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EFFECT OF SYRUP CONCENTRATION ON SHATAVARI ROOTS

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Abstract: *Asparagus racemosus* is a plant and roots used in traditional Indian medicine (Ayurveda), *Siddha and Homoeopathy medicines. Asparagus Racemosus* is mainly known for its phytoestrogenic properties. The mass reduction and water loss of shatavari roots increased from 0 to 37.61%, 34.78% and 49.96% respectively as the duration of osmosis increased from 0 to 120 min during this period. The sugar gain was also found to be increased from 0 to 14.95 %. A rapid water loss (37.61%) was observed in the beginning (first hour of osmosis).

Keywords: *Asparagus racemosus*, Shatavari Roots

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INTRODUCTION

Asparagus Racemosus (family Asparagaceae; Liliaceae), is commonly called Satavari, Satawar or Satmuli in Hindi; Satavari in Sanskrit; Shatamuli in Bengali; Shatavari or Shatmuli in Marathi; Satawari in Gujarati; Aheruballi in Kannada; Kairuwa in Kumaon; Narbodh or atmooli in Madhya Pradesh; and Norkanto or Satawar in Rajasthan.

It is also useful in treatment of epilepsy, kidney disorders, chronic fevers, excessive heat, stomach ulcers and liver cancer, increases milk secretion in nursing mothers and regulates sexual behaviors. *Asparagus racemosus* cleanses, nourishes, and strengthens the female reproductive organs and so, it is traditionally used for PMS, amenorrhea, dysmenorrhea, menopause and pelvic inflammatory disease like endometriosis. *Asparagus racemosus* is considered as the most potent female health tonic. *Asparagus racemosus* also supports deeper tissue and builds blood, helping in treating infertility, prevents miscarriage and acts as a post-partum tonic as it increases lactation, regularizes the uterus and balances hormones, probably due to phyto-estrogens. *A. racemosus* is also suggested for its soothing agent upon systemic dryness which is part of the natural aging process. It endorses positive emotions that calming fresh sensitivity and the sizzling emotions such as irritability, anger, jealousy, resentment, andhatred. It also helps with pain, restless sleep, disturbing dreams, and those who have weak emotional and physical heart. *Asparagus racemosus* possesses a strong rejuvenating, fostering, and stabilizing action on excessive air, gas, dryness and agitation in the body and mind; for this action, the root infusion is traditionally used in treating nervousness, anorexia, insomnia, hyperactive children, and slow growing of humans .

Drying is one of the important post harvest processes for medicinal plants to prevent spoilage of the plants by lowering the amount of moisture in the products during storage. In addition, drying of medicinal plants must be accomplished immediately after harvesting to retain the quality of the plants and to prevent contamination and losses caused by insects, birds and fungi (Yahya et al., 2001). However, improper thermal drying can cause a significant loss of the active ingredients in medicinal plants as they are thermolabile. Furthermore, adverse effect on the quality of medicinal plants such as browning and degradation of essential oil content occur when they are exposed to high temperatures (e.g. hot air drying) during the drying process (Arabhosseini et al., 2007; Arslan and Ozcan, 2008). Hence, proper drying techniques are important to enhance the quality of the dried medicinal plants especially in terms of the contents of active ingredients with an ovbjectve to study osmotic dehydration behaviour at different time of immersion.

Materials and Methods

This chapter deals with the materials used, preparation of test sample and methodology followed during the experimentation conducted for drying of shatavari roots. The methods used and analysis of data has been discussed.

3.1 Raw Materials

The fresh sample of shatavari roots was procured from Nagarjun Medicinal plant research Unit, Dr. PDKV, Dist Akola. The cleaning, sorting and peeling was done manually for removing impurities, dirt, dust and infected roots etc.

Plate 1 Shatavari roots

3.2 Determination of moisture content.

For determination of moisture content AOAC method was used. First weight of sample was measured then put the sample in hot air oven at 105±2 °C for 24 h. (AOAC, 2000) Plate 3.2 shows hot air oven.

After drying, the sample was kept in dessicator for 1 h then the final weight of sample was measured. The mean of three replications was reported throughout the experimentation. The moisture content of sample was calculated by using following formulas

$$M.C.(w.b.),\% = \frac{W_1 - W_2}{W_1} \ X\ 100 \quad \text{.... 3.1}$$

$$M.C.(d.b.),\% = \frac{W_1 - W_2}{W_2} \ X\ 100 \quad \text{...3.2}$$

Where,

M.C. (w.b.) =Moisture content, % (w.b.)

M.C. (d.b.) =Moisture content, % (d.b.)

W_1= Initial weight of sample, g

W_2= Final weight of sample, g

3.3 Drying methods

3.3.1 Osmotic Dehydration

In the process of osmotic dehydration, water comes out from a sample placed in the hypertonic solution due to concentration difference and the simultaneous transport of solids takes place from solution to sample. The mass transport in terms of water loss, mass reduction and sugar gain were studied as discussed in the following section.

Plate 2 Temperature controller water bath

Water loss (WL)

Water loss was calculated as the net loss of water from food material (per 100 g) on an initial mass basis as follows:

$$WL = \frac{W_{si} X_{swi} - W_{s\theta} X_{sw\theta}}{W_{si}} \times 100 \quad \text{..... (3.3)}$$

Mass reduction (WR)

Mass reduction was calculated as the net mass reduction of the food material (per 100 g) on an initial mass (100 g) basis as follows:

$$WR = \frac{W_{si} - W_{s\theta}}{W_{si}} \times 100 \quad \text{..... (3.4)}$$

Sugar gain (SG)

Sugar gain was calculated as a net uptake of solids by food material (per 100 g) on an initial mass (100 g) basis as follows:

$$SG = \frac{W_{s\theta}(1 - X_{sw\theta}) - W_{si}(1 - X_{swi})}{W_{si}} \times 100 \quad \text{..... (3.5)}$$

From Eqns (3.6) and (3.7), the sugar gain (SG) can be correlated with mass reduction (MR) and water loss (WL) as

$$SG = WL - WR \quad \text{..... (3.6)}$$

where, WL = water loss (%) ,

WR = mass reduction (%) ,

SG = solid gain (%)

W_{si} = initial mass of sample, g ,

$W_{s\theta}$ = mass of the sample after time θ, g

X_{swi} = water content as a fraction of the initial mass of the sample

$X_{sw\theta}$ = water content as a fraction of the syrup at time θ.

A small capacity laboratory temperature controlled water bath of size 50 x 30 x 25 cm (approximate capacity, 5 litres) was used as an osmotic dehydration unit. A temperature controller was used to regulate the required temperature in the experimental studies (Plate 3.2).

3.3.2 Sun drying

Sun drying is the process in which drying can be done in natural atmospheric condition. For drying of shatavari roots accurately 100 g of sample taken with three replications. The sample kept in the trays and placed where adequate amount of sunlight. During drying, the samples were weighed at an interval of 30 minutes until the samples attained constant moisture content (6 to 7% d.b). The sun drying of shatavari roots was done during the month of December to January at 33-37 ^{o}C temperature and 40% RH.

RESULTS AND DISCUSSION

This chapter deals with the results of the investigations carried out on drying of shatavari roots by using different drying methods on quality parameters. The diffusivity during drying process was estimated. A mathematical model has been fitted for predicting kinetics of drying process and it has been verified experimentally. The temperature was optimized for minimum water activity, and color damage. Drying method was selected on the basis of colour, water activity, drying time and overall acceptability. The initial moisture content of long paper was found to be 77.50% wet basis and on dry basis is 344.44%.

4.1 Drying methods

Osmotic dehydration

The mass transport data of water and sugar from shatavari roots slice and syrup with duration of osmosis for 50 ^{o}Brix sugar solution at 50 ^{o}C temperature having syrup to sample ratio (R’) as 4:1 are presented in Table 4.1(a) to (c) respectively. It has been observed that mass reduction, water loss and sugar gain of sample increased with increase in duration of osmosis. The mass reduction and water loss of shatavari roots increased from 0 to 37.61%, 34.78% and 49.96% respectively as the duration of osmosis increased from 0 to 120 min during this period. The sugar gain was also found to be increased from 0 to 14.95 %. A rapid water loss (37.61%) was observed in the beginning (first hour of osmosis).

Table 4.1(a) Osmotic dehydration of shatavari at 60 min time of immersion

Time (min)	Initial weight (g)	Final weight (g)	IMC (%)	Final moisture content (%)	WR (%)	WL (%)	SG (%)
10	100.3	90.61	77.5	67.81	9.661	16.241	6.580
20	100.3	83.92	77.5	61.12	16.331	26.362	10.031
30	100.3	81.37	77.5	58.57	18.873	29.984	11.111
40	100.3	78.42	77.5	55.62	21.815	34.013	12.199
50	100.3	76.37	77.5	53.57	23.858	36.711	12.853
60	100.3	75.67	77.5	52.87	24.556	37.613	13.057

Table 4.1 (b) Osmotic dehydration of shatavari at 90 min time of immersion

Time (min)	Initial weight (g)	Final weight (g)	IMC (%)	Final moisture content (%)	WR (%)	WL (%)	SG (%)
10	100.28	89.26	77.5	66.480	10.989	18.326	7.336
20	100.28	84.9	77.5	62.120	15.337	24.907	9.570
30	100.28	81.433	77.5	58.653	18.794	29.870	11.076
40	100.28	79.87	77.5	57.093	20.350	32.025	11.675
50	100.28	78.11	77.5	55.327	22.111	34.407	12.295
60	100.28	77.85	77.5	55.073	22.364	34.743	12.379
90	100.28	77.82	77.5	55.040	22.397	34.787	12.390

Table 4.1 (c) Osmotic dehydration of shatavari at 120 min time of immersion

Time (min)	Initial weight (g)	Final weight (g)	IMC (%)	Final moisture content (%)	WR (%)	WL (%)	SG (%)
10	100.33	91.12	77.5	68.2933	9.1767	15.4737	6.2970
20	100.33	82.83	77.5	60.0000	17.4430	27.9658	10.5228
30	100.33	74.7	77.5	51.8733	25.5432	38.8768	13.3336
40	100.33	71.59	77.5	48.7667	28.6398	42.7000	14.0602
50	100.33	68.22	77.5	45.3933	32.0021	46.6335	14.6314

60	100.33	65.43	77.5	42.6067	34.7797	49.7118	14.9321
90	100.33	65.22	77.5	42.3933	34.9924	49.9411	14.9487
120	100.33	65.2	77.5	42.3733	35.0123	49.9625	14.9502

4.2 Drying characteristics

Drying data for various drying methods of shatavari roots was presented in Appendix. The drying was carried out in osmotic dehydration with convective tray drying methods. Drying behaviour was investigated for shatavari roots dried at air temperature of 50 ^{o}C in tray dryer, osmotic dehydration was done at 50 ^{O}C and 50 ^{O}B for 60, 90, 120 min and sun drying at atmospheric temperature range of 33-37 °C and relative humidity of 40%. Table 4.2 shows drying time required to obtained final moisture content during drying of shatavari roots by using different drying methods.

Table: 4.2 Drying time required for various drying methods

Drying methods	Time required for drying	Temperature / concentration of osmotic solution
Osmo-Convective drying	240 min (fmc 6.37g wb)	Pre-treatment 50°C and 50°B 60 min Convective drying : 50 ^{0}C
	240 min (fmc.4.28 g wb)	Pre-treatment 50°C and 50°B 90 min Convective drying : 50 ^{0}C
	300 min (fmc.6.74 g wb)	Pre-treatment 50°C and 50°B 120 min Convective drying : 50 ^{0}C

4.2.1 Variation in moisture content with time

The typical curves showing variation in moisture content with drying rate for drying of shatavari roots by different methods at varying time and temperature are shown in Fig. 4.1 (a) to (d). The initial moisture content of shatavari roots was found to be 344.44% (d.b) for all the samples investigated and after drying up to nearly constant weight, the moisture content was reduced in the range of 4 to 5 per cent (d.b). From Fig. 4.1 (a), (b), (c) and (d), it can observed that moisture content from these curves of shatavari roots samples decreased exponentially with drying rate under all drying conditions. Increase in the air temperature reduced the time required to reach a certain level of moisture content.

The variation in moisture content of dried shatavari roots with drying time, drying rate and moisture ratio were calculated and shown in the Fig. 4.1 (a) to (d) and Fig 4.2 (a) to (d) respectively .

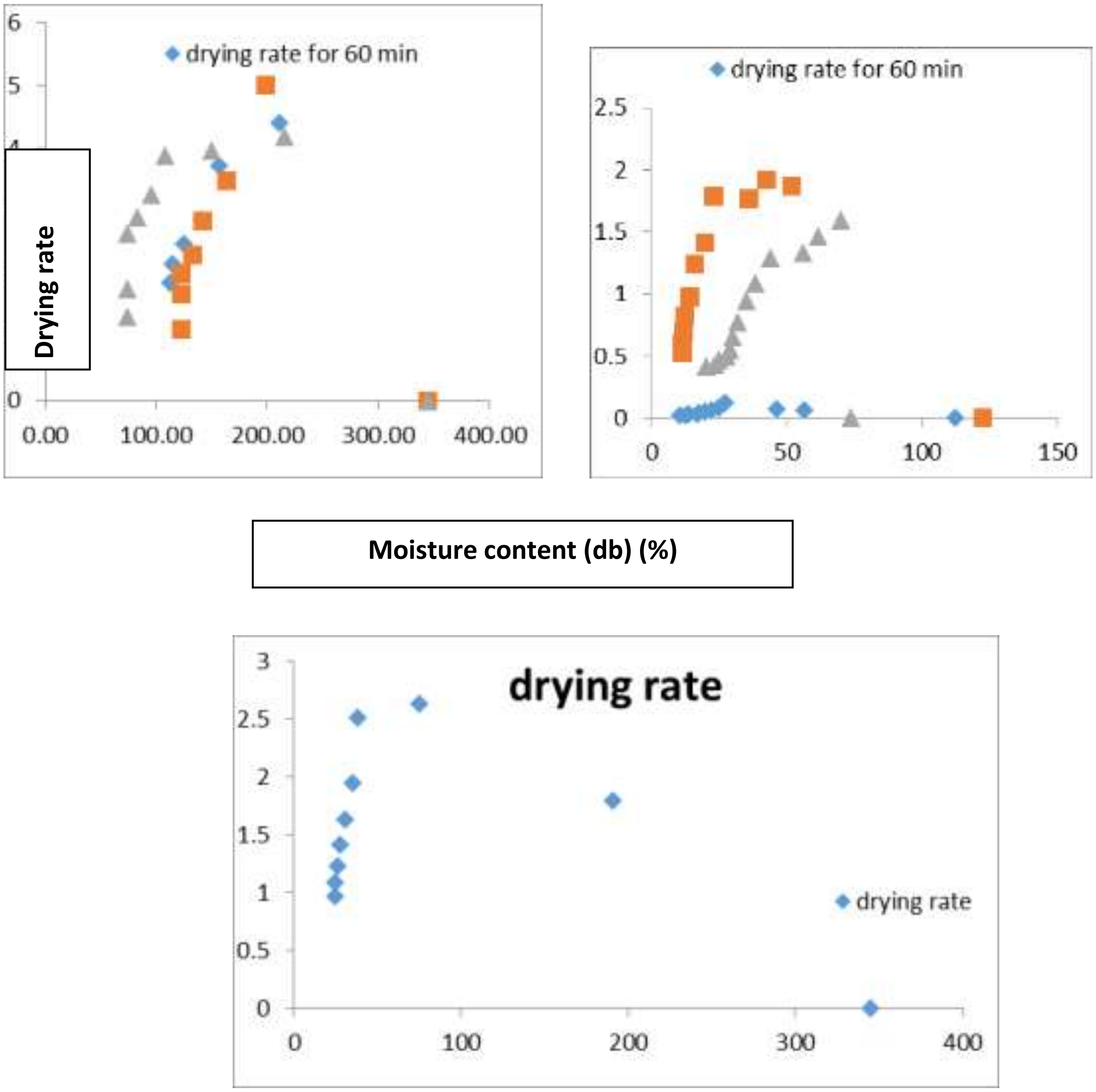

Fig 1.: Variation in moisture content vs drying rate for osmotic dehydration

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