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EXPLORATORY STUDIES AND OPERATIONS RESEARCH
ON POST PRODUCTION TECHNOLOGY

TECHNICAL REPORT
NOVEMBER 1990



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**EXPLORATORY STUDIES AND OPERATIONS RESEARCH
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POST PRODUCTION TECHNOLOGY**

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POST PRODUCTION TECHNOLOGY

1.0 INTRODUCTION :

Through BAIF's various rural development programmes a production base has been created for various agri-horticulture produce. It is planned to develop effective forward linkages for processing this produce in order to reduce vulnerability to market fluctuations, provide value addition and generate off-farm employment opportunities through taking up various post production activities in BAIF's operational areas. In the initial phase, work has been focused on the produce generated as a result of BAIF's tribal development efforts. Details of work taken up during this year follow.

2.0 ACTIVITIES / RESEARCH STUDIES UNDERTAKEN :

The post production activities of mango were introduced on a trial basis during 1989 and were put on a sound footing during 1990. A facility for fruit processing has been established at BAIF's operational headquarters at Vansda, Gujarat, in the project area. This facility consists of :

a. Housing :

This consists of an insect-proof production centre which houses all the processing and packaging machinery, storage for raw fruit and finished products, preparation space for fruit sorting and washing etc.

b. Installation of the following fruit processing equipment :

Pulper-cum-finisher, steam jacketted kettle, boiler, bottle sealing machine, canning retort and material handling equipment.

The above facility was made use of for the first pilot run to process mango during the harvesting season in May - June 1990. It is further decided to use the same facility for vegetable processing in the coming months.

In order to have a methodical standardisation of the processing activity a few studies were planned and have been initiated. Details of the studies are enclosed as Enclosures 1, 2 and 3.

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ENCLOSURE 1

CHARACTERISATION OF MANGO PULP

CHARACTERISATION OF MANGO PULP

1.0 BACKGROUND :

Four varieties of mangoes are planted as part of the tribal rehabilitation programme in Vansda. The total mango plantation of these varieties is about 120,000 trees with about 10,000 (8.0%) being Alphonso, 8,000 (7.0%) being Kesar, 12,000 (10.0%) being Langda, and 90,000 (75.0%) being Rajapuri. The four varieties of mango have different characteristics. Alphonso, Kesar and Langda are premium table varieties. Of these Alphonso has unique flavour and both Alphonso and Kesar have excellent colour. Alphonso variety does not bear fruit every year but there is a flush every alternate year. The Rajapuri variety is more juicy and has a regular fruit bearing every year but receives a lower rate than the other three varieties. Typically the effective pulp yield is of the order of 50% of the fruit weight but would vary considerably from variety to variety. Further, other characteristics such as total solids % and acidity are also different, resulting in difference in taste, requirement of addition of sugar and so on. It was therefore thought important to study the characteristics of the relevance to processing, in respect of the above mango varieties.

2.0 OBJECTIVES :

1. To record the pulp characteristics like sugar content, acidity (pH value), total solids (TS) and pulp yield for different varieties and at different stages of ripening of the fruit.
2. To observe and record the change in these characteristics at various stages in processing to help in process standardisation.

3.0 STUDY DESIGN :

It was decided to note the characteristics of the pulp with respect to the following physical and chemical parameters.

a. Physical :

1. Pulp yield (% of fruit weight).
2. Colour
3. Total solids content (%)
4. Settling characteristics (phase separation)

b. Chemical :

1. Acidity (pH)
2. Preservative content

It was decided to note the above characteristics for fresh pulp as well as boiled pulp.

Pulp processing consisted of a standard process of pulping - sugar addition - boiling - packing - sterilizing. Detailed process description is given in Annexure 1.

4.0 PROGRESS MADE :

The current year mango season was peculiar in two respects :

- Overall fruit bearing was highly reduced comparing to last year and hence much smaller quantities of harvest were realised.

- Most of the fruit available was of Rajapuri variety and hardly any fruit belonging to the other three varieties was harvested. As a result, the plan for the study had to be considerably modified. The study was taken up only in respect of Rajapuri variety and it is planned to take up the same for the other three varieties during the next season. The parameter values for the fresh and boiled pulp of the Rajapuri variety are provided in Annexure 2. Repeat analysis in respect of bottled pulp is presently underway to note any changes that may have occurred over the storage period.

Comparative analysis and process recommendations for making products from different varieties will be possible only when similar data is available in respect of the other mango varieties. Process standardisation for making dehydrated mango products using the stored pulp of Rajapuri variety has been taken up.

ANNEXURE 1

PROCESS FOR PREPARING MANGO PULP

1. Select the fruits to be taken for processing (Mixture of over ripe and just ripe mangoes which are healthy).
2. Take fruits to preparation area and wash thoroughly with bacteria-free water so as to put away other impurities.
3. Take fruits on table and cut into three pieces.
4. Feed the pieces into pulper.
5. Draw the pulp from the of pulper and pour in a steam jacketted kettle. (Start the boiler 30 minutes before this and boil clean water. Make 70 % sugar syrup in the kettle before pouring pulp).
6. Check TS and add sugar syrup in sufficient quantity to raise the TS to 25.
7. Check acidity of pulp and add citric acid in sufficient quantity so as to decrease pH to 0.5.
8. Wait till the pulp boils and then add preservative in predecided quantity (Potassium metabisulphite or sodium benzoate to attain 350 ppm in the final product).
9. Take out the first batch of pulp from kettle and fill in pre-cleaned and preheated bottles.

10. Each time while taking out pulp from kettle ensure that pulp temperature is within a range of 90^o to 95^o C. Achieve this by controlling steam flow.
11. Seal the bottle with a crown-cap.
12. Keep bottles inserted in boiling water for about 25 minutes in a canning retort.
13. Take out the bottles and keep in a cool breeze for speedy cooling.
14. Stock the ready bottles in a store room.

The factors to be checked :

Test for all batches :

Check total solids (TS) of fresh pulp from pulper and of pulp ready to be filled in bottles.

Sample testing :

Once a day test fresh pulp and final product for its pH value on-line (If infrastructure is not available, measure pH value of each mango variety only once and decide the addition level of citric acid for the final product).

ANNEXURE 2

OBSERVED PARAMETER VALUES OF RAJAPURI PULP

SR NO	PARAMETERS	FRESH PULP	BOILED PULP	PRESERVED PULP (AFTER 5 MONTHS)
A. PHYSICAL :				
1.	Pulp yield (% of fresh fruit weight)	67%	55%	NA
2.	Colour	Yellow	Yellow	Yellow
3.	Total sugar	16°Brix	25°Brix	23°Brix
4.	Settling characteristics	No settling	No settling	Occasional phase separation
B. CHEMICAL :				
1.	Acidity (pH)	0.34	0.50	0.48
2.	Preservative content (ppm)	NA	550	473

*Figures in column 'Boiled pulp' indicates values of pulp ready to be bottled i.e. after adding additives.

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ENCLOSURE 2

STANDARDISATION OF PROCESSES FOR TRADITIONAL MANGO PRODUCTS

STANDARDISATION OF PROCESSES FOR TRADITIONAL MANGO PRODUCTS

1.0 BACKGROUND :

A number of dried products are already made from mango pulp in traditional mango growing areas. These include mango leather and mango pulp concentrate (mango mawa). Generally only Alphonso variety is used for making such products in traditional mango areas of Maharashtra.

Further, the traditional methods are home based and are not standardised for mass scale production. It is however seen that these products enjoy a good demand. As these products are not at all made in the Gujarat area and have not been made from other mango varieties such as Kesar, Langda and Rajapuri, it was decided to take up a study for standardisation of the process for making these products on a small scale.

2.0 OBJECTIVES :

1. To standardise the process for mango leather production.
2. To standardise the process for producing mango pulp concentrate.

3.0 STUDY DESIGN :

The two products mentioned above are traditional, made by sun-drying (mango leather) and by boiling and concentrating the pulp in an open pan. (Mango Mawa).

Parameters like crispness, colour, taste decide the product quality for mango leather. In order to standardise the process for making these products it was planned to try combinations of different pulp varieties and different sugar addition levels. Details of the combination planned are presented in Annexure 1.

It was decided to note observations on the following parameters :

A) MANGO LEATHER

1. Crispness : Brittleness.
2. Texture : Whether granular or not
3. Taste : Acceptability to be assessed by sensory evaluation methods.
4. Colour : Dark / Golden Yellow.
5. Moisture percentage

B. MANGO MAWA :

1. Colour : Dark / Yellow.
2. Taste : Acceptance as per sensory analysis.
3. Texture : Putty - like / gummy.
4. Moisture percentage.

The traditional processes used for the above products are detailed in Annexure 2. It was decided to follow the same process but keep detailed records on batch cycle time, and product yield.

4.0 PROGRESS MADE :

Work on the study was hampered due to the following factors :

1. Non-availability of mango of all varieties.
2. Early onset of monsoon hampering sun-drying.

In view of the above the study has been modified so as to take up work only on use of Rajapuri variety for the above products. Further mango leather production has now been initiated using both sun drying of mango pulp as well as forced drying through a tray dryer which is being procured. Results of the Rajapuri variety are expected to be in hand before the next mango season. Studies on other varieties will be carried out during the next mango season (May 1991). This standardised process can be applied for small scale production and economics will be worked out on the basis of observations made.

ANNEXURE 1

COMBINATIONS TO BE INCLUDED IN TRIAL PRODUCT : MANGO LEATHER

BATCH NO.	PULP MIXES	PROPORTIONS	SUGAR ADDITIONS	
1.	Rajapuri + Alphonso	70 : 30	All these 6 batches will be tried at following three sugar addition levels :	
2.	Rajapuri + Alphonso	80 : 20		
3.	Rajapuri + Alphonso	90 : 10		Sugar
4.	Rajapuri + Kesar	70 : 30		10 % W / W
5.	Rajapuri + Kesar	80 : 20		15 % W / W
6.	Rajapuri + Kesar	90 : 10		20 % W / W

COMBINATIONS TO BE INCLUDED IN TRIAL PRODUCT : MANGO MAWA

VARIETY : RAJAPURI

BATCH NO	SUGAR ADDITION LEVELS
1.	20 % by pulp weight
2.	25 % by pulp weight
3.	30% by pulp weight

ANNEXURE 2

TRADITIONAL PROCESS FOR MANGO LEATHER

1. Procure fresh or preserved pulp.
 2. Add ground sugar in pulp.
 3. Spread first layer of pulp.
 4. Leave the tray for sundrying (Appxly for 3-4 hours).
 5. Once the surface layer is dried spread second layer.
 6. Leave the tray for sundrying (Appxly for 4-5 hours).
 7. Spread the third layer after surface of the second layer is dried.
 8. Leave the tray for sundrying (Appxly for 7-8 hours).
 9. Cut the slab in tray into pieces and take out all pieces.
 10. Invert pieces to be sun-dried.
 11. Pack into batches of equal weight.
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TRADITIONAL PROCESS FOR PREPARING MANGO MAWA

1. Procure pulp and mix it with 25% w/w ground sugar.
2. Pour pulp in an open pan and heat on low fire.
3. While heating stir the pulp continuously so that it does not get charred.
4. Concentrate to about 50% moisture level, and cool.

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ENCLOSURE 3

USE OF SOLAR DRYER FOR PRODUCTION OF MANGO LEATHER

USE OF SOLAR DRYER FOR PRODUCTION OF MANGO LEATHER

1.0 BACKGROUND :

Mango leather is traditionally made by the sun drying process. By this method the batch cycle time is about 3 days in case of bright sunny days. However if the days are cloudy this can increase the cycle time considerably and might also spoil the product, especially in case of occasional showers. These problems become more critical in BAIF's operational area in South Gujarat where mango harvesting is only about 15 days prior to onset of monsoon. It is therefore necessary to circumvent these problems by speedy drying process and protecting from possible showers. Solar dryers might be able to achieve this without much additional cost. Further, solar dryers would also help in improving the quality of the products because of dust free production. It was therefore thought worthwhile to study use of different designs of solar dryers for this purpose.

2.0 OBJECTIVES :

1. To procure existing designs of solar dryers.
2. Study of suitability of different designs for production of mango leather.
3. To evolve modified designs if necessary.

3.0 STUDY DESIGN :

Mango Leather is prepared by drying pulp in trays and hence

the design of solar dryers that are to be tried under this study should accommodate a number of trays. With this condition in mind it was decided to procure one solar dryer which is presently being used for drying agricultural produce. In addition to this, another low-cost design of a solar dryer would be fabricated and tried out.

Batch production trials would be taken up on both the designs along with similar batch under sundrying as a control. For comparison between these models and the control, the following data would be collected :

1. Weight reduction (from pulp to final product).
2. Batch process time.
3. Temperature : Ambient, inlet of dryer, and outlet of dryer.
4. Relative humidity : Ambient, inlet of dryer, and outlet of dryer.

Depending on the observations design modifications would be carried out to achieve lowest possible cycle time.

After standardising the dryer parameters a number of such units would be installed for large scale production.

In the whole study it would only be checked that there is no degradation in taste, appearance and quality of the product.

4.0 PROGRESS MADE :

One standard solar dryer unit has been procured for the trials at Vansda while another unit is under construction. Comparative studies would be shortly initiated and completed before next monsoon.