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Effect of concentration of osmotic solution on: *Aloe vera*

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Abstract
Aloe vera, a tropical and subtropical plant belonging to the Liliaceae family, contains a transparent mucilaginous jelly known as *Aloe vera* gel. The drying of osmo air consists of preheating the sample by osmotic dehydration and subjecting it. Osmotic dehydration is incomplete removal by osmotic agent of water from a food product. Initial moisture content of *Aloe vera* gel was found to be 98.8% and minimum moisture content of dried *Aloe vera* was found to be 3.01% (wb) after 12hr of osmo-air dehydration treatment. Osmotic dehydration of *Aloe vera* reduces the initial moisture content of 98.8% to 48.9% at 30^0 brix sugar concentration whereas reduction from 98.8% to 25.14% was observed in case of 70° brix. An intermediate value of reduction to 36.61% wb was observed in case of osmotic treatment at 50^0 brix. In osmotic treatment at 30^o brix the drying rate decreased from 0.2838, 0.1741,0.1233, 0.1138 and 0.0911g/min from 1st to 5th hour, whereas in 70^o brix drying rate obtained was found to be highest in the first hour 0.6268 g/min and starts gradually decreasing from 0.6268, 0.2176, 0.1238, 0.0970 and 0.0505 g/min within five hours.

Keywords: Osmotic solution, *Aloe vera*, drying rate

Introduction
Aloe vera is an important plant like cactus it has been used for thousands of year for traditional medicinal purpose. The island of arid tracts of India is reported to grow wild. The common name of *Aloe vera* is Ghritkumari, but the names Kwargandal, Gwarpathaorgiloy are also known in Chhattisgarh (Sahu *et al*, 2013) [3]. *Aloe vera* plant is member of the alow babadensis lily family, which is full of juice and closes like a cactus. Aloe is mistakenly called a "Desert Cacti" because of its cactus-like feel (Gupta *et al*, 2018) [1]. *Aloe vera* serves as an antimicrobial agent that kills or prevents microorganism growth and development such as microorganisms (bacteria), fungi, protozoa etc. Antimicrobial drugs kill and destroy the microbes or protect bacteria (micro biostatic) from growth and development. Various parts of this have served to sure a wide range of health-related issues. This plant synthesizes a vast array of medicinally important secondary metabolites. (Pathak and Sharma, 2017) [2]

Materials and Methods
Osmotic dehydration is the incomplete removal by osmotic agent (usually either sugar or salt solution) of water from a substance. It gives rise to at least two large simultaneous counter current flows resulting in a substantial flow of water out of the food into the solution and a transfer of the solution into the food. It is a valuable method for maximizing the shelf life and reducing the energy costs.

Experimental Site
The experiment was conducted in laboratory at Chhattisgarh Agricultural Engineering Collage (affiliated to Indira Gandhi Krishi Vishwavidyalaya, Raipur), Rishali, Dhanora road, Durg (C.G.) at $21^0$15'North latitude and $81^0$32'East longitude with altitude in 2017.

Collection of sample
Fresh whole *Aloe vera* (common name *Ghritkumari* and is locally known as *Kwargandal*, *Gwarpatha* or *Giloy*) leaves of between 30 and 50 cm length from 3 to 4 year old plant was procured from the locally available gardens.

Preparation of *Aloe vera* slices
Aloe vera leaves were washed and placed vertical manually. The spikes, placed along the margins, were removed before slicing the leaves. The thick epidermis (or skin) was carefully separated from parenchyma (or gel fillet) using a stainless steel knife.

Preparation of sugar solution
Sugar solution was prepared for five different concentration *viz.* 30°brix, 40° brix, 50° brix, 60° brix and 70° brix.

Measuring instruments
A refractometer was used to calculate sugar solution concentration for conducting the experiment at various concentration levels. The content was measured with a measuring tool.

Refractometer
Erma hand refractometer (Japan) ranges from 28-62%, 58-92% and 0-32% was used.

Weighing machine
A weighing machine of micro weighing scale KERRO BL5002 series that can weigh the minimum value of 0.01gm to a maximum weight of 500 g, and macro weighing scale HC-K3KA series that can weigh the minimum value of 10 g to the maximum weight of 3kg.

Hand knife
Two different sized Hand knives are used for slicing operation.

Anemometer
For measuring the air velocity of the dryer, a anemometer of model no. AGRONIC-45227 is used.

Hot air oven
For measuring the moisture content of the sample, a hot air oven is used. Hot air ovens are electrical devices which use dry heat and sterilize. Generally, they can be operated from 50 to 300 °C, using a thermostat to control the temperature.

Moisture Content
The sample's humidity content was determined using standard air-oven method. 10g test sample was held in a hot air electric oven maintained at 60 ^{0}C until concordant value was achieved. After every one hour has the sample was taken from the oven and measured, the weight loss was estimated and the moisture content was calculated using the formula below (Shubhashini *et al*, 2015) [4]:

mc (%,wb)= $\frac{W_w}{W}$×100

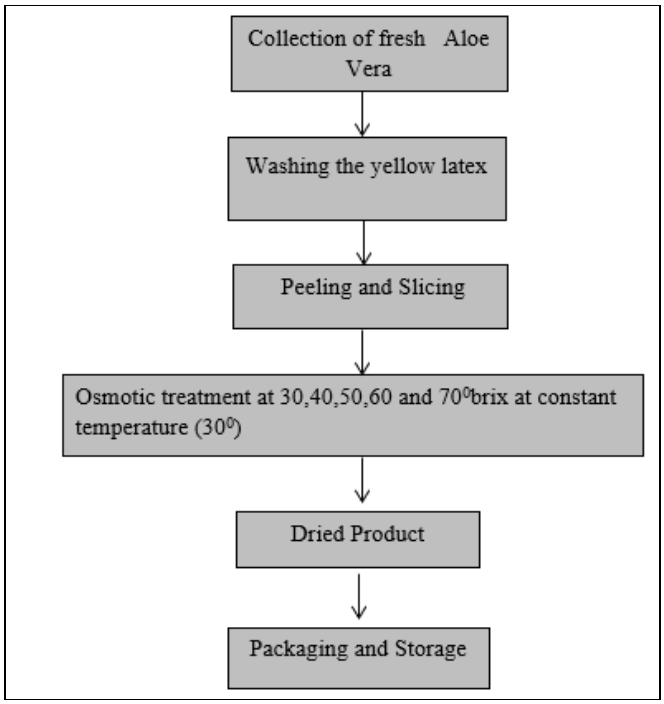
mc (%,db) = $\frac{W_w}{W_d}$× 100

Total weight (W) = W_w+ W_d

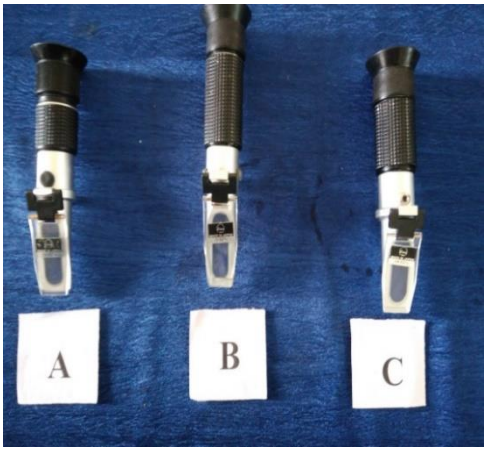
Where,
M_c= moisture content
wb = wet basis
db = dry basis
W_w= weight of water
W_d= weight of dry mater
W = total weight

Drying rate
Dryingrate is defined as, the amount of moisture removal from a sample in a certain period of time. The drying rate is calculated by using the following formula:

Rate of drying = $\frac{\text{Moisture loss}}{\text{time difference}}$ × 100



The process flow chart for osmo air drying of *Aloe vera*.



Hand Refractometer

Weighing Machine

Anemometer

Hot air oven

Results and Discussion

Effect of concentration of osmotic solution on drying time

The effect of concentration of sugar solution on osmotic dehydration of *Aloe vera* slice was studied for thickness of slice 1×1×1.5 cm at 5 different concentration i.e. 30º, 40º brix, 50º brix, 60º brix, and 70º brix, at osmotic solution 1:5 and at osmotic treatment time of 1hr, 2hr, 3hr, 4hr and 5hr. Here, we have concluded the observation taking an average of 4 times of experiment. Fig: 1 depicts the effect of concentration of sucrose solution on drying time.

Effect of osmotic treatment time on moisture content Initial moisture content of *Aloe vera* gel was found to be 98.88%. The moisture content gradually decreases. 100 gram of *Aloe vera* slices dipped in 30º brix concentration of sugar solution the moisture content with reduced to osmotic treatment time i.e. 1hr, 2hr, 3hr, 4hr and 5hr reduces from 82.97% to 70.37%, 62.31%, 54.63%, and 48.9% respectively. At same osmotic treatment time for 40ºbrix the moisture content reduce from 76.97% to 59.1%, 54.02%, 47.37% and 42.27% respectively, here moisture content decreases in nonlinear fashion. The same osmotic treatment for 50ºbrix at same osmotic time the moisture content reduces from 73.03% and 53.79%, 45.2%, 40.17% and 36.61% respectively. Here within 4hr the moisture content reduces to 40.17%. At osmotic treatment of 60º brix and same osmotic time the moisture reduces from 67.39%, 44.9%, 38.01%, 34.82% and 31.21% respectively, here moisture content decreases suddenly to 38.01% in 3hr. The osmotic treatment at 70ºbrix at and same treatment temperature of 30ºC and same treatment time, the moisture content drastically reduces from 98.88 (%,wb) to 62.05%, 41%, 32.06%, 28.73% and 25.14% respectively, here moisture content suddenly decreases with-in 2 h to 41%.

Effect of concentration on the drying rate Osmotic dehydration treatment was done for 5hr by dipping the slices of *Aloe vera* at various sugar solution concentrations. In 30^0 brix the drying rate fell from 1st to 5th hour to 0.2838, 0.1741, 0.1233, 0.1138 and 0.0911 g/min. The drying rate obtained in 40º brix was higher, and then decreased in five hours from 0.3838, 0.2299, 0.0968, 0.0958, 0.0958 and 0.0808 g/min. The same drying rate obtained in 50º brix was still higher and gradually decreased from 0.4495, 0.2341, 0.1665, 0.0720 and 0.097 g/min. Dry rate decreased in 60º brix from 0.5432, 0.2525, 0.1381, 0.0811 and 0.0638 g/min. The drying rate attained in 70º brix was the highest in the first hour at 0.6268 g/min. It slowly decreased within five hours from, 0.6268, 0.2176, 0.1238, 0.0970 and 0.0505g/ min. There is a big drop in drying rate up to 3hr of treatment in all cases, there after the drying rate drops to very low level. Constant drying time is totally absent here; dropping drying rate period can be seen. Its dropping drying rate period is visible up to 3rd hour of drying, and subsequently 2nd dropping rate period.

Fig.4.3 shows the impact of concentration on drying rate when osmotic dehydration is performed at 30ºC for specific time period. In each case, the drying rate has the maximum value in the first hour, and then decreases gradually. The rate then decreases with time. The initial high drying rate is due primarily to bound moisture and adequate surface moisture. The bound moisture, however, decreases with time, making removal difficult hence the rate decreases thereafter.

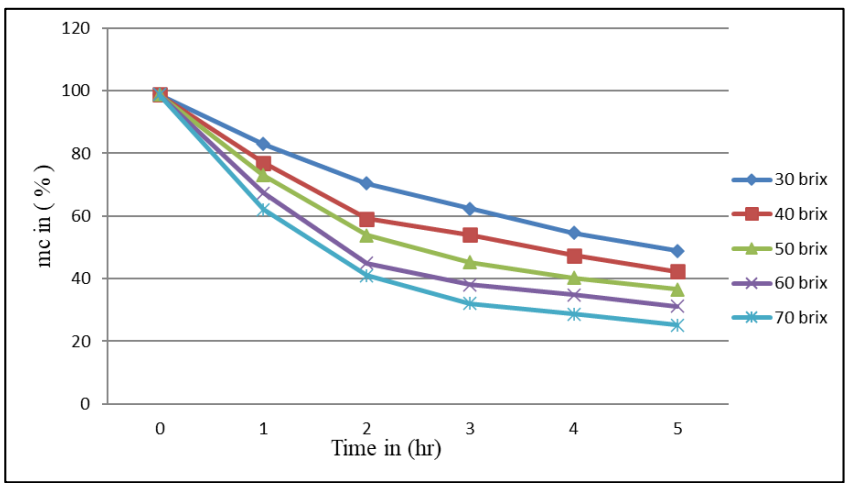


Fig 1: Effect of concentration of sugar solution on drying time

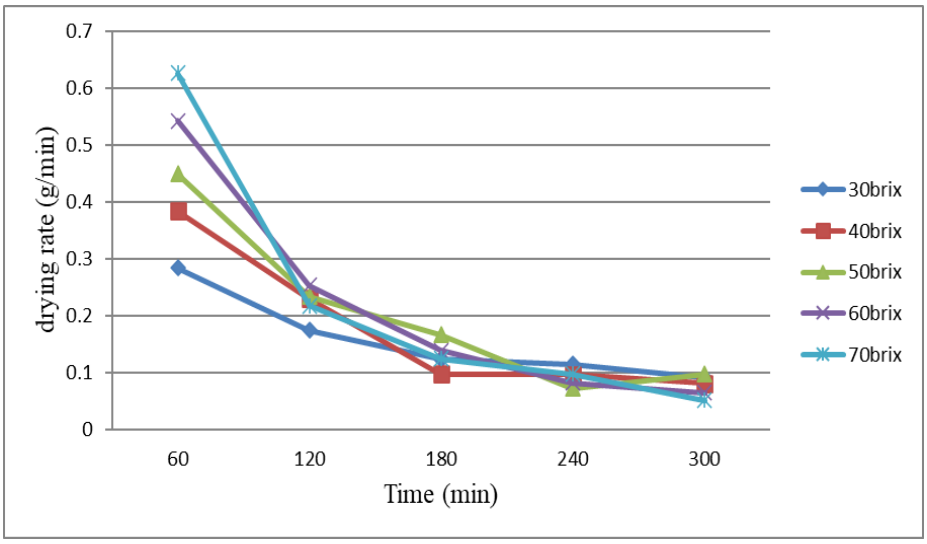


Fig 2: Variation of drying rate with drying time at different concentration of sugar solution

Table 1: Effect of concentration of sugar solution on drying time

Time(h) →	0	1	2	3	4	5
30 brix	98.88	82.97	70.37	62.31	54.63	48.90
40 brix	98.88	76.97	59.10	54.02	47.37	42.27
50 brix	98.88	74.03	53.79	45.20	40.17	36.61
60 brix	98.88	67.39	44.90	38.01	34.82	31.21
70 brix	98.88	62.05	41.00	32.06	28.73	25.14

Table 2: Variation of drying rate with drying time at different concentration of sugar solution

Time(h) →	60	120	180	240	300
30 brix	0.2838	0.1741	0.1233	0.1138	0.0911
40 brix	0.3838	0.2299	0.0968	0.0958	0.0808
50 brix	0.4495	0.2341	0.1665	0.0720	0.097
60 brix	0.5432	0.2525	0.1381	0.0811	0.0638
70 brix	0.6268	0.2176	0.1238	0.0970	0.0505

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