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Response of magnesium oxide treatment and method of drying on quality of dried lasoda (*Cordia myxa* Roxb.) fruits

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Abstract

Dried lasoda fruits are generally used as off-season vegetable in kitchen for preparing curry, pickle, 'Pachkutta', a special five star hotel dish and snacks. The aim of the study was to determine effect of concentration of magnesium oxide and drying method on quality attributes of lasoda fruits *viz.*, protein content, ascorbic acid, organoleptic acceptance, solid gain ratio and minimum non-enzymatic browning (NEB). Mature, green and uniform sized lasoda fruits were selected and blanched in various concentrations of magnesium oxide (0.1, 0.2, 0.3 and 0.4 %) before drying and dried under different drying methods (open sun, solar and oven). The statistically better quality dried lasoda fruits were obtained when blanched with 0.2 % magnesium oxide solution and dried in a solar drier.

Key words: Drying, magnesium oxide, blanching, solar drier, NEB, organoleptic acceptance.

Introduction

Lasoda (*Cordia myxa* Roxb.), popular among the arid fruits, is a small tree grown wildly through out the world and has wide ecological adaptability. Its fruits are eaten either processed when they are mature green or raw after ripening. Its dried fruits are also used to prepare 'pachkutta' a special dish, pickles, curry and snacks that's why it occupy a top place in menu of five star hotels and parties and have a very good export potential. Nutritionally, lasoda fruits contain 70 percent mucilageneous pulp, 74-82.5 g water, 65 K calories, 1.8-2.0 g protein, 1.0g fat, 12.2 g carbohydrates, 0.3 g fibre, 40 mg calcium, 60 mg phosphorus and 114 mg 100 g^{-1} ascorbic acid (Singh and Arora, 1978). Lasoda fruits are also used medicinally as anthilmintic, diuretic and demulcent. The availability of lasoda fruits is for very short duration and the shelf life of fresh fruits is also very short, which as such becomes almost unfit for human consumption within a week time of harvest. Some conventional methods varied from place to place are available to process these fruits locally. However, produce generated by these methods did not have any quality standards. Further, it has been observed that lasoda fruits often loose their green colour and nutritional quality and turn brown to black during drying process which is major hindrance of its marketing. Processing in different concentrations of magnesium oxide and drying with appropriate method checks the enzymatic spoilage and improves the colour, texture and taste. Thus, the present experiment was undertaken to study the response of blanching in magnesium oxide solution and methods of drying, on the quality and storage stability of lasoda fruits.

Materials and methods

The present investigation was conducted using four concentrations of magnesium oxide (MgO) *viz.,* 0.1, 0.2, 0.3 and 0.4 % as blanching solution and three methods of drying *viz.,* open sun, solar drier and oven. Matured green fruits of uniform size were selected, washed in running tap water and their stalks and caps were removed. Fruits of each treatment were blanched by immersing them in boiling water containing different concentrations of magnesium oxide (MgO) for 5 minute duration followed by cooling in running tap water to avoid over-blanching. The blanching duration for lasoda fruits was standardized by tests of catalase and perioxidase enzyme. Just after blanching, the fruits were destoned and sulphited by soaking in 0.1 per cent potassium-meta-bi-sulphite (KMS) solution for 3 minutes. The experiment was laid out in a completely randomized design (CRD) with three replications. The details of drying/dehydration methods are as follows:

Open sun (32-43^{0}C) drying: After applying above described pre-drying treatments, the fruits were well spread in the open sun from 8.00 AM to 6.00 PM in the month of May on the white and neat cloth. They were kept as such till complete drying. The completion of drying process was judged by weighing the dried fruits whenever two consecutive weights were constant. Drying of lasoda fruits under open sun condition was completed in 98 hours (active sun-shine duration).

Solar drier (32 to 49 ^{0}C) drying: Solar drier was made locally with iron frame, fitted with tin sheets in sides and glass on top. It appeared hollow cube with a chimney at top (20 cm^2 x 50 cm). The drying chamber (110 x 60 x 10 cm^3) of this device accommodated four trays (60 x 60 x 10 cm^3) with loading capacity of about 1-1.5 kg/tray. The drier had a solar energy catching area of 0.66 m^2 painted with an ordinary black paint. After giving the pre-drying treatments, fruits were spread uniformly in trays. To avoid burning of the product due to excessive heat and ensure uniform drying of the entire mass, the position of trays was changed in rotation from lower shelf to the upper one and the drier was covered with white thick cotton cloth during noon (12.00 to 3.00 PM) hours. The drying was completed in 21 hours (active sun-shine duration).

Oven drying/dehydration: Fruits were spread in the trays after completion of preliminary treatments. The trays were kept for dehydration in the oven initially at 80 ^oC for one hour then at 70 ^oC for two hour and finally at 60^oC temperature until two consecutive weights were constant. The fruits were dried in 5 hours.

Packing and storage of dried lasoda fruits: After applying the respective treatments, the dried fruits were sealed into 250 gauge polyethylene pouches. The packed samples were stored in a dry place at ambient temperature (25-35 °C) for six months and analyzed at 0, 3rd and 6th month of storage for various physico-chemical changes. Solid gain was measured as ratio of weight of fresh product to dried product. Ascorbic acid (vitamin C) was estinated by direct Colorimetric determination using 2 per cent metaphosphoric acid (HPO_3) with dye 2,6-Dichlorophenol-indophenol solution as suggested by Ranganna (1986). Crude protein was estimated by determining the total nitrogen content by colorimetric method (Snell and Snell, 1939) and multiplied by the factor 6.25. Non-enzymatic browning of dried lasoda fruit was measured on spectrophotometer by recording the optical density (O.D.) of the extract at 420 nm (Ranganna, 1986). Total chlorophyll content was extracted by a non-macerating method using dimethyl sulfoxide (DMSO) and calculated in terms of mg g^{-1} dried product on weight basis using the formula given by Arnon (1949). Organoleptic evaluation for colour, taste and flavour was carried out by a panel of five judges based on Headonic Rating Test (Amerine *et al.*, 1965). The equilibrium relative humidity (ERH) was determined by Wink's weight equilibrium method (1946). A change in colour, general conditions of the product and the appearance of mould growth was recorded regularly. A moisture content curve was drawn and points marked on the curve as follows: (1) The optimum moisture point (M): The moisture content and the ERH of the product as prepared. (2) The critical point (C): The stage at which the product became soft (lumpy) in texture and (3) The danger point (D): A point which was of 5 per cent lower to relative humidity than the critical point. The portion of the curve between D and C is known as safety range (SR) and between M and D as safety margin. The package adopted should not permit the product to reach upto danger point otherwise there may be a error in safety margin of product (Sagar, 1999).

To test the significance of treatment, analysis of variance technique was adopted as suggested by Gomez and Gomez (1984). Significance of the difference in the treatment effect was tested through 'F' test.

Table 1. Effect of magnesium oxide and drying methods on ascorbic acid content, total chlorophyll and solid gain ratio of dried lasoda fruits

Treatments	Ascorbic acid content (mg 100 g^{-1})	Total chlorophyll content (mg g^{-1})	Solid gain ratio
M 0.1 + OS	56.07	0.125	5.48
M 0.1 + SD	54.90	0.136	6.18
M 0.1 + OV	57.45	0.138	6.07
M 0.2 + OS	57.68	0.143	5.98
M 0.2 + SD	58.12	0.150	6.20
M 0.2 + OV	58.41	0.145	6.18
M 0.3 + OS	58.25	0.156	6.02
M 0.3 + SD	57.12	0.163	6.25
M 0.3 + OV	60.07	0.165	6.24
M 0.4 + OS	55.26	0.173	6.02
M 0.4 + SD	58.27	0.181	6.34
M 0.4 + OV	62.30	0.171	6.27
S Em ±	0.88	0.002	0.06
CD (P=0.05)	2.47	0.004	0.17

Concentration of magnesium oxide solution (M): 0.1, 0.2, 0.3 and 0.4 per cent. Drying methods: Open sun (OS), solar drier (SD) and oven (OV)

Results and discussion

In general, the solid gain ratio and ascorbic acid content of lasoda fruit increased significantly irrespective of increasing concentration of magnesium oxide solution (Table 1). Although, statistically increase in solid gain ratio and ascorbic acid were recorded upto 0.2 per cent magnesium oxide and solar drier. The significantly higher solid gain of these treatments might be because of binding action of molecules as magnesium is part of the molecule of magnesium-pectate, which together with calcium-pectate binds the cellulose chains in the formation of the cell walls (Edmond *et al.*, 1993). Similarly, among drying methods, solar drier and oven recorded better values for retention of ascorbic acid which might be due to the fact that there was uniform drying in these methods. The increase in ascorbic acid with respect to higher concentration of magnesium oxide and solar drier might be due to less oxidation of ascorbic acid. This is in confirmation with Lal (2001) in kachri and Fageria and Choudhary (2003) in sangri and Choudhary *et al.* (2007) in kachri.

Data (Table 1 and Fig. 1) indicate that the fruit treated with magnesium oxide @ 0.4 per cent and dried in solar drier recorded highest chlorophyll content and minimum non-enzymatic browning (NEB) although, the statistical difference was recorded

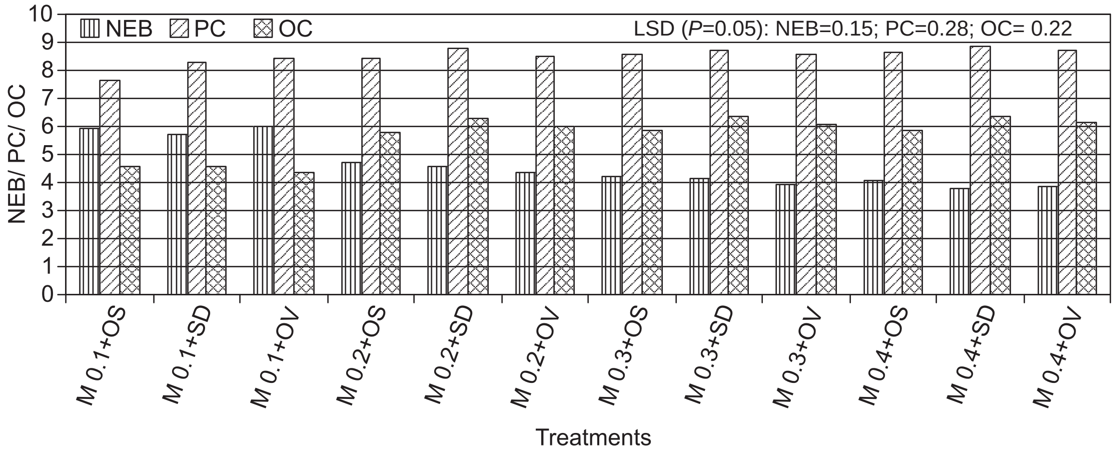

Fig 1. Effect of magnesium oxide and drying methods on non-enzymatic browning, protein content (%) and organoleptic scores of dried lasoda fruits. Concentration of magnesium oxide solution (M): 0.1, 0.2, 0.3 and 0.4 per cent drying methods: Open sun (OS), solar drier (SD) & oven (OV)

upto 0.2 % magnesium oxide and solar drier. The lowest chlorophyll content in dried fruit was noticed with magnesium oxide 0.1 % and open sun drying. The reason is that magnesium is the center of the molecule of both chlorophyll a and b which helps to maintain the concentration of chlorophyll (Edmond *et al.*, 1993). There may be two reasons which may lead reduction in non-enzymatic browning. First, there was sufficient retention of chlorophyll content and second, blanching of fruits in magnesium oxide solution which might have reduced the intensity of maillard reaction and ascorbic acid browning (McBean *et al.* 1971). Similarly, the maximum retention of chlorophyll in solar drier fruits might be due to uniform drying. These results are in close conformity of Choudhary *et al.* (2007) in kachri.

The significantly higher protein content and scores for organoleptic acceptance *viz*., texture, flavour and colour of dried lasoda fruits were recorded under treatment M0.4 + SD which was statistically at par with treatment M0.3 + SD and M0.2+ SD (magnesium oxide 0.2 per cent and solar drier) (Fig. 1).

These results are in close confirmity with those of Rama and John (2000), who have reported that both blanching and storage reduced the protein content in dehydrated mushroom. An improvement in retention of protein content and organoleptic acceptance had also been reported by Fageria *et al.* (2003) in ker and Choudhary *et al.* (2007) in kachri. Results revealed that fruits dried in solar drier were significantly superior in terms of organoleptic acceptance. Lal (2001) and Choudhary *et al.* (2007) also reported that solar drier drying was better in regards to colour and texture in comparison to oven and open sun dried fruits, if produce is protected against intense sun scorch during noon hours.

It is inferred from Table 2 that dried fruit of lasoda had an initial moisture content of 4.00 per cent equilibrates at a relative humidity of 60 per cent. From moisture content of 6.61 to 9.09 per cent, the product remained slightly hard in texture with normal flavour. The lasoda fruit remained hard in texture having original flavour at or below 2.64 per cent moisture. At moisture level of 14.21 per cent (ERH 60 %), the product was just acceptable with slightly soft textured. The critical point and danger point were at moisture level of 14.21 and 11.00 per cent, respectively (Fig. 2). Above 22.83 per cent moisture corresponding to 80, 90 and 100 per cent equilibrium relative humidity (ERH), the fungus growth was observed after 15, 11 and 9 days, respectively. The quality of the dried fruit in storage was greatly influenced by relative humidity. The work of Khurdiya (1980) supported that portion of curve between the point optimum (M) and danger (D) was defined as the safety margin (SM) as a helpful guide in the packaging material.

Table 2. Equilibrium relative humidity for dehydrated lasoda fruit at room temperature (35°C)

Equilibrium moisture content (%)	ERH (%)	Number of days required to reach equilibrium	Remarks
1.44	10	70	Colour brown, difficult to chew, flavour original.
2.54	20	65	Colour brown, difficult to chew, flavour original.
2.64	30	55	Hard in texture, flavour original
6.61	40	50	Slightly hard in texture, flavour normal
9.09	50	30	Slightly hard in texture, flavour normal
14.21	60	25	Slightly soft in texture, flavour changed
18.92	70	22	Product became slightly soft
22.83	80	15	Product very soft, mould growth after 15 days
32.68	90	11	Product watery, mould growth after 11 days
39.36	100	9	Product semi solid, mould growth after 9 days

Initial moisture content of dried lasoda fruit is 4.0 %

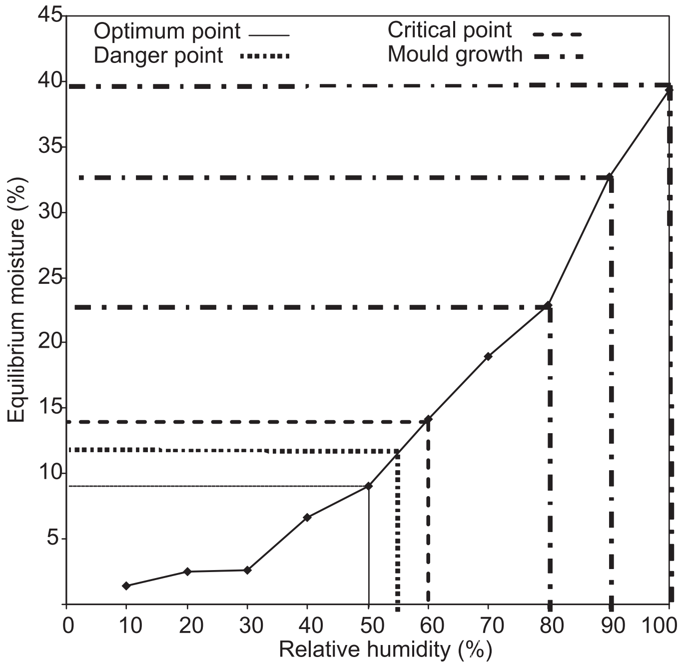

Fig. 2. Equilibrium relative humidity curve for dried lasoda fruit.

On the basis of the results obtained in present investigation, it may be concluded that blanching of lasoda fruit in 0.2 per cent magnesium oxide solution and drying in solar drier gave better quality product in terms of higher solid gain, protein content, chlorophyll and lower non-enzymatic browning with acceptable texture, flavour and colour. As per results, solar drier not only resulted in production of better quality hygienic product but also helped to save valuable electricity by utilizing conventional solar energy which may be a boon for arid hot rural areas.

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