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# Plant extracts to reduce physiological loss in weight of ber (*Zizyphus mauritiana* Lamk.) fruits during storage

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**Abstract**
Natural extracts from plant parts have antimicrobial activities as they contain phenolics, alkaloids and many bioactive molecules. These extracts in water, ethanol, acetone, methanol, esters etc. are being actively used as an alternative technique for pre-storage treatment of fruit crops. The extracts prepared from curry leaves, ginger rhizomes, neem leaves, kinnow peel and ber leaves have been reported to have antimicrobial activities and so reduces microbial decay and physiological loss in weight (PLW) of ber fruits.

**Keywords:** ber leaves, curry leaves, extract, ginger, kinnow peel, neem leaves

## Introduction
Plant extracts are mostly used now days to delay the shelf life of fruits especially Ber as it is eco-friendly and are of low cost. Plant extracts are basically gathering of rough blends extracted from any part of the plant. These natural extracts also possess antimicrobial properties which control the incidence of plant pathogens that cause disease in plants and helps in maintenance of longer shelf life of fruits. Plant extracts also acts as natural insecticide which controls the incidence of various insects-pests and increases the shelf life of Ber. Joshi *et al.* (2011) [1] reported that the extracts of various medicinal plants such as tulsi, clove, datiwan and neem had several biological properties. The ethanolic extracts of tulsi, clove, datiwan and neem extracts had antimicrobial and antibacterial properties i.e. neem leaves found to be resistant against bacteria *Escherichia coli, Salmonella typhi, Klebsiella pneumoniae* which can be used against any contagious disease which in turn improve the storage life of fruits by reducing the risk. The use of natural extracts is very much important to extend the shelf-life of Ber by reducing the insect-pest and disease attack. The present study emphasizes importance and application of five different natural extracts as Curry Leaves, Ginger, Neem Leaves, Kinnow peel and Ber Leaves for improvement of shelf life of ber fruits by reducing the physiological loss in weight of fruits.

## Properties of natural extracts
### Ber leaves extracts
Ashraf *et al*. (2015) [2] had reported the medicinal and nutritional properties along with various biological properties in extracts of ber leaves. These properties include antimicrobial, antibacterial, antifungal, anticancer, antioxidant and performed wide range of biological activities so is utilized in various pharmaceutical industries as anticancer and antioxidant agent that ultimately improve storability of ber. Abdallah *et al*. (2016) [3] observed the various biological properties of some biologically active phytochemical compounds *viz.* alkaloid, terpenoid, flavonoid, tannin, saponin and phenolic compounds in leaf extracts of ber (*Ziziphus mauritiana*). The methanol and ethanol extracts of ber has antibacterial properties against bacteria *Proteus vulgaris* and *Bacillus cereus* ATCC 10876, anti- inflammatory properties, curative properties and antioxidant properties which ultimately reduces the risk of decay and increases the shelf life of ber fruits. The leaves of ber were known to be used as a major material in industries of pharmaceutical drugs. Ansary *et al.* (2018) [4] formulated silver nanoparticles from leaf extract of ber (*Ziziphus spina*) i.e. Christ's thorn jujube which showed many biological properties against five gram-negative and five gram-positive bacteria. It reflected neurotoxic property, antibacterial properties and acts as antimicrobial agent for the treatment of bacterial infection.

**Neem leaves extracts**

Biswas *et al*. (2002) [5] reported the various medicinal and biological properties of Neem (*Azadirachta indica*) due to presence of bioactive compounds *viz*. nimbidin, sodium nimbidate, nimbin, nimbolide, gedunin, azadirachtin, gallic acid, catechin and margolone. The common biological properties are anti-inflammatory, antibacterial, antifungal, antipyretic and antiviral properties that reduces the hazardous problems through various extracts of neem and increases the storage life of the fruits. Mahmoud *et al*. (2011) [6] found that various extracts from neem leaf have antifungal activity and contain nimonol which is effective against the treatment of different human pathogens. Kurniati *et al.* (2018) [7] observed that the extracts of neem leaf (*Azadirachta indica*) have antifeedant activity i.e. a natural or chemical substance that prevents the feeding of the insect or a pest.

**Citrus peel extracts**

Kirbaslar (2009) [8] observed the biological properties of peel of different citrus fruits namely grapefruit, lemon, bergamot, mandarin, sweet orange and bitter orange. Among all the fruits of citrus, peel of bergamot and lemon fruits had more antimicrobial activities as compared to others. The peel of these fruits has been confirmed with antimicrobial properties against *Proteus vulgaris* as compared to any other microorganism. In addition to this, fruits of citrus also have antifungal properties against *Debaryomyces hansenii, Rhodoturla rubra, Candida albicans and Kluyveromyces fragilis.* Dhanavade *et al.* (2011) [9] described that peel of *Citrus* contains many biologically active compounds such as polymethoxylated flavones and many flavanones which play important role in pharmaceutical and food industries. The citrus peel extracts in acetone, ethanol and methanol has strong antimicrobial property against various microorganisms such as *Salmonella typhimurium, Micrococcus areus* and *Pseudomonas aeruginosa* respectively.

Kaviya *et al*. (2011) [10] synthesized silver nanoparticle by using Kin now peel extract which bears antibacterial activity and was found to be effective against various gram positive *viz. Staphylococcus areus* and gram-negative bacteria such as *Pseudomonas aeruginosa*, *Escherichia coli*. Qadir *et al.* (2018) [11] reported considerable variation in antifungal, haemolytic and antibacterial properties of citrus peel extracts. Among various citrus species, kinnow (*Citrus reticulata*) have maximum capacity to resist against bacterial infection whereas regarding fungal strain, Mussammi (*Citrus sinensis*) performed best.

**Curry leaves extracts**

Ningappa *et al.* (2008) [12] had confirmed the alcohol: water extract of curry leaf (AWEC) can be used as a source of natural antioxidant. Pande *et al.* (2009) [13] reported the antihepatotoxicity or hepatoprotective (ability to prevent damage to the liver) property of bark of curry leaf (*Murraya koenigii* L.). An antioxidant protein extracted from curry leaves which is monomeric molecule with molecular mass of 35 kDa showed antibacterial activity (Ningappa *et al.* 2010) [14]. This APC protein was found to inhibit the growth of bacteria such as *Vibrio cholera, Escherichia coli, Salmonella typhi, Staphylococcus areus and Bacillus subtilis* because it is non-toxic at all doses. The methanolic extract of brown type of curry leaf possess hydroxyl free radical and antioxidant activity (Sivakumar and Mira, 2013) [15]. Sajeshkumar *et al*. (2015) [16] synthesized silver nano-particles by using extracts of curry leaf (*Murraya koengii* L.) which showed resistance against many bacteria's such as *Escherichia coli*, *Micrococcus* species, *Staphylococcus* species, *Bacillus* species, *Klebsiella* species.

**Ginger rhizome extracts**

Stoilova *et al*. (2007) [17] has reported maximum total phenolic content in alcoholic extract and the maximum antioxidant activity in water emulsion extract of ginger which inhibited the growth of hydroxyl radicals and showed higher antioxidant properties than quercetin. Singh *et al.* (2008) [18] studied about the various properties of ginger (*Zingiber officinale*) especially antimicrobial properties and antioxidant properties on oleoresin and oil content. The antimicrobial activity of ginger was effective against various bacteria, food borne fungus, pathogens that cause diseases. Thiobarbituric acid (TBA), peroxidase, anisidine, ferric thiocynate (FTC) considered as better antioxidant to evaluate the antioxidant activities of essential oil and oleoresin. On the other hand, the essential oil and oleoresin found to inhibit the growth of the fungus namely *Fusarium moniliformae.* Auta *et al.* (2011) [19] reported that ethanolic extract of ginger had antimicrobial activities against two different bacteria namely *Pseudomonas aeruginosa* and *Escherichia coli*. The phenolic content of water and methanol extract of ginger that was fermented by using *Trichoderma* spp. have antibacterial activities against various pathogenic bacteria (Saleh *et al*. 2018) [20].

**Preparation of aqueous extracts**

Plant extract was prepared from curry leaves, ginger rhizomes, neem leaves, kinnow peel and ber leaves. Three grams of plant parts per 100 ml of water were boiled for 30 minutes and for 5 minutes. Fruits of both varieties Umran and Sanaur-2 dipped in extracts at temperature $50^0$C for 5 minutes and air dried for 15 minutes. After treatments fruits were packed in CFB (Corrugated Fiberboard). The average weight loss was determined at the interval of 3 days and was expressed in percentage.

**Physiological loss in weight during storage**

Observation recorded on physiological loss in weight of ber fruits of both cultivars has been presented graphically through Figure-1 ('a' to 'e'). The observation confirmed the gradual loss of fruit weight due to water loss and shrinkage of fruits during various stages of storage. The percentage weight loss at 3 days confirms the maximum weight loss (10.22%) in $T_5$ in Sanaur-2 followed by 9.55% in $T_4$ while in Umran it was highest (6.46%) in $T_4$ followed by 5.93 in $T_5$ at 3 days of storage. At 6 days of storage, the highest (23.43%) weight loss in $T_1$ (control) followed by $T_4$ (22.02%) while it was least in $T_2$ (14.68%) in Sanaur-2 cultivar of ber. In Umran, the lowest weight loss (7.51%) was reported in $T_3$ followed by (12.57%) in $T_1$ (control). The lowest weight loss (21.15% and 13.95%) in $T_2$ and $T_3$ for Sanaur-2 and Umran cultivars, respectively was reported at 9 days of storage which was followed by $T_6$ (25.71%) and $T_5$ (18.02%) in Sanaur-2 and Umran ber, respectively. At 12 days and 15 days of storage similar pattern of physiological weight loss in both, Sanaur-2 and Umran, ber cultivar was reported. The observation confirms the effect of plant extracts over retention of weight by minimizing the moisture loss. Among all plant extracts curry leaves extracts, Ginger rhizomes extracts, Neem leaves extracts, and hot water treatment have resulted in slow down of moisture loss which might associated with de activation of enzymes resulting reduced breakdown of complex molecules and so reduced utilization of water in biochemical processes.

Further, these extracts have antimicrobial properties as reported by Singh *et al*. (2008) [18] in ginger, Ningappa *et al.* (2010) [14] in curry leaves, and Biswas *et al*. (2002) [5] in neem leaves. These microbial properties are also responsible to keep microbial process at slower possible rate so had hindered the moisture loss during storage.

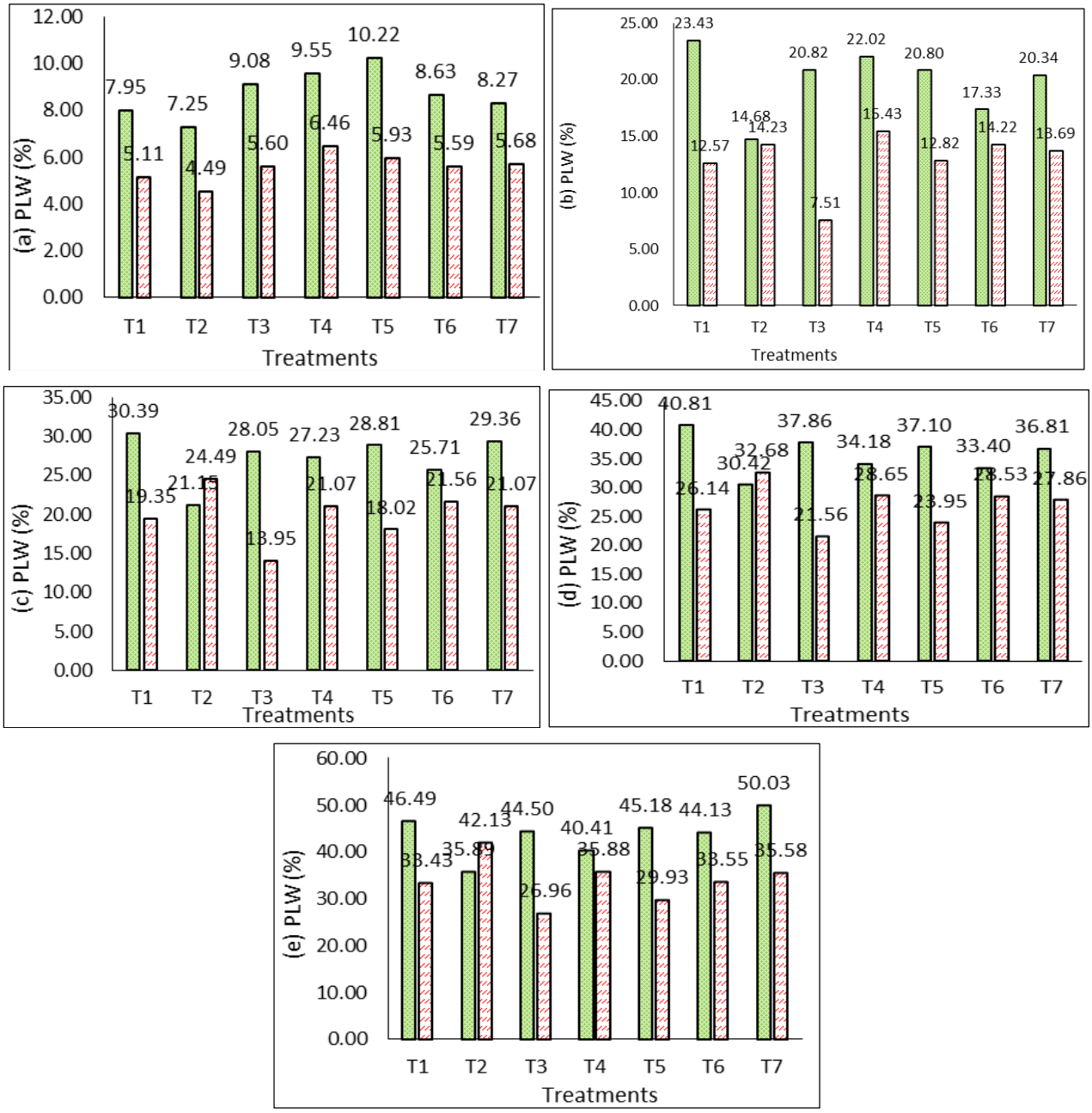


**Fig 1:** Physiological loss in weight of ber fruits cv., Sanaur-2 and Umran, at (a) 3days, (b) 6days, (d) 12days and (e) 15 days of storage under different treatments [$T_1$ contral; $T_2$ dipping fruits in hot water at $50^0$c; $T_3$ curry leaves extracts; $T_4$ ginger rhizomes extracts; $T_5$ Neem leaves extracts; $T_6$ kinnow peel etracts; $T_7$ ber leaves extracts]

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