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Review Article

Various Method for Minimizing Post-harvest Losses of Betelvine leaves (*Piper betel* L.)

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A B S T R A C T

Betel leaves (*Piper betel* L.) undergo quick spoilage because of its perishable nature and fungal infections during storage and transportation This may cause a post harvest loss worth of Rs 900 million every year to the country. In view of the alarming losses, attempts should be made to minimize the wastage by drying the leaves, controlling senescence by chemical treatments, manipulation of storage temperature, adopting better packaging materials and methods besides curing and bleaching of the leaves. Such wastage may also be minimized by extracting essential oil from the leaves which remains unsold in the market. Essential oil from betel leaf has been reported remarkable medicinal and aromatic properties by various scientists which indicate a promising industrial future. If a well-coordinated effort by the farmers, traders, scientists, and policy makers are made, it will definitely help in reducing the post-harvest losses of betel leaves with enhancement of national economy and generation of employment opportunities in country.

Keywords

Betel leaves, Depetiolation, Dehydration, Curing and chemical treatments

Introduction

Betel leaves (*Piper betel* L.) serves as a cheap source of medicine which is easily available in the market. Mastication of betel leaves produces a sense of freshness, alertness, salivation, energetic feeling with enhanced mental and physical response of the human body (Guha, 2006). Betel leaves have been reported to exhibit antioxidant, anti-inflammatory, immune-modulatory and antitumor activities (Khanra, 1997). The extracted essential oil also possesses anti-fungal and anti-bacterial properties (CSIR, 1969). Owing to huge potential in the industrial market, on account of its medicinal benefits indicates a promising industrial future of betel vine cultivation. In India, around 20 million people consume fresh leaves of betelvine and there is tremendous demand from the European countries (Balasubramanian *et al*., 2011). Leaves worth about Rs. 30-40 million are exported to the countries like Bahrain, Canada, Great Britain, Hong Kong, Italy, Kuwait, Nepal, Pakistan, Saudi Arab and many other European countries (Jana, 1996; Singh *et al.,* 1990). This clearly indicates that this crop has a promising industrial future and a tremendous potentiality in earning the foreign exchange which will strengthen the nation by enhancing national economy and generating employment opportunities. But betel leaves (*Piper betel* L.) undergo quick spoilage because of its perishable nature and fungal infections

during storage and transportation. This may cause a post harvest loss ranging from 35% to 70% during transport and storage. Even if the most conservative estimate of 10% loss were considered that is equivalent to loss of worth Rs 900 million every year to the country. Wastage may be minimized by drying the leaves for further value addition. Other than curing, few attempts are also being made to reduce losses by chemical treatments, beneficially modifying the storage conditions and by adopting better packaging techniques. Such wastage may also be reduced by extracting essential oils from the leaves which remains unsold in the market. Some of the methods for minimizing post-harvest losses of betel leaves are (i) depetiolation, (ii) Dehydration, (iii) bleaching and curing, (iv) chemical treatments, (v) combined treatment of de-petiolation, de-midribbing and chemicals and (vi) extraction of oil from betel leaf.

Methods for minimizing post-harvest losses of betel leaves

1. Depetiolation

Depetiolation is removal of the petioles from the leaves. It reduces about 10-25% weight of leaves due to 10-40% reduction in length of leaves. It helps in delaying senescence (Mishra and Gaur, 1972). Depetiolated condition was always better than petiolated condition for enhancing storage life (Imam and Pariari; 2012). They reported that Chlorophyll degradation was found minimum in petiolated condition either in packing with banana leaves or in treatment with Benzylaminopurine (BA) @ 30 ppm compared to depetiolated condition. Ascorbic acid content was more in sterilized paddy straw packing and in hessian cloth lined with mustard seed and ice pieces compared to other treatments. Winter season (December-January) was the best for longer storage of betel leaves in any form. Among method of storage, zero energy cool chamber was the best for longest period of storage followed by packing with banana leaves in bamboo basket

2. Dehydration

It is an essential method of processing of betel leaf that can avoid spoilage and facilitate preservation. Dehydration means removal of moisture from any substance. Drying is preservation process of any product by reducing the amount of moisture content in the materials (Drouzas and Schubert, 1996). Drying may be of different types (i) solar drying, (ii) shade drying, (iii) mechanical drying and (iv) microwave drying or hot air drying.

Shade drying of betel leaves in dark rooms is a time consuming process, resulting into a product with inferior quality. Sun drying is widely practiced, but prolonged direct exposure to solar radiation leads to adverse changes in colour, texture and flavor, contamination with sand, soil and foreign matter (Adom *et al*. 1997; Middili 2001). Because of this reason, using hot air dryers seems inevitable for drying to improve the quality of the final product (Doymaz and Pala, 2002; Ertekin and Yaldiz 2004). Solar drying produced better results as compared to shade drying, mechanical drying and microwave drying (Ramalakshimi *et al*; 2002). Hence, modern drying (microwave drying) should be promoted for beneficiary outcomes (Balasubramanian *et al*., 2010) because in this method, there was substantial losses of volatile oil which is responsible for improving organoleptic qualities of the leaves.

3. Bleaching and curing

Generally bleaching and curing procedure of leaves is done in a bhatti or closed room. It can be made up of mud, cement, brick or any other locally available suitable material. The curing process for betel leaves was

probably first invented at Varanasi, India where the techniques were traditionally used for making *Banarasi paan* (Das *et al;* 2017). Betelvine Research Centre, Islampur under Bihar Agricultural University, Bhagalpur, Bihar (India) took initiation from the year 2013 in the studied of curing of betelvine and constructed two *paan bhati* at the centre (Kumar and Pandey, 2014). The basic principle in curing process of betel leaf is that the green leaves are treated with smoke, high temperature and pressure in a bhatti or closed room with little or no ventilation so as to regulate the temperature inside the room for improving organoleptic qualities and ultimately the green leaves are converted to white or yellowish white colour leaves. Actually it is alternate heating of 6 hours at 50-60 °C and cooling of 12 hours, two to three times followed by aeration of leaves by turning and stored under dark condition. It took 15-20 days for making complete white or yellowish from green betel leaves. In this process, the shelf life of betel leaves is extended up to one month and the superior quality bleached leaves being very soft and coloured a uniform green yellow (Burkhill, 1935 and Pandey *et al*. 2016). This process heightens flavour, which is due to the presence of volatile oils. The chief of these is eugenol, an unsaturated aromatic phenol, usually very pale yellow in colour, which has a strong pungent odour reminiscent of cloves, and a pungent spicy taste. This substance has antiseptic and local anaesthetic properties (Weatherby and Haag, 1958). Chewing a betel leaf for five minutes leaves the mouth rather numb. Terpenes are also present, these are pungent, and unpleasant if present to excess. Unusually large amounts of potassium nitrate, and small quantities of sugar, starch and tannin have been found (Mann and Patwardhan, 1916). Changes in the chemical composition of leaves after curing leads to earn more money (Rs. 0.50 per leaf in the local market of Bihar) for the farmers. After completion of the process, the leaves are graded , spoiled leaves are discarded, bleached leaves are taken out and the unbleached green leaves are cured again for 8-24 hrs depending upon the colour of the leaves. Generally bleached Betelvine leaves of these bhattis are prepared with lesser quality green leaves and the leaves are sent to north India like Varanasi, Allahabad and Delhi. The better quality green leaves of the areas are sent as such to Bombay where they are bleached by stacking of Betelvine baskets one on the other. The finished goods are of good quality and are exported to different countries from there.

Types of bhatti or closed room for curing of betel leaves

(i). Natural without external energy source which takes 3-10 days for bleaching in summer and 7-15 days during winter.

(ii). With outer source of Heat (Coal & Charcoal in a ration of 2:½ kg) that takes 24 hours for bleaching and gives better result, it depends upon the expertise & experience of the technician or mistri to manage the temperature inside the bhatti. The temperature of the closed curing room is maintained at 60-70 °C.

(iii). Bleaching process can also taken place in a chamber made of galvanized iron sheet. Mature leaves are selected and filled in the chamber and covered with moist gunny bags. The leaves are to be examined every alternate day to see the progress of bleaching which is involved in the lightening of the leaf colour. After attaining the desired colour bleaching process should be stopped. Normally it completes in about 8-15 days in summer and 15-25 days in winter.

4. Chemical treatments

Attempts are also being made to reduce wastage by controlling senescence (Mishra and Gaur, 1972) through chemical treatments, manipulation of storage temperature, adopting better packaging materials and methods (Guha, 2004; Rao and Narasimham, 1997) besides curing and bleaching of the leaves (Dastane, 1958; Sengupta, 1996).

The storage of the betel leaves could be extended by including a mixture of sodium bicarbonate and tartaric acid in the packaging. Before packaging, the packing material could be disinfected with sodium hypochlorite as it reduces the spore load and development of yellow colour. Ventilation was found to be most important as no aeration leads to moist discolouration and fermentation and too much aeration leads to dry discolouration. For prolonged storage and distant transport, the betel leaves treated with benzyl adenine (BA) had less chlorophyll destruction with greater build up of carotenoids and yellowing was delayed about 3 days. Betel leaves packed in traditional packaging subjected to heat treatment for 1hour at 45 0C had as extended storage life. Storage life of betel leaves was extended by 5 days with acceptable qualities by keeping in cold chamber; Storing betel leaves for 10 days at 2000C under modified atmosphere packing had better retention of chlorophyll which could be an alternative for retail handling and storage which is at present done by ice boxes and gunny bags. (Bhuvaneswari and Narayana, 2014). Post-harvest dipping of betelvine leaves for 6 hours in solutions of 25 ppm benzyladenine (BA) and 50 ppm kinetin and packed in vented polythene bags stored under refrigerated conditions prolonged the shelf life of the leaves. Leaves packed in baskets and stored at room temperature could keep up to 40 days.

5. Combined treatment of de-petiolation, de-midribbing and chemicals

A combined treatment of de-petiolation, de-midribbing and dipping in 25 ppm of BA for 6 h resulted in the further increase of shelf life by about 10 days. In these treatments, spoilage due to yellowing was negligible. From a commercial point of view, matured harvested leaves, after de-petiolation, treated with 5 mg/ l of BA for 6 hours and stored in conventional packing was observed to be best suited to prolong the shelf life of betelvine leaves (Bhuvaneswari and Narayana, 2014). Thus, de-petiolation and de-midribbing increased the shelf life of leave

6. Extraction of essential oil

Despite the knowledge of traditional and modern preservation methods, India is still facing the serious issue of post-harvest losses. Surplus leaves which remain unsold in the market can be utilized through extraction of essential oil. The constituents present in the oil may vary with the variety, soil and agro-climatic conditions followed to raise the crop like any other essential oil yielding crop (Sankar *et al.*, 1996; Sharma *et al*., 1981)

Two bioactive phytochemicals that found in betel leaves are hydroxychavicol (HC) and eugenol (EU) contribute to the beneficial bioactivity of betel leaves (Rathee *et al*. 2006; Mazura *et al.*, 2007; Nalina and Rahim, 2007). The industrial use of such range indicates promising future for betel leaves. IIT, Kharagpur design and develop an apparatus for extraction of essential oil from betel leaves that recovered essential oil 16.2 % more as compared to Clevenger Apparatus.The essential oil extracted with

this apparatus clearly revealed that the Meetha, Bangala and Sanch varieties of betel leaves contained about 2.0%, 1.7% and 0.8% essential oil respectively, on dry weight basis. Essential oil of Bangala variety contained a mixture of about twenty-one different compounds of which eugenol (29.5%) was chief ingredients (Guha, 2014). Betel leaf has many unique properties including those of its essential oil besides medicinal ones which can be utilized for development of Novel food and non-food products. Accordingly at IIT, Kharakpur a few novel food product like cup cake, suji halwa, Ice cream, Chocolate and Biscuit have been developed with using essential oil of betel leaves ranging from 0.01 to 0.5% (Guha, 2014). One other hand, as far as non-edible products are concerned, developed an herbal Shampoo with very low concentration of essential oil of betel leaf which was found to be beneficial against Dandruff with very pleasant smell and smooth feeling in hair without addition of hair conditioner or oil. As a raw material, it can be used for the manufacturing of tooth-pastes, skin emollients, tooth-powders, paan masala, de-odorants, mouth fresheners, facial creams, antiseptic lotions, cold-drinks, chocolates, appetizers, carminative mixtures, digestive agents, tonics, medicines etc (Guha, 2000). Therefore, for exploitation of the unique qualities of the crop, there is a tremendous requirement for research on developing new products from betel leaves and essential oil. This would definitely be helpful for minimizing the menace of post-harvest losses of the leaves.

Hence concluded, in view of the commercial potentiality of betel leaf in India, Post-harvest losses of betel leaves can be prevented if proper preservation techniques are followed. Right from the ancient techniques of solar drying and depetiolation to the modern methods of preservation including modern drying technologies, bleaching and curing, chemical treatments, advanced packaging technologies, etc., can prove to be beneficial in reducing post-harvest losses of betel leaves that might be helps to generate employment opportunities and enhance national economy.

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