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EFFICACY OF EDIBLE COATINGS ON JUJUBE (*ZIZIPHUS MAURITIANA* LAMK.) FRUITS : A REVIEW

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ABSTRACT

Nowadays, Jujube fruits have tremendously marketed value because of its rich nutritive value. Jujube has a meagre storage life (2-4 days) in ambient condition because of its highly perishable nature. The edible coating is an efficient approach to solve this problem as It contains edible substances like polysaccharide, proteins, lipids to protect the fruits. It is safe for the environment and human consumption. Nowadays, herbal edible coatings are utilized because of its nutritional value and beneficial for human health. Edible coatings on jujube maintained the quality, increase the shelf life and prevent microbial growth in both ambient and cold storage condition.

***Keywords*:** Ber, Jujube, Edible coating, Quality, Shelf life

Introduction

Jujube (*Zizyphus mauritiana* Lamk.) is the most valuable fruit crop in tropical and sub-tropical regions Baloda *et al*. (2012). The native place of *Z. mauritiana* is central Asia Morton (1987). It belongs to the family Rhamnaceae. The circle of relatives has 50 genera and extra than six hundred species. In excess of three hundred varieties of jujube have been recorded in India, however, just a couple of them are monetarily significant. It is mostly consumed as fresh fruit and also makes some processed products. The pulp of Ber with high nutrient value has been comprehensively perceived and it contains varied of phytochemicals like flavonoids, sugars, phenolic acids, and nutrients like vitamin A and C, P, Ca, and Fe Choi *et al.* (1911). It is considered to be the poor man's apple which contains good quantities of vitamins, minerals, and sugar Pareek (1997).

Ber has been generally viewed as a useful organic product with a high advertising an incentive in India, on account of its sustenance esteem, unique parts, and delightful taste. In India area is roughly one lakh ha, and the yearly production of jujube is evaluated 10 lakh ton. and Productivity of jujube is 10 metric ton ha^{-1} and India positions 2nd among jujube-developing nations on the planet after China. The significant territories for jujube development in India are Gujarat, Uttar Pradesh, Maharashtra, Tamil Nadu, West Bengal, Andhra Pradesh, Jammu and Kashmir, Punjab, Madhya Pradesh, Karnataka, Rajasthan, and Haryana Bal (2014). The growing areas are given in the following:-

State Growing Areas

Punjab – Patiala, Sangrur

Rajasthan – Jaipur, Jodhpur, Bharatpur

Haryana – Hisar, Rohtak, Jind, Panipat, Mahindergarh

Karnataka – Gulbarga, Belagaum, Raichur Bijapur, Bellary

Gujarat – Banaskantha, Sabarmati

Tamil Nadu – Salem, Ramanathapuram, Tirunelveli, Dharmapuri

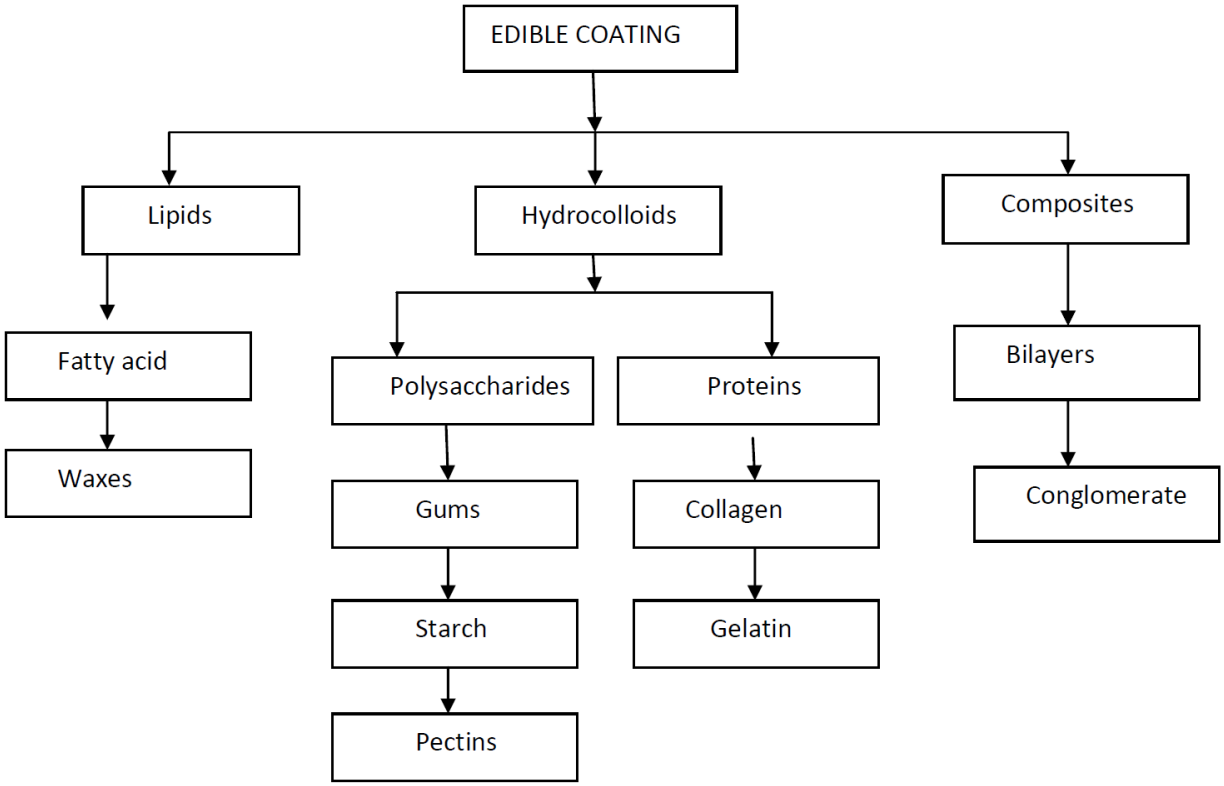
Ber is particularly perishable and has a terrible storage life (2-4 days) at room storage Meen *et al.* (2009). Fresh jujube increase physiological weight loss and rot because of high respiration rate and other enzymatic activity during storage Wang *et al.* (2011) and is a non-climacteric fruit and maturity is judge by the appearance of fruit peel color Saranant (1992). The color changes of the ber From bright green to red and black due to quinone polymerization and anthocyanin oxidization under improper storage conditions Holton and Cornish (1995).

Several strategies which include refrigeration changed surroundings storage, chemical preservatives, and packaging are getting used to limit deleterious outcomes Zhang and Quantick (1997). All these are considerably more costly than edible coating Baldwin *et al.* (1999). Using semi-porous coatings has appeared to increase the storage-life of fruit Lowings and Cutts (1982). For instance, expert long covering postponed the maturity of kalpataru fruit through changing the inner environments (Banks, 1984), and comparable outcomes were gotten in Malus and pyrus fruts with Nutri-Save™ Davis *et al.* (1988). Quantick & Zhang (1997) found that a consumable covering dependent on sucrose esters of unsaturated fats deferred pericarp caramelizing of litchi organic product.

The edible films and coatings are prepared from edible material Shin & Melvin (2012), which are lean layers of fit for human utilization material executed straight forwardly on the floor of the fruit, which may likewise give a specific boundary to dampness, CO_2, and O_2, and control responses that are unfavorable to nourishment quality (Ayranci (2004), Azarakhsh *et al.* (2014), Siripatrawan & Harte (2010) and

thin layer of edible materials are restrict the loss of water, respiration rate of food Lachman *et al.* (1986) and Lowe *et al.* (1963). Herbs like aloe vera, cinnamon oil, ginger oil are used as edible coatings because of their nutritional (vitamins, minerals) and medicinal values Chauhan *et al.* (2014), Martinez *et al.* (2006), Nasution *et al.*(2015) and herbs also contain some antimicrobial activity Douglas *et al.* (2005). It is safely eaten with the food product as Anand *et al.* (2007) and coatings have long been regarded to guard perishable food merchandise against deterioration Voilley *et al.* (1998).

The edible coating contains numerous materials like Gums, proteins, lipids, or their mixtures, which extending the storage life of post-harvested vegetables and fruits Raghav *et al.* (2016).



Efficacy of edible coatings on quality and shelf life of Jujube

Respective authors have observed the efficacy of edible coatings in maximize the storage-periods of fresh fruits by retaining quality**.** The efficacy of edible coatings (1-MCP & chitosan) on the quality and enzyme activities of jujube fruit for storing 42 days at 0 ± 1 °C. The results revealed that individual treatment of 1-MCP and chitosan reduced the rotting rate, firmness, soluble solids and increased the enzyme activities of peroxidise, superoxide dismutase, ascorbate peroxidise and catalase. The combined treatment of 1-MCP and chitosan was more efficacy for postharvest quality and storage life than individual treatments Cheng *et al.* (2020). The researcher have showed both carnauba wax and carnauba wax + glycerol monolaurate coatings were reduced the water loss, ethylene production and respiration rate, maintain pectin methylesterase, cellulose, polygalacturonase activities and also maintained the skin colour and chlorophyll content and vitamin c in comparison to the control. The combined coating of CW+GML had increased shelf life and maintained quality when stored for 12days at 20 °C Chen *et al.* (2019).

Evaluation of the effect of surface coatings and packaging materials on ascorbic acid and sugars of apple ber (*Zizyphus mauritiana*) at different storage conditions. The results showed coating of Chitosan 1% with High Density Polyethylene plus cold storage(10±2ºC) extent the shelf life upto 21 days and also increased vitamin c and total sugar than the all treatments i.e. Chitosan 1% + PP (Polypropylene) + cold storage and ambient condition Bhavana *et al.* (2019). The efficacy of edible coatings ($CaCl_2$ + PME) on storage quality of jujube fruit. The results revealed that $CaCl_2$ (1% w/w) combined with pectin methylesterase (15U/mL) under vacuum impregnation, delayed physiological weight loss and increasing quality of fruits by retaining Firmness, vitamin c and soluble solids content Zhang *et al.* (2019). The influence of edible coatings i.e. aloe vera gel (33 and 50% v/v), carboxymethyl cellulose and pectin (1, 1.5 and 2% w/v) on postharvest quality of fresh Chinese jujube fruits during refrigerated storage at 4^0 c for 40 days. The results showed that both aloe vera gel 30% and pectin 1.5 % coated fruits decreased physiological weight loss upto 30%, when stored for 40 days but higher sensory quality and TA was observed fruits were coated with 50% v/v Aloe vera, 1 and 2% w/v carboxymethyl cellulose than control condition. Finally Researcher observed both vera gel (33 and 50% v/v), carboxymethyl cellulose and pectin (1, 1.5 % w/v) were maintained quality of ber fruits when storage at 4^0 c for 40 days Moradinezhad *et al.* (2018).

The combined mixture of guar gum with aloe-vera minimize the loss of physiological weight, titratable acidity, decay, firmness of fruit and also maintain ascorbic acid & greenish-yellow colour of the fruit upto 15 day at ambient storage condition Arghya *et al.* (2018). The study evaluated by dipping of ber in hydros solution of $C_2H_2O_4$ for 10 minutes at varied concentrations (two mM, four mM, six

mM, eight mM and ten mM). The study revealed that 10mM concentration was more effective by maintaining physiology & enzymatic activity and also extended the storage period up to 9 days in ambient condition other than all concentrations Ravi *et al.* (2018). Five treatments (T1- GA3 40 ppm, T2 - $CaCl_2$ 1.0%, T3– Aloevera Gel, T4 – Olive oil, T5 - Almond oil) were coated on ber and store at two different conditions (ambient temperature and cold storage). The results showed $CaCl_2$ 1.0% coating was more effective in cold storage (shelf life 30 days) and 9 days at ambient condition but maximum total soluble solid was observed in GA_3 coated @ 40 ppm.in cold storage Jain *et al.* (2017).

The effects of three treatments T1 = control, T2= corn starch (1%) and T3= aloevera gel (2%) on jijube. The results indicated aloe-vera coating was effective to maintain quality by reducing the ripening rate , slower the rate of reducing sugar, minimize the loss of ascorbic acid and also reduce shrinkage percentage, lower physiological loss (weight) and maximum colour retention in comparison to uncoated ones. Corn with aloevera gel coated fruits had good shelflife Mani *et al.* (2017). The effects of edible coatings (1% pullulan, 1% chitosan and 2% $CaCl_2$) on quality and enzyme activity of jujube fruit During Storage. The results showed all three coatings(1% pullulan, 1% chitosan and 2% $CaCl_2$) were retain the fruit quality and antioxidant activity at storage condition. The observation was that among these three treatments 2% $CaCl_2$ was best, followed by other two coatings Kou *et al.* (2017). Using coating with varied concentrations of tea polyphenols (1, 3, and 5 g/L) integrated with alginate-based edible coating for retain quality of jujube under room temperature for 8 days. The alginate-based edible coating mixed with Tea polyphenols (1g/L) decreased respiration rate, red indices, chlorophylls content, malonaldehyde content and also maintained the activities of antioxidant enzymes, vitamin c, and total phenol content under ambient storage condition Zhang *et al*. (2016).

The efficiency of coatings of alginate (2%)-olive oil (0.2%) combined with antioxidants on the quality and storage period of jujube at ambient condition with 65 % relative humidity. The combined treatments decrease the physiological weight loss, increase TSS and also maintained quantity of antioxidants by enhancing the storage life of the ber fruit Rao *et al.* (2016). The researcher have studied how to increasing the shelf-life and quality jujube fruits (BAU variety) by using different edible coatings like gum tragacanth (1.0%, 1.5%, 2.0%), guar gum (1%, 1.5%, 2%), chitosan (0.5%, 1.0%, 2.0%). The edible coatings decrease respiration rate and delayed the decrease of TSS, vitamin c, titrable acidity, total and reducing sugar, weight loss and maintain quality & green colour in jujube fruit as compared to uncoated fruit. Guar gum (2%) extended the storage life of jujube up to 16 days Dutta *et al.* (2016**)**. 1% chitosan combined with 0.1% cinnamon oil, maintain quality by reducing the weight loss and decay of fruits when stored at 4^0 c for 60 days but reduction occurred in vitamin C and titratable acid Xing *et al.* (2015).

The combination of chitosan coating with UV radiation on maintenance of jujube under room temperature. The results revealed delayed increase of the respiration rate, Malonaldehyd, weight loss, firmness, and maintain decrease of vitamin c, chlorophyll content, and activity of (superoxide dismutase, catalase, and Peroxidase). This treatment of ultraviolet irradiation with chitosan was best to retain the postharvest quality of ber fruit Zhang *et al.* (2014). The effects of chitosan 1% with nano-silicon dioxide 0.04 % on the storage quality for 32 days at ambient condition. The results revealed that this composte coating reduced the physiological weight loss, spoilage, respiration rate, red index and also increase the enzyme activities i.e. catalase, superoxide dismutase, and peroxidise Yu *et al.* (2012). The efficacy of chitosan and 1-MCP coating on quality evaluation of jujube fruit. The results indicated combine of 1-MCP (600 nl l^{-1}) with chitosan (1.5 g/100 ml) reduced respiration rate, climacteric ethylene evolution stem-end rots incidence, & decreased PG and LOX activities and also maintained chlorophyll content, vitamin c, firmness and TSS of ber fruits. This combined treatment 1-MCP and chitosan extend shelf life and maintain quality of jujube fruit Yu *et al.* (2012).

Efficacy of edible coatings against Spoilage Microorganisms

Many authors have found that the potential of edible coatings in extending the storage-life of fresh fruits by inhibiting the growth of spoilage bacteria. Researchers have tested the combinational efficacy of essential oils to control decaying caused fungus i.e. (*Alternaria alternata* and *Penicillium expansumin)* and to maintain fruit quality. The results showed combinational treatment of cinnamon (0.156g L^{-1}), thyme (0.078g L^{-1}) and rosemary (0.625g L^{-1}) restrict both spoilage fungus i.e. *Alternaria alternata* and *Penicillium expansumin* in ber fruit. The essential oils treated fruits were reduce physiological weight loss, respiration rate and also retained vitamin-c Nikkhah, & Hashemi (2020). The effects of coatings based chitosan (0.1 mol L^{-1}) incorporated with sodium silicate (hundred mmol L^{-1}) to induces resistance against spoil caused by fungus during postharvest storage. The results indicated that combined treatment of chitosan with sodium silicate, decreased the physiological weight loss, alesion diameter, decay, red index and increased some substances like vitamin c, flavonoids, lignin content and total phenolic compounds. Chitosan + sodium silicate induced the activities of superoxide dismutase, phenylalanine ammonia lyase, polyphenol oxidase, β-1,3-glucanase and peroxidase, chitinase which accumulate the disease resistane of jujube Guo *et al.* (2019). The edible coatings along with potassium meta bisulphate reduced the microbial activity (both bacteria and fungi) Padmaja and John (2014). Chitosan application inhibited germination of spore, germ tube length and mycelial growth by causing plasma membrane collaps of P. expansum and also restricting postharvest diseases without any harmful effect on fruit quality Wang *et al.* (2014). Chitosan mixed with cinnamon oil 2.0%, completely reduce growth activity of blue mold fungus (Penicillium citrinum) and also retained ascorbic acid, and phenolic compounds in jujube Xing *et al.* (2011).

Conclusion

Palatable coatings are utilized by food industry from many years to store vegetables and fruits. Varied types of edible coatings are used like polysaccharide, proteins, lipids. Nowadays researchers used herbal edible coatings because of its environment friendly and safety for consume with fruits. This review indicates edible coatings increases the shelf life (by reducing physiological weight loss, respiration rate) and maintains quality and also prevent microbial growth of ber fruit at storage condition.

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