



## **CITRUS JUICE POWDER DEVELOPMENT**



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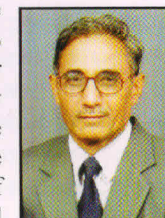
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## FOREWORD

The mandarin, sweet oranges and acid lime are the commercial citrus cultivars grown in India having 85-90% share in total citrus production in the country. However, per capita per day availability of citrus is very low in our country than that of the advance citrus growing countries. The nutritional value of these cultivars is well known in the dietary requirement as fruits contain fairly high amount of ascorbic acid, organic acids, minerals, flavonoids, phenols and several beneficial enzymes. Most of these fruits are consumed in fresh form and hardly 2% of total citrus produce is processed in different beverages like squash, cordial, marmalades, some drinks and pickles etc. beside some new products namely carbonated RTS, preserve and peel candy have been prepared experimentally from this fruits. The scope to utilize these fruits in development of juice powder and different products still exist. The dried powder from pulps of various fruits is prepared by using various methods but information available on preparation and storage of juice powder of Nagpur mandarin, mosambi and acid lime is quiet scanty and whatever it is it has not yet reached upto the commercial level.



Many new developments in processing and value addition of different fruit products have taken place which are important for production system to be remunerative to the grower and various stake holders. This is high time to have constant interactions among stake holders to develop an effective and suitable technology for EDP programme to address to the enthusiasm of upcoming entrepreneurs. The communication is the key for ensuring the technology developed reach end users for which awareness among farmers/ entrepreneurs for the technology developed has to be included to have important place in value chain.

The present extension bulletin on “**Citrus juice powder development**” will provide the much needed information about the technology for equipment ( Tray dryers), technical parameters and conditions, product quality and production time scale , techniques, process, benefit cost ratio and other scientific information as indicative which would directly and indirectly develop confidence in rural and urban educated youths to enter into the agro processing to generate employment opportunity and indirectly increase the profitability of the farmers due to effective backward linkages. This bulletin will also be useful for extension workers, students, researchers, extension personnels, private entrepreneurs, NGOs and all others intercede in the sector. I appreciate the authors for their efforts put up on bringing out this useful publication.

A handwritten signature in black ink, appearing to be 'V.J. Shivankar'.

Date : Feb, 2012  
Place : Nagpur

V.J. Shivankar  
Director

## CITRUS JUICE POWDER DEVELOPMENT

### 1. Introduction

Fruits with their attractive colour, pleasant taste and distinctive aroma have been consumed since time immemorial which is important for human nutrition. Fruits are seasonal commodities and are highly perishable in nature. Citrus fruits contain 85–95% moisture having valuable sources of ascorbic acid, carotene, low in B – complex vitamins, low in protein, excellent sources of potassium, calcium and iron, substantial quantities of carbohydrates, including varying proportions of dextrose, fructose, sucrose and glucose depending upon the type of citrus cultivars and its maturity. The principle acids found in fruits are citric, malic and tartaric acids. The pH of fruits ranges from 2.5 to 4.5. Other constituents of fruits include cellulose and fibers, mineral salts, pectin, pigments and volatile compounds. About 25–30% losses of citrus fruits have been reported during their post-harvest handling. Citrus fruits play a vital role in human nutrition resultantly increasing the intake due to the awareness created among the citrus growers subsequently area and production is increased to explore the potential of processing to develop the product for industrial uses. India is the largest producer of fruits and vegetable in the world. With reference to citrus, it has 3<sup>rd</sup> important place in fruits production after mango and banana. Sweet orange, mandarin, lemon and lime are the major citrus fruits being grown in our country. The China is leading in citrus production followed by Brazil and USA. In the developed countries, about 40-70% of the citrus are processed into value added products while in India, hardly 2% of total fruit production is made available for processing. There exists tremendous scope to process the citrus fruits into value added product and export the same and ensuring its availability around the year including during off-season. Several factors contributed towards hindering the citrus processing industry in the country. Heat processing application is the major one. The latest juice processing technique for products development is considered to be adopted as it offer products of high quality like high flavor and aroma retention, nutritional value, minimal change in colour, appearance and easily rehydrable of the final product compared with other drying methods. This drying technique has been applied successfully in other fruits like cherries and figs but their commercial application has not been encouraging. Such concentrated efforts is needed in juice processing of Nagpur mandarin, Mosambi, acid lime and their juice blend in the country. Therefore, an attempt has been made to develop the citrus juice powder with application of juice drying technique and to study their storage behavior and quality.

Production of a food in powder form approaches ultimate in concentration and offers convenience, versatility and storage without refrigeration. Dehydration of food saves 86 percent in shipping, 77 percent in storage space and 82 percent in handling costs. Further the price of the ultimate product in terms of canned product is considerably reduced owing to reduction in cost of containers. Minimum labour requirements for the production and packing and reduced distribution costs are the other advantages of the dehydrated products of fruits juice powders.

## 2. Important Attributes of Good Quality Fruits Juice Powders

- Instant reconstitution
- Retention of good flavour and colour and
- Good storage stability.

Besides these, it should be comparatively cheaper. In other words, on reconstitution, the resultant product should be similar in quality to the original raw juice from which it is prepared.

## 3. Factors Affecting Quality

- Quality of raw material – i.e. the concentrate or the pulp used must be of good quality.
- Structure of material during drying – it should be porous and rigid. This will be helpful in drying and reconstitution.
- Time – Temperature limit
- Additives – to have preserving effect (e.g. SO<sub>2</sub>) and as drying aid (sugars, foaming agent, air etc.)
- Agglomeration

## 4. Packaging and Storage of Fruit Juice Powder

Packaging includes barrier properties, physical strength, appearance and cost. The most usual packaging system for domestic packs is a four pin sachet and a typical laminate is paper/ polyethylene/ aluminium. For greater moisture protection, a paper/PE/ aluminium foil may be chosen. After filling, it is heat sealed and packed.

## 5. Storage Stability

- The storage stability is dependent on the deteriorative actions during storage.
- In general, storage stability is increased by lowering the temperature /or water activity.
- Storage period of citrus juice powder : at 38°C for 1 to 2 below.
- At 21°C temperature moisture content should be 1% or below.
- At higher temperature high moisture level losses in: NEB, Vit.A, off flavour

## 6. Application of Fruit Juice Powders

- Reduce weight and volume which results in the reduction of storage space and costs, refrigeration costs, transportation costs and packaging.
- More profitable export marketing through efficient handling.
- Improvement in product quality, stability and shelf life.

## 7. Maintaining the Characteristics

- The aroma can be separated from the fruits before the actual concentration or drying and added back.
- The process can be chosen and operated in a way that most of the aroma is retained in the food during water removal
- The concentrated or dried powder can be flavoured with a synthetic formulation of the original aroma by adopting encapsulation technique.

## 8. Principles of Spray Drying

- The fluid that is to be dried is fruit atomised by pumping through either a rotary atomizer or *anozzle*, thus forming small droplets with large surface areas.
- This droplet spray immediately comes into contact with a hot drying gas, usually air,
- Rapid evaporation of liquid, minimizing contact time and heat damage.
- The final product consists of spherical particles of uniform size, often in terms of hollow beads.
- The dried product is often agglomerated to facilitate its rapid dispersion in water.

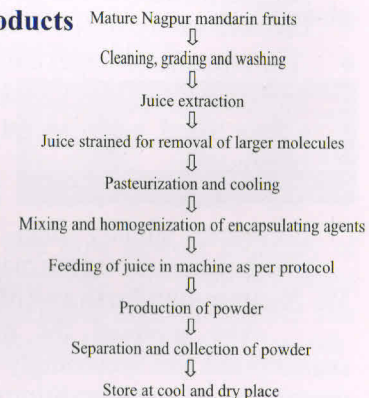
Spray drying aids : Sucrose, corn syrup, lactose, gums (eg. Arabic, tragacanth and agar – agar), alginates, pectic substances, milk solids, starch, sodium carboxymethyl cellulose, methyl cellulose and glycerol monostearate.

## 9. Citrus Juice Powder/Process and Products

### 9.1 General Flow diagram :



Juice Powder production in spray dryer





Blended Juice Powder



Juice Powder

### 9.2 Stepwise process of juice powder development

- Collection of mature fresh Nagpur mandarin fruits.
- Wash in tap water followed by distilled water to remove the surface residues.
- Extracted the juices and filtered twice in muslin cloth
- Blended the Nagpur mandarin juice with carrot juice to make the powder, Honey blended juice powder
- The juices were homogenized at 5000 rpm for 10 minutes
- Mixing the encapsulating maltodextrin and agents. The protocol for manufacturing the juices were standardized and accordingly the blended juices were fed @2.5ml/min in to laboratory model spray dryer under vacuum condition (35 - 40mm/WC) and aspirator using spray nozzle (0.77 micron).
- The juice powder manufactured was got separated in cyclone (course powder particles), chamber 1<sup>st</sup> and chamber 2<sup>nd</sup> (fine powder particles). The free flow powder recovery were of 14.92% , 10.95 % and 9.10 % in carrot blend, honey blend and Mosambi as well as acid lime blend combinations with Nagpur mandarin juice

### 9.3 Powder Quality :

- The flavor, color, aroma , TSS, acidity and limonin content were found to be similar to natural juices in all the blend combination of Nagpur mandarin. The powder particle size was recorded to varying between nano size 300-500 nm in both the citrus cultivars.
- The a/b ratio (orange) color of Nagpur mandarin juice powder was found to reduced slightly than that of juice while trend was reverse in Carrot blend, honey blend and Mosambi as well as acid lime juice blends.
- The vitamin-C content of juice powder was recorded to be decreased slightly than that of fresh juice in all the blend combination of Nagpur mandarins.

### 10. Nagpur mandarin and Mosambi juice powder

The protocol for manufacturing the juice powder were standardized and accordingly the juices was fed @2.5ml/min in spray dryer under vacuum condition (-35 to -40 mm/WC) using 0.77 micron

spray nozzle. Nagpur mandarin and Mosambi juices was fed one after other. The juice powder manufactured were got separated in cyclone (course particles), chamber -1st and chamber -2nd (fine particles). The free flow powder recovery was of 10% and 9.5% in Nagpur mandarin and Mosambi juices, respectively. The flavor, colour, aroma, TSS, and limonin content were found to be similar to their fresh natural juices. The powder particle size was recorded to vary between 300 to 500 nm in different citrus juices. The shelf life of powder was recorded to better beyond one year in air tight poly-glass container in ambient storage condition except Vit. C, which was altered slightly.

**11. Acid lime, juice powder :** The extracted acidic citrus fruit juice were diluted @ 1:2 ratio of juice and water and mixed with maltodextrin encapsulating agents, homogenized at 5000 rpm for 10 minute homogenized. As per protocol developed, juices were fed @2.5 ml/min., into laboratory model



spray dryer in vacuum condition (-35 - 40 mm/wc) and aspirator using 0.77 micron spray nozzle. The powder manufactured was collected in cyclone (course particles), chamber 1st and 2nd (fine particles). The powder recovery was of 11%, respectively in acid lime juice. Chemical analysis indicated that flavor, colour, aroma, TSS, acidity and limonin content were of similar to natural juices of acid lime. The storage life of powder under ambient condition was observed to be higher with good quality, water solubility except slight alteration a in Vit-C under 12 months ambient storage.

**12. Production of blended Nagpur mandarin Juice Powder :** The protocol for development of blended Nagpur mandarin juice powder was similar as in case of non-blended juice powder. The honey, carrot, mosambi and acid lime blended Nagpur mandarin juice powder developed were glass packed for ambient storage studies.

**12.1 Honey blended juice powder :** The honey blended Nagpur mandarin juice powder was developed in proportion of 5 : 95 ratio with both molecules which was packed and stored in glass bottles



under ambient condition indicated the free flow powder recovery of 10.95% with attractive colour of finished product. The limonin content were found to be well within optimum limit tasted organoleptically. The finished product was recorded to have prolonged shelf life for 12 month

in air tight container, easily rehydrable with good aroma and flavor under ambient storage condition. Being highly hygroscopic product, it could be stored in cool and dry places out of moisture content.

**12.2 Carrot blended juice powder :** The carrot blended Nagpur mandarin juice powder were manufactured in ratio of 90 : 10% which was packed in glass and stored under ambient storage. The blended juice powder recovery was recorded to be 14.97% having dominated



carrot juice colour due to carotenoid content. The acidity, TSS and carotenoids were recorded of 0.51%, 11.6% and 0.009 mg/ml, respectively in finished products which has prolong storage life with unaltered physicochemical properties under ambient storage condition except Vit. C which was reduced in storage.

**12.3 Mosambi and Acid lime blended juice powder :** The prepared juice powder of blended Nagpur mandarin with Mosambi and acid lime juice in the ratio of 80 : 15 : 5 were stored in glass bottle under ambient condition. The blended juice powder recovery was of 9.10% containing 9% (TSS), 0.25% (acidity), 9 mg/100 ml (Vit. C), 7.6 ppm (limonin) and 0.009 mg/ml (Carotenoids) content. L\* and a\* value of finished product recorded to be unchanged under ambient storage condition except Vit. - C. beyond one year.

### 13. BENEFIT COST ANALYSIS

#### 13.1 Nagpur Mandarin Juice Powder Produced

- 10 Kg.

- Cost of fruits (237 Kg@ 20 rupees /Kg) - Rs.4740/-
- Sorting, Washing, Extraction /Blending of Juice @Rs,8/ Kg Fruit - Rs.1896/-
- Energy Charges for 7 hrs @150/Kg Powder - Rs.1500/-
- Miscellaneous Expenses @100/Kg Powder - Rs.1000/-
- Chemicals (Maltodextrine)/Sugar etc 500/Kg. - Rs.5000/-
- Depreciation cost - Rs.1000/-
- Packing/Transportation/ Storage charges@ Rs.100/Kg -Rs.1000/-
- Consumables@10% - Rs.1613/-

Total cost of 10 Kg Powder - Rs.20170/-

Cost of Powder/Kg of Juice - Rs.250/-

#### 13.2 Mosambi Juice Powder Produced

- 10 Kg.

- Cost of fruits (220 Kg@ 20 rupees /Kg) - Rs.4400/-
- Sorting, Washing, Extraction /Blending of Juice @Rs,8/ Kg Fruit - Rs.1760/-
- Energy Charges for 7 hrs @150/Kg Powder - Rs.1500/-
- Miscellaneous Expenses @100/Kg Powder - Rs.1000/-
- Chemicals (Maltodextrine)/Sugar etc 500/Kg. - Rs.5000/-
- Depreciation cost - Rs.1000/-
- Packing/Transportation/Storage charges @ Rs.100/Kg - Rs.1000/-
- Consumables@10% - Rs.1566/-
- Profit @15% - Rs. 2349/-

Total cost of 10 Kg Powder - Rs.19575/-

Cost of Powder/Kg of Juice - Rs.200/-

#### 13.3 Acid Lime Juice Powder Produced

- 10 Kg.

- Cost of fruits (220 Kg@ 20 rupees /Kg) - Rs.4400/-
- Sorting, Washing, Extraction / Blending of Juice @Rs,8/ Kg Fruit - Rs.1760/-
- Energy Charges for 7 hrs @150/Kg Powder - Rs.1500/-
- Miscellaneous Expenses @100/Kg Powder - Rs.1000/-
- Chemicals (Maltodextrine)/Sugar etc 500/Kg. - Rs.5000/-
- Depreciation cost - Rs.1000/-
- Packing/Transportation/Storage charges @ Rs.100/Kg - Rs.1000/-
- Consumables@10% - Rs.1566/-
- Profit @15% - Rs. 2349/-

Total cost of 10 Kg Powder - Rs.19575/-

Cost of Powder/Kg of Juice -Rs.200/-



हर कदम, हर उगर  
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