.8
14.	04/7/16	10:00am	25	15	25	20	77	74	86.9	86.3
15.	08/7/16	12:00pm	25	15	25	20	76	74	86.3	99.4

* (For both batches of sugar syrup equal amounts of sugar and water are used. Weights taken are approximate values)

Step No 4: Mixing of Boondi and Sugar Syrup to make BoondiLaddoo

Sr. No.	Date and Time of Reading		Temperature of BoondiLaddoo mixture (˚C)	Moisture Content of Final Laddoo mixture (% Moisture)
1.	13/6/16	11:45 am	62.0	12
2.	17/6/16	9:00 am	58.0	12
3.	18/6/16	11:40 am	60.0	12
4.	18/6/16	12:30 pm	50.0	12
5.	20/6/16	9:00 am	53.0	12
6.	20/6/16	11:45 am	50.0	12
7.	22/6/16	10:00 am	51.8	12
8.	22/6/16	12:00 pm	50.3	16
9.	24/6/16	9:00 am	74.9	12
10.	24/6/16	12:00 pm	54.6	14
11.	25/6/16	4:50 pm	53.7	14
12.	27/6/16	10:49 am	67.3	16
13.	27/6/16	12:20 pm	57.0	14
14.	04/7/16	10:00am	60.1	14
15	08/7/16	12:00pm	62.2	16

Step No 5: Final product (BoondiLaddoo)

Sr. No.	Date and Time of Reading		Temperature of BoondiLaddoo (°C)		Weight of BoondiLaddoo (g)		Moisture content of BoondiLaddoo (%)	
			Before Drying	After Drying	Before Drying	After Drying	Before Drying	After Drying
1.	13/6/16	11:45 am	50.0	38.0	52.8	51.1	16	12
2.	17/6/16	9:00 am	40.1	33.0	56.3	58.2	12	12
3.	18/6/16	11:40 am	37.0	33.0	55.3	55.5	12	10
4.	18/6/16	12:30 pm	36.6	33.0	52.0	52.8	12	12
5.	20/6/16	9:00 am	40.8	32.1	56.4	55.4	12	12
6.	20/6/16	11:45 am	42.5	33.0	57.1	56.8	12	12
7.	22/6/16	10:00 am	41.0	38.0	56.9	58.2	12	12
8.	22/6/16	12:00 pm	52.3	36.4	58.4	57.9	16	14
9.	24/6/16	9:00 am	53.4	34.8	59.6	59.4	12	14
10.	24/6/16	12:00 pm	49.4	31.1	57.9	57.7	14	14
11.	25/6/16	05:00 pm	40.9	30.6	57.5	58.7	16	14
12.	27/6/16	10:49 am	42.5	30.9	55.4	55.4	14	12
13.	27/6/16	12:20 pm	36.6	31.7	57.4	57.4	14	14
14.	04/7/16	10:00am	45.5	30.6	57.48	57.4	12	10
15.	08/7/16	12:00pm	59.4	42.6	59.1	58.88	14	18

Step 6: Packaging

Sr. No.	Date and time of Reading		Temperature of Laddoo when packaging (˚C)	Moisture content of Laddoo when packaging (%)	Yield
1.	13/6/16	11:45 am	33.0	12	From 30 kg mixture, 460 Laddoos were rolled out, of approximately 60 g each.
2.	17/6/16	9:00 am	33.0	12	
3.	18/6/16	11:40 am	33.0	10	
4.	18/6/16	12:30 pm	31.0	12	
5.	20/6/16	9:00 am	31.2	12	
6.	20/6/16	11:45 am	31.0	12	
7.	22/6/16	10:00 am	31.0	12	
8.	22/6/16	12:00 pm	31.6	14	
9.	24/6/16	9:00 am	30.1	12	
10.	24/6/16	12:00 pm	29.9	12	
11.	25/6/16	05:30 pm	29.1	14	
12.	27/6/16	10:49 am	30.2	12	
13.	27/6/16	12:20 pm	29.6	14	
14.	04/7/16	10:00am	29.1	10	
15.	08/7/16	12:00pm	29.8	18	

Coconut Barfi Processing

[Data Recording Sheet]

Step No 1: Sugar Syrup Preparation

Sr. No.	Date and Time of Reading		Sugar (Weight in kg)	Water (Weight in kg)	Total Solid Content of Sugar Syrup (˚Brix)
1.	17/06/16	10:20 am	50	10	80
2.	18/06/16	12:00 pm	50	10	81
3.	20/06/16	11:00 am	50	10	80
4.	22/06/16	02:00 pm	50	10	81
5.	22/06/16	04:40 pm	50	10	83
6.	24/06/16	01:10 pm	50	10	84
7.	25/06/16	04:00 pm	50	10	85
8.	25/06/16	05:00 pm	50	10	85
9.	27/06/16	10:30 am	50	10	77
10.	27/06/16	04:30 pm	50	10	81

Step No 2: Preparation of Coconut Barfi Mix

Sr. No.	Date and Time of Reading		Temperature During Processing (°C)	Moisture Content of Grated Coconut (% Moisture)	Moisture Content of Final Mixture (% Moisture)
1.	17/06/16	12:00 pm	78.0	60	10
2.	18/06/16	01:20 pm	71.1	50	10
3.	20/06/16	12:45 pm	79.0	50	10
4.	22/06/16	03:55 pm	78.1	46	12
5.	22/06/16	05:45 pm	78.0	54	10
6.	24/06/16	02:20 pm	77.2	50	14
7.	25/0616	05:15 pm	78.1	52	14
8.	25/06/16	06:25 pm	76.2	56	04
9.	27/06/16	11:15 am	82.2	48	14
10.	27/06/16	05:40 pm	73.6	52	16

Amount of Grated Coconut used for each Batch : 75 kg

Step No 3: Cooling, Cutting and Storage of Barfi

Sr. No.	Date and Time Of Reading		Temperature for Drying Barfi (˚C)	Temperature During Cutting Barfi Pieces (˚C)	Storage Temperature for Barfi (˚C)	Moisture Content of Coconut Barfi (% Moisture)	Yield
1.	17/06/16	12:30 pm	66.0	35.0	33.0	10	100 kg mix-ture is placed in over 18 Trays for drying and yields about 4000 pieces.
2.	18/06/16	01:45 pm	58.0	34.0	33.0	10	
3.	20/06/16	01:00 pm	70.0	60.0	30.0	10	
4.	22/06/16	04:15 pm	64.0	32.0	30.7	14	
5.	22/06/16	06:00 pm	64.0	32.0	30.0	10	
6.	24/06/16	02:45 pm	63.0	31.2	30.5	10	
7.	25/06/16	05:30 pm	55.9	33.4	29.7	10	
8.	25/06/16	06:40 pm	60.5	31.2	29.0	14	
9.	27/06/16	11:30 am	45.3	30.6	29.8	10	
10.	27/06/16	06:00 pm	63.7	31.4	29.2	14	

*1 Tray gives approximately 275 pieces.

Variations in the Process and their Inferences:

FOR BOONDILADDOO

1. Variations in viscosity of the batter were observed.
   Lumps formed during batter preparation were discarded leading to wastage of raw material. Large variations in moisture content of the batter were also observed.
2. Temperatures of the ghee added to the kadaifor frying showed large variations resulting in inconsistent moisture content of fried Boondi and final product. Additionally the time of frying is also less (Within a minute)
3. The temperature for preparation of the sugar syrup varies resulting in slight variations in Brix of the sugar syrup
4. The moisture content of the final mixture is high and this results in high moisture content of the final Laddoo.
5. Food color needs to be added to obtain the desired yellow color of the final Laddoo product.
6. The Drying conditions vary.

Sometimes fans are used to dry the Laddoosfor a few hours while other times they are left in storage room without a fan.

Due to the load of orders sometimes wet Laddoos are also packaged which may affect the shelf life of the product.

FOR COCONUT BARFI

1. Brix of Sugar syrup varies with variation in the time and temperature of cooking.
   Sugar syrup with higher Brix value is desired for increased Shelf Life.
2. Moisture content of grated coconut varies which in turn leads to varying moisture content of the Final Barfi
   The changes in processing temperature also affect Moisture content of the Final product.
   It has been observed that the Batch containing high moisture content for grated coconut has a lower moisture content for the Barfi when high temperature processing is used.
   But sometimes higher temperature yields high moisture content, this is due to variation in the time of processing.
3. The conditions used for drying and cutting of final Barfi mixture vary.
   Inefficient drying leads to higher moisture content of the final product and reduced shelf life.
   Over drying of Barfi under fans was observed, this leads to crumbling of the Barfi during cutting thereby decreasing the final yield.
4. Due to variation in the processing temperatures, the degree of caramelization of the sugar is different thus producing a range of color which affects the appearance of the final product.

Suggested Actions

FOR BOONDILADDOO

- ✓ Use of a **Viscometer** for control of Batter consistency
  If the batter is too thin, more flour can be added to increase the thickness
  If the batter is too thick, more water can be added for required viscosity
- ✓ For frying of Boondi, in order to obtain a better fried Boondi, the Boondi batter should be dropped into the ghee when its temperature reaches **180˚C(start of frying)**. A drop in temperature during frying operation occurs (around 150˚C) .After 2-3 minutes, when the temperature of the ghee during frying reaches back to 180˚C, the Boondi should be removed from the ghee.
  This will be the end point of frying.
  This method of frying the Boondi could give a product with suitable crispiness and moisture content will also be low.
  It may also give the Boondi a better color for the final Laddoo without the use of a coloring agent.
- ✓ The **moisture content** of Fried Boondi must be maintained below 3%
- ✓ **Brix** of Sugar syrup (Batch 1) can be increased by increasing the temperature which could in turn extend shelf life.
- ✓ Use of **Thermocouples** with temperature indicators to track the temperatures during processing is suggested.
- ✓ Uniform time of processing is required for better consistency in the final product.
- ✓ Rise in temperatures for processing may decrease yield but this can be compensated by having uniform weights of Laddoos for packaging.
  Using a measured quantity of mixture to make Laddoos of approximately equal weights and sizes. For this a weighing mechanism or the use of a measuring vessel can be employed during the rolling of the Laddoo mixture. This may decrease the time required and yield could improve.
- ✓ The Moisture content of the final BoondiLaddoo should be maintained **below 8%** for higher shelf life.

FOR COCONUT BARFI

- ✓ Instead of using Sugar crystals, **powdered sugar** can be used for the production of Coconut Barfi.
  Powdered sugar can be directly added to grated Coconut; while water can be added as per the requirement and cooked rather than the current process of making sugar syrup first which requires 20-25 mins.
  This Process will save time, energy and will also making the Barfis set faster.
- ✓ 20% **Jaggery** powder can be added to remaining 80% powdered sugar in order to improve the color of the final product.
- ✓ In order to standardize the conditions for Drying Barfi mixture, a **mechanical Tray Dryer** can be used.
- ✓ The Moisture content of the Final Barfi must be maintained below 8% for higher shelf life.

Labeling:

Information about Sugar content and Trans fat needs to be mentioned on the packet according to the new regulations.

Ash content is not needed to be mentioned.

General Observations

- ✓ During monsoon season, severe leakages were observed in the area of frying Boondi and preparation of Sugar syrup. Water could leak into the batter or the sugar syrup. This is also alarming as the laborers could suffer from serious injury if the water falls in the hot ghee and splashes on them.
- ✓ Presence of Rodents was observed several times in raw material and final product storage rooms.
- ✓ Washing area for laborers and area used to make Boondi batter is shared.
- ✓ Personal Hygiene and safety needs to be reinforced in terms of wearing head caps and face masks.

Instruments Required and their Quotations

Sr. No.	Suggested Instruments	Cost	Quantity	Purpose
1.	Ostwald Viscometer	10,000/_	1	Batter control
2.	Thermocouple with Temperature indicator	8000/- each	3	To track temperature of Ghee during frying of Boondi and Preparation of Sugar syrup
3.	Mechanical Tray Dryer (Trolley of 48 trays)	1 lakh	1	For efficient Drying of Barfi mixture

Suggested Tests:

Sr. No.	Tests to be Performed	Charges (per sample)	Purpose
1	Estimation of Free Fatty Acid content in the Ghee used	450/-	To find the free fatty acid content in ghee used for frying Boondi and determine its safety.
2	Moisture Content [After increasing temperature]	300/-	Moisture content of the BoondiLaddoo and its shelf life estimation
3	*Microbiological test [After increasing temperature]	2850/-	Susceptibility to microbial contamination and spoilage of final product
4	Water Activity [After increasing temperature]	850/-	Estimate water activity in the product and its effect on the shelf life
	TOTAL	4450/-	

*Includes tests for TPC, YLM, Coli forms, *E.coli*, *Staphylococcus*, *and Salmonella*

PROJECT PHASE II

Objective

To establish standard measures of process parameters involved in the Boondi Laddoo and Coconut Barfi Processing in order to obtain products with lower moisture content, hence increasing its shelf life.

Methods

In order to understand and prove the effect of establishing set parameters for temperature and time for both processes and the resultant improvement in the quality of the products and their shelf life, the following processes were followed:

I. Frying of the boondi :
When the temperature of the Ghee in the Kadai reaches 180˚C, boondi batter is beaten into the Ghee. During frying, the temperature of this ghee would reduce down to 150˚C; hence after 2-3 minutes of heating, when the temperature of the Ghee climbed back to 180˚C, the boondi would be removed from the Kadai. This will give a boondi of the desired crispiness and colour.

II. Processing temperature of Barfi mixture: Using high temperatures of processing the coconut Barfi mixture, maintained above 85˚ C, the ideal reduction in Moisture content could be achieved.

Yield Improvement

Along with this improvement of process parameters, increasing the yield of the BoondiLaddoos was also studied by employing certain methods. Due to manual rolling out of the laddoos, non-uniform weights of the Laddooresulted in the yield being unpredictable and insufficient. Hence, in order to solve this problem by the simplest and least expensive method, the laborers employed in rolling of Laddoos were given measured and marked containers. Initially they would use these containers to get a measured amount of the mix and then roll out this mix into laddoos of ideal weights. As they got used to this method, it gave an output of almost uniform weight of laddoos and this boosted their yield.

Due to experience, they were able to achieve the same result even without using the containers after a few days' time

Observations

Boondi Laddoo Processing

[Data Recording Sheet]

❖ Batter Preparation

Sr. No.	Date and Time of Reading		Besan Flour (Kg)	Water (Kg)	Boondi Batter (Kg)	Moisture Content of Boondi Batter (% Moisture)
1.	09/07/16	10:30 am	25	30	55	56
2.	13/07/16	09:30 am	25	30	55	58
3.	14/07/16	10:45 am	25	30	55	60
4.	15/07/16	01:20pm	25	30	55	58
5.	18/07/16	11:00 am	25	30	55	58
6.	20/07/16	11:00 am	25	30	55	58
7.	21/07/16	12:30pm	25	30	55	58
8.	23/07/16	11:45 am	25	30	55	56
9.	25/07/16	01:40pm	25	30	55	56

❖ Frying Boondi Batter

Sr. No.	Date and Time of Reading		Initial Amount of Ghee (Kg)		Initial Temperature of Ghee (˚C)		Temperature of Ghee during frying (˚C)		Moisture Content of Fried Boondi (% Moisture)
			A	B	A	B	A	B	
1.	09/07/16	10:45am	40	55	181.3	180.0	153.8	155.0	4
2.	13/07/16	09:45am	40	55	164.0	170.0	181.8	180.2	2
3.	14/07/16	11:00am	40	55	165.0	170.0	178.5	180.0	0
4.	15/07/16	1:35pm	40	55	128.0	175.2	178.0	180.0	2
5.	18/07/16	11:15am	40	55	183.8	170.0	154.0	147.2	4
6.	20/07/16	11:15am	40	55	146.8	132.0	170.0	180.4	4
7.	21/07/16	12:45 pm	40	55	172.4	173.2	157.8	142.0	4
8.	23/07/16	12:00 pm	40	55	172.2	165.4	129.2	136.2	4
9.	25/07/16	1:55pm	40	55	183.6	170.6	146.8	130.2	2

❖ Sugar Syrup Preparation

Sr. No	Date and Time of Reading		Sugar (Kg)	Water (Kg)	Time of Preparat-ion for Sugar Syrup (min)		Total Solids in Sugar Syrup (˚Brix)		Temperature of processing Sugar Syrup (˚C)	
					A	B	A	B	A	B
1.	09/07/16	11:00 am	25	25	25	20	76	76	98.2	97.4
2.	13/07/16	10:00 am	25	25	25	20	76	71	89.4	93.6
3.	14/07/16	11:15 am	25	25	25	20	75	72	96.6	99.0
4.	15/07/16	1:50 pm	25	25	25	20	76	71	98.2	96.0
5.	18/07/16	11:30 am	25	25	25	20	78	73	102.2	100.4
6.	20/07/16	11:30 am	25	25	25	20	75	72	104.4	100.6
7.	21/07/16	1:00 pm	25	25	25	20	76	71	102.6	100.2
8.	23/07/16	12:15 pm	25	25	25	20	74	71	94.0	100.4
9.	25/07/16	2:15 pm	25	25	25	20	76	74	102.4	110.2

❖ Preparation of Final Mixture

Sr. No.	Date and Time of Reading		Temperature of making Boondi Laddoo Mixture (˚C)	Moisture Content of Final Mixture (% Moisture)
1.	04/07/16	11:00 am	60.1	12
2.	08/07/16	01:00 pm	62.2	14
3.	09/07/16	11:30 am	60.6	16
4.	13/07/16	10:30 am	65.6	20
5.	14/07/16	11:45 am	70.4	20
6.	15/07/16	01:15 pm	65.3	16
7.	18/07/16	12:00 pm	74.5	22
8.	20/07/16	12:00 pm	72.8	24
9.	21/07/16	01:30 pm	82.4	24
10.	23/07/16	12:45 pm	75.2	16
11.	25/07/16	02:45 pm	68.4	20

❖ Final Product- Boondi Laddoo

Sr. No.	Date and Time of Reading		Weight of Boondi Laddoo (gm)		Temperature of Boondi Laddoo (˚C)		Moisture Content of Boondi Laddoo (% Moisture)	
			Before Drying	After Drying	Before Drying	After Drying	Before Drying	After Drying
1.	09/07/16	12:00 am	55.24	54.46	51.4	32.6	16	16
2.	13/07/16	11:00 am	58.72	58.2	54.2	40.2	14	16
3.	14/07/16	12:15 am	53.52	53.2	57.2	37.4	20	20
4.	15/07/16	1:45 pm	58.26	57.94	54.3	30.8	16	20
5.	18/07/16	12:30 am	56.59	55.82	57.4	33.4	22	20
6.	20/07/16	12:30 am	55.2	54.98	49.2	31.8	24	16
7.	21/07/16	2:00 pm	56.42	55.92	58.8	36.2	24	16
8.	23/07/16	01:15 am	55.04	54.46	51.2	42.6	16	18
9.	25/07/16	3:15 pm	55.92	55.4	42.4	31.6	20	16

❖ Packaging and Storage

Sr. No.	Date and Time of Reading		Temperature of Laddoo During Packaging (˚C)	Moisture content of Laddoo (% moisture)
1.	09/07/16	12:00 am	29.8	16
2.	13/07/16	11:00 am	30.2	16
3.	14/07/16	12:15 am	29.2	20
4.	15/07/16	01:45 pm	29.2	20
5.	18/07/16	12:30 am	31.2	20
6.	20/07/16	12:30 am	29.2	16
7.	21/07/16	02:00 pm	29.0	16
8.	23/07/16	01:15 am	31.4	18
9.	25/07/16	03:15 pm	30.8	16

Coconut Barfi Processing

[Data Recording Sheet]

❖ Sugar Syrup Preparation

Sr. No.	Date and Time of Reading		Sugar (Kg)	Water (Kg)	Temperature of making Sugar Syrup (˚C)	Total solids Content of Sugar Syrup (˚Brix)
1.	04/07/16	12:45 pm	50	10	101.4	84
2.	04/07/16	05:00 pm	50	10	96.2	79
3.	07/07/16	10:30 am	50	10	92.8	74
4.	07/07/16	12:30 pm	50	10	90.6	84
5.	07/07/16	02:45 pm	50	10	98.3	85
6.	14/07/16	02:50 pm	50	10	96.6	82
7.	15/07/16	12:30 pm	50	10	104.2	81
8.	16/07/16	10:30 am	50	10	104.8	82
9.	16/07/16	01:30 pm	50	10	106.0	79
10.	18/07/16	03:00 pm	50	10	105.4	75
11.	20/07/16	03:00 pm	50	10	82.8	81
12.	21/07/16	03:00 pm	50	10	105.6	83
13.	23/07/16	1:15pm	50	10	106.6	71
14.	25/07/16	11:10 am	50	10	106.0	85

❖ Preparation of Coconut Barfi Mix

Sr. No.	Date and Time of Reading		Temperature during processing (˚C)	Moisture Content of Grated Coconut (% Moisture)	Moisture Content of Final Mixture (% Moisture)
1.	04/07/16	12:45 pm	83.7	52	14
2.	04/07/16	05:00 pm	80.3	52	08
3.	07/07/16	10:30 am	81.2	52	12
4.	07/07/16	12:30 pm	82.3	56	20
5.	07/07/16	02:45 pm	77.8	50	14
6.	14/07/16	02:50 pm	84.2	52	22
7.	15/07/16	12:30 pm	82.4	54	16
8.	16/07/16	10:30 am	81.6	52	20
9.	16/07/16	01:30 pm	82.0	50	24
10.	18/07/16	03:00 pm	81.8	58	20
11.	20/07/16	03:00 pm	82.0	52	20
12.	21/07/16	03:00 pm	80.2	52	20
13.	23/07/16	1:15pm	82.8	50	16
14.	25/07/16	11:10 am	80.6	56	24

❖ Cooling, Cutting and Storage of Barfi

Sr. No.	Date and Time of Reading		Temperature for Drying Barfi (˚C)	Temperature during Cutting Barfi pieces (˚C)	Storage Temperature for Barfi (˚C)	Moisture Content of Coconut Barfi (% Moisture)
1.	04/07/16	12:45pm	54.9	30.8	29.9	10
2.	04/07/16	5:00 pm	43.9	31.2	29.2	08
3.	07/07/16	10:30am	64.4	30.2	29.0	12
4.	07/07/16	12:30pm	52.2	30.3	30.2	20
5.	07/07/16	2:45 pm	63.7	30.2	29.0	14
6.	14/07/16	2:50 pm	64.8	32.4	29.8	24
7.	15/07/16	12:30pm	52.2	31.6	31.2	22
8.	16/07/16	10:30am	41.7	34.2	30.8	24
9.	16/07/16	1:30 pm	52.0	41.2	30.8	24
10.	18/07/16	3:00 pm	52.0	31.4	30.6	22
11.	20/07/16	3:00 pm	56.8	36.6	31.6	20
12.	21/07/16	3:00 pm	56.6	31.0	28.6	16
13.	23/07/16	1:15pm	56.4	31.8	31.4	16
14.	25/07/16	11:10am	57.9	31.0	30.8	24

Yield of Boondi Laddoos

Plastic containers were given to the workers that roll out the final mixture into round balls of laddoos. Each of these containers were weighed and marked to indicate how much mixture should be filled.

5 laddoos were taken, one from each worker to find the average weights of the laddoos being made. In order to differentiate, four batches were taken, two when the containers were not used (before) and two when the containers were used (after).

- **Without using measuring containers: (Before)**

	Weight of the Laddoos			
	Batch1		Batch 2	
	Before drying	After Drying	Before drying	After drying
Date and time	8/7/16 4:00pm	9/7/16 9:00am	15/7/16 4:30pm	16/7/16 10:40am
1.	**58.3**	**58.1**	**62.6**	**62.3**
2.	**61.4**	**61.2**	**55.7**	**55.3**
3.	**58.6**	**58.4**	**57**	**56.8**
4.	**56.1**	**55.9**	**56.6**	**56.3**
5.	**61.1**	**60.8**	**59.4**	**59**
Average weight of laddoos in batch	**59.1**	**58.88**	**58.26**	**57.94**

- **Using Measuring containers:**

	Weight of the Laddoos			
	Batch1		Batch 2	
	Before drying	After Drying	Before drying	After drying
Date and time	20/7/16 12.15pm	21/7/16 9:30am	25/7/16 4:40pm	27/7/16 11:00am
1.	**55.6**	**55.4**	**55.1**	**55.4**
2.	**55.6**	**55.3**	**56.3**	**55.6**
3.	**55**	**54.7**	**56.2**	**55.4**
4.	**54.7**	**54.6**	**55.2**	**54.5**
5.	**55.3**	**54.9**	**56.8**	**56.1**
Average weight of laddoos in batch	**55.24**	**54.98**	**55.92**	**55.4**

Conclusion

- Due to high humidity and damp weather, both products absorbed moisture thus leading to increase in the moisture content. Even during storage, the laddoos and barfis were gaining moisture leading to an increase in the moisture content of the final product. This led us to conclude that the shelf life and stability of the mahaprasad was lowered especially during monsoons and unfavorable weather as they are not dried or stored in a controlled environment.

  Thus further study for this phase must be resumed during suitable climate.

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