

Research article

Study of preservation and storage methods for *Gmelina arborea* (Gambhari) fruits

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ABSTRACT

Gambhari (*Gmelina arborea* Roxb.) is one of the important medicinal plants used in Ayurveda. In fresh fruits of Gambhari, the moisture content is higher and the rate of deterioration is also higher over a short period of time if not handled appropriately. So, the use of drying techniques is encouraged as it reduces postharvest losses and provides easiness in storage and transport, and ensures product availability throughout the year. This study aims to provide a drying method of preservation of Gambhari fruits for further use. Among the various drying techniques, the natural method of preservation of fruit i.e. sun drying was used for 15 days. The preservation method of Gambhari fruits was completed in total 6 steps that were collection, washing, spreading, drying, screening, packing and storage. The total time duration in drying was 15 days during which fruits were shrunk and reduced in size. The present study may encourage researchers in pharmaceutical and clinical research to easily understand about preservation and storage of Gambhari fruits.

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INTRODUCTION

Gambhari (*Gmelina arborea* Roxb.) belongs to the family *Lamiaceae*. Acharya Pandit Narahari in his text Raj Nighantu, mentioned Gambhari fruit in *Madhura Triphala* (group of three drugs which are sweet in taste), such as Draksha (*Vitis vinifera*), Kashmarya (*Gmelina arborea*) and Kharjura (*Phoenix sylvestris*) because they are predominated by *Madhura Rasa* (sweet taste drugs) (Tripathi, 2010). Charak has included Gambhari fruits in *Virechanopago* (laxative), *Dahaprasamana* (pacifying heat) *Mahakasayas* (Group of ten drugs) and also in *Madhuraskandha* (drugs of sweet taste). This has also been mentioned in *Phala Varga* (fruit). *Sushruta* has included it in *Sarivadi gana* and *Madhura Varga*. He has also described the fruits in *Phala Varga* where they have been said as *Medhya* (enhance memory), *Rasayana* (immunomodulator), *Hridya* (beneficial for the heart), *Mutral* (diuretic) and *Kesya* (beneficial for hairs) (Sharma, 1979).

Botanical description

The plant is found scattered in deciduous forests throughout the greater parts of India and the Andaman up to an altitude of 1500 m. It is a moderate-sized unarmed deciduous tree, with greyish-yellow bark. Its leaves are broadly ovate, acuminate, entire, glabrous above when mature, stately fulvous, tomentose beneath, base cordate

and shortly cuneate, petiole cylindrical, glandular at the top. The flowers are usually in small cymes of about 3 flowers arranged along the branches of a densely fulvous hairy panicle, buds clavate, angular, bracts linear-lanceolate. The calyx is broadly campanulate, teeth 5 and triangular acute while the corolla is brownish yellow, densely hairy outside, 5 lobed and 2 lipped. The fruits are drupe ovoid or pyriform, smooth and orange-yellow when ripe. Its root, bark, leaf, flower and fruit are used for medicinal purposes. Linoleic acid is found as a major constituent whereas lauric, palmitic, stearic, oleic, linolenic, and arachidic acids were found as minor constituents (ICMR, 2009).

Macroscopic characteristics of the fruit

An ovoid, oblong or pyriform, succulent, 1 to 2-seeded drupe, surface smooth, glossy and dark orange-yellow in colour when fresh, dried fruits are highly shrivelled, longitudinally ridged, wrinkled, reticulated or covered with flattened patches of the pericarp of various sizes and shapes. The calyx is persistent, attached at the base of the pointed end of the fruit, a short pedicel lies at the center of it, and a small depression is occasionally located at the broader end, 1.5 to 2cm in length, 0.5 to 1cm in width and 0.5 to 0.8 mm in thickness, dark brown to blackish in colour with occasional laterally running yellowish streaks extending from the pointed end of the fruit. The pericarp is sweetish slightly bitter and

mucilaginous. Seeds are ovoid and oblong with thin and papery testa, 0.5 to 1 cm in length and 0.4 to 0.6 cm in width, pale yellow in colour (ICMR, 2011).

Microscopic characters of fruit

The transverse section of the fruit is circular in outline and shows an outermost layer of the epidermis, a narrowband of hypodermis, and a wide zone of mesocarp, encircling the stony endocarp, embedded with an embryo. The longitudinal section is oval in outline, showing short pedicel and the calyx attached at the narrow end, a wide zone of encloses the oval stony endocarp and centrally located are one to two seeds (ICMR, 2011). The detailed transverse section shows a layer of epidermis covered with thick cuticle, 10 to 15 rows of isodiametric, spherical parenchymatous cells of hypodermis lying underneath this, followed by a wide zone of 15 to 20 layers of radially elongated closely packed, narrow cells of mesocarp. Vascular strands are embedded in the inner side of it, tangentially running celled layer of inner epidermis lies underneath this, followed by a broad zone of sclerenchyma band of the endocarp. The transverse section of the seed shows a narrow, small-sized cell of outer epidermis followed by 2 to 4 rows of reticulated lignified compactly arranged celled tissue, endosperm inconspicuous very narrow, consisting of 1 or 2 rows of tangentially running cells embedded with aleurone grains, cotyledons consist of outer and inner epidermis enclosing the wide mesophyll tissue embedded with fixed oil and aleurone grains.

Ayurvedic descriptions

Gambhari is an important medicinal plant in Ayurveda. It is named *Gambhari* because of its fastly growing tree. *Gambhari* root is one of the ingredients of commonly used Ayurvedic preparation *Dashmoola* (group of ten drugs) particularly in *Brihat Panchamoola* (group of special five drugs). *Shriparni*, *Sarvatobadhra*, *Hira*, *Pitarohini* and *Madhuparni* are common synonyms of *Gambhari*. One of the synonyms *Hira* is described by Ayurvedic text for *Gambhari* fruits because it acts as *Rasayana* (Sharma, 2000). The fruits were used in the preparation of *Phalasava* (soup) as fermented liquor. This has also been mentioned in *Phala Varga* (fruits) due to its edible nature. The fruits are sweet when ripe and are used as a substitute for *Draksa* (*Vitis vinifera*) (Sharma, 1979). Its Ayurvedic properties (API, 2001) are given in Table 1.

Table 1. Ayurvedic properties of *Gambhari* fruits

<i>Rasa</i>	<i>Madhura</i>
<i>Guna</i>	<i>Guru, Snigdha</i>
<i>Virya</i>	<i>Sheeta</i>
<i>Vipaka</i>	<i>Madhura</i>
<i>Doshaghata</i>	<i>Vatapittahara, Kaphakaraka</i>
<i>Karma</i>	<i>Vrisya, Hridya, Rasayana, Brimhana, Medhya, Raktasamgrahika, Kesya</i>
<i>Rogaghata</i>	<i>Mutrakricha, Trishna, Kesya, Daha, Raktapitta, Ksataksaya, Vatarakta</i>

Therapeutic uses of *Gambhari* fruits

Dried fruits were reported useful in *Ksata* (lacerated wounds), *Ksaya* (immunosuppressive/emaciating disease), *Mutrakrichra* (dysuria) and *Hridroga* (cardiac disease), *Raktapitta* (haemorrhagic disorders), *Daha* (burning sensation) and *Trisna* (polydipsia).

Fruits are an ingredient of refrigerant and decoction for fevers and bilious affections. *Chakradatta* gave ripe fruits with honey for checking haemorrhage. Ripe fruits dried and cooked with cow's milk, for urticaria. Fruits are also used in dysuria and hemorrhagic disease. The fruits are reported hepatoprotective, antibacterial, antioxidant and antidiabetic activity (ICMR, 2009).

Fruits are used for shortness of breath, as a cooling agent diuretic, as a nutritive, used in tuberculosis; promote hair growth, menorrhagia and burning sensation. The fruits are edible. Decoction of fruits is used to treat swelling of the body, fever and bilious disorders. Fruits powder is used with milk or ghee in pregnancy for the settlement of the foetus. *G. arborea* fruits have reported diuretic, antiepileptic, analgesic, antipyretic, antibacterial, antioxidant, antidiabetic and hepatoprotective activity (Chothani and Patel, 2014).

Because of the maximum moisture content in fresh fruits of *Gambhari*, there is a need to be proper preservation and proper storage of fruits for further use. Drying/Dehydration is an excellent way of preservation. Fruits like bananas, mango, apples, figs, berries, plums, and grapes and vegetables like potatoes, carrots, corn, onions, tomatoes and beets can be dehydrated as whole or thin slices or puree can be dried. Various advanced drying techniques such as solar, microwave, vacuum, infrared, freeze, oven drying and different hybrid drying technologies have been developed around the globe as being successfully used for various fruits and vegetables.

MATERIAL AND METHODS

Preservation methods of *Gambhari* fruits

There are many ways of preserving fruits for an extended time various preservation methods freezing, canning, pickling & drying or dehydration in which drying and dehydration is the simplest way to save fruits. Among the various drying techniques, the natural method of preservation of fruit sun drying is used for 15 days.

Drying or dehydration

Drying is a natural method of moisture removal. Dehydration is an artificial or mechanical method of moisture removal. Dehydration means getting rid of all the water in a given compound by a controlled method of removing moisture (controlled temperature and humidity), commonly using sophisticated equipment. A drying process requires a simple method of moisture removal like sun drying.

Principle of drying/dehydration

The removal of moisture (increasing the temperature of fruit makes its moisture evaporate and air moving over the fruit carries the moisture away) and maintaining the equilibrium of temperature and humidity are the main principles of drying (Andress and Harrison, 2014).

Merits and demerits of drying/dehydration

The main merits of drying/dehydration methods (Andress and Harrison, 2014) are as follows.

1. One of the oldest and cheapest methods of preservation of food.
2. It is the self-degradation method.
3. It prevents microorganism contamination by removing moisture.
4. Due to weight loss transportation is easy.
5. Packing and Storage space is minimized and easy to store for a long time.
6. Nutrition value is retained in their viability.
7. Alternative to canning and freezing.
8. Simple, safe and easy to learn.
9. No refrigeration is needed.

However, it also has some demerits as given below.

1. It is a slow and time taking process.
2. Due to the natural method, this method is affected by weather conditions.

Factor affecting drying/dehydration

Surface area – Greater the surface area faster the product dries.

Temperature – Greater the temperature difference between the product and drying medium, the greater the rate of drying.

Humidity – Higher humidity slower the drying.

Atmospheric pressure – On lowering the atmospheric pressure, the temperature gets low which is required to remove water.

Air velocity and direction of airflow – The rate of air velocity and direction of airflow affect the drying time and product quality. The drying rate and overall moisture transfer coefficient increased with increasing air velocity (Andress and Harrison, 2014).

Steps of drying /dehydration

Collection and authentication of raw drugs

The raw Gambhari fruits were collected in May 2022. The fruits were identified and authenticated at the Department of Dravyaguna, Rishikul Campus, Haridwar. The pictures of Gambhari fruits are given in Fig. 1.

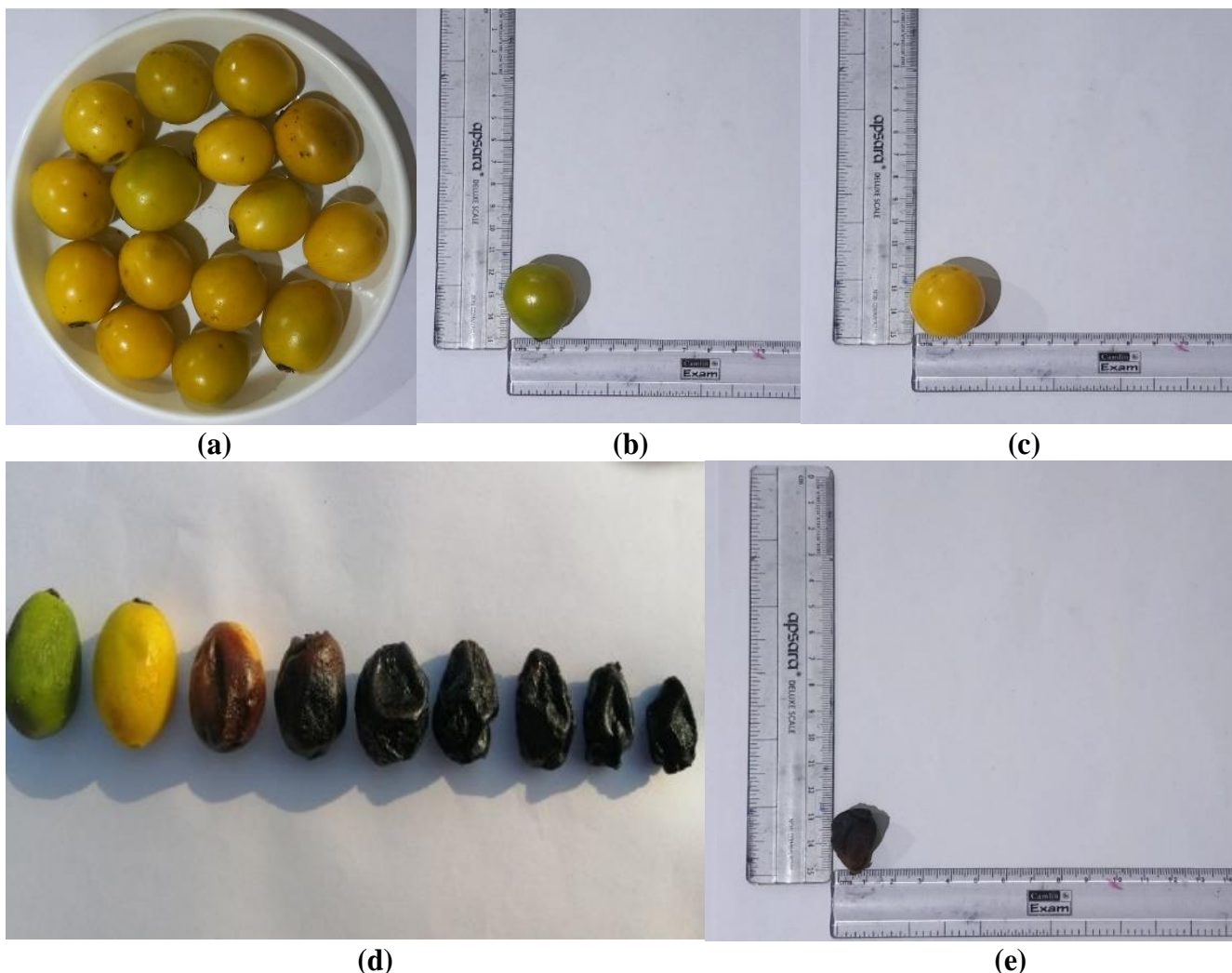


Fig. 1. Gambhari fruits. (a) ripe fruits, (b) measurement of unripe fruit, (c) measurement of ripe fruit, (d) gradually decrease in size during the drying process and (e) measurement of dry fruit

Washing

Collected fruits were washed under normal cold water to remove foreign matter.

Spreading

Washed fruits were spread on flat wooden trays or cotton cloth for absorption of excess water from them.

Drying

Sun and solar drying have been practised extensively since ancient times. The fruits were spread in thin layers on paved grounds and exposed to sun and wind for drying.

In addition, other products like fruits, cereals, spices, oil seeds, vegetables, and fish are naturally dried in the sun by spreading them. It is a slow and inexpensive process but environmental contamination, insect infestation and microbial deterioration cause low-quality food. The fruits of Gambhari were dried under sunlight for 15 days. During the dried process, different phases are seen in which the fruits were gradually reduced in size (Fig. 1).

Drying phases

The different drying phases include heat and mass transfer, drying of the outer layer, establishment of moisture gradient, establishment of normal equilibrium, and relative humidity.

Drying test

The drying test was done when the moisture content of the dried fruits reach about 20%. Because the fruits were more pliable when warm, cool several pieces and tested by folding the fruit upon itself when they were not stuck together.

Screening

Select a uniform size of fruit, and remove discoloured and contaminated fruits.

Packing and storage

After completion of the drying procedure of Gambhari fruits, dried fruits were packed in an airtight container and stored in a cool dry place.

RESULTS AND DISCUSSION

The preservation method of Gambhari fruits was completed in a total of 6 steps that is collection, washing, spreading, drying, screening, packing & storage. The total time duration in drying was 15 days which fruits are shrinkage and reduced in size.

Gambhari fruits are the fruits of the highly medicinal valuable plant in Ayurveda which is *Gmelina arborea* Roxb. It belongs to the family *Lamiaceae*. Gambhari fruits are described in many diseases because of containing amazing medicinal properties. There are different Ayurvedic formulations indicated in different diseases that have Gambhari fruits as one of their main contents. But for treatment purposes, Gambhari fruits are not available

throughout the year because their fruiting season is May-June only, for resolving this problem they need to be preserved and storage this medicinal drug for further use. Gambhari fruits have higher moisture content so, it is responsible for their early deterioration. From various preservation method sun drying is selected because of its easy and natural method. Drying is based on two major principles that are adequate moisture removal and balancing between temperature and humidity. Many factors are affecting the drying procedure of fruits among them surface area, temperature, atmospheric pressure, and air velocity are directly proportional to the rate of the drying process whereas humidity is the only factor which is inversely proportional to the rate of the drying process. The preservation method of Gambhari fruits was completed in a total of 6 steps that were collection, washing, spreading, drying, screening, packaging and storage. The total time taken was 15 days for shrunk and reduced in size of fruits. So, the major benefits of using the drying techniques are it reduces postharvest losses and provides easiness in transport, and storage and ensure product availability the whole year. This Preservation method is simple, cheapest and easy which is suitable for small as well as the broad scale pharmaceutical laboratories and clinics for their further study. The need for big space for drying and fluctuation in weather conditions are the limitations of this type of preservation method.

CONCLUSION

To date, there is no pharmaceutical and clinical research or physicians use Gambhari fruits for their study/trials, because of their early deterioration they are not available throughout the year for the preparation of different formulations of Gambhari fruits, because their fruiting season is only May-June. This study will help other researchers and practitioners with their research and treatments/trials. Provided data will be helpful to easily understand about preservation and storage of Gambhari fruits and further preparation of different formulations of Gambhari fruits.

CONFLICTS OF INTEREST

The author(s) declare(s) no conflicts of interest.

DECLARATION

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