Original Research Article

Studies on some Drying Characteristics of Amla

Pankaj Minj[1*], Kipoo Kiran Singh Mahilang[2*], John Diamond Raj[1] and Khilendra Sonboier[1]

[1]*Department of APFE, SHIATS, Allahabad, UP, India*
[2]*Department of FMP, SVCAET&RS, IGKV, Raipur, CG, India*

*Corresponding author

A B S T R A C T

A research work was carried out to determine the drying characteristics of amla using cabinet tray dryer and open sun drying as drying methods at Department of Food Process Engineering, SHIATS, Allahabad in the year 2015-2016. The variety of amla fruit taken for the study was Chakaiya. The final moisture contents of amla at 50°C, 60°C, and 70°C for cabinet tray dryer was 2.69 (% db), 2.38 (% db), 2.22 (% db) respectively whereas for open sun drying it was 3.72 (% db). The time required to achieve the above levels of moisture content for amla were 25, 21, 16 and 40 hr in respective drying. The cabinet tray drying method required the lowest time, since the temperature of the dryer was constant (70°C). The rate of drying was the highest in cabinet tray drying at 70°C is 8.19 to 0.72 (min^{-1}), followed by cabinet tray drying at 50°C is 5.19 to 0.46 (min^{-1}), at 60°C is 6.78 to 0.55 (min^{-1}) and in open sun drying is 1.26 to 0.29 (min^{-1}) at similar climatic conditions. The cost of drying was maximum (Rs. 224.43/kg) in case of cabinet drying at 50°C followed by cabinet drying at 60°C (Rs. 192.47/kg), cabinet drying at 70°C (Rs. 152.52/kg) and open sun drying (Rs.75.90/kg).

Introduction

Amla has a hallowed position in Ayurveda an Indian indigenous system of medicine. It belongs to the family of *Euphorbiaceae* that grows on *Phyllanthus Emblica* trees and is scientifically identified as *Emblica officinalis* (1).

The Annual production of Amla in India was 1319000 tonnes under an area of 107000 hectares and annual production of amla in Uttar Pradesh was 395870 tonnes under an area of 34970 hectares and in Allahabad it was 29580 tonnes under an area of 2710 hectares. (Horticultural Statistics at a Glance, 2015) (2).

The fresh or the dry fruit of amla are widely used in the Ayurvedic preparation, medicine, food, beauty industries and are believed to increase defence against diseases. It has beneficial role in degenerative disease like common cold, gastric troubles, bronchitis, headache, cough, asthma, constipation, enlarged liver, cancer, ophthalmic disorders, dyspepsia, colic, flatulence, skin diseases, leprosy, jaundice, scurvy, diarrhea, grayness

of hair, diabetes, ulcer, anemia, heart trouble and also is an important constituent in hepatoprotective formulas available. It is very effective in shedding weight when supplemented by good diet, nutritional supplements and a healthy lifestyle (3).

Most of the research work on Amla is related to the nutritive value of the fresh fruit and its products but little information is available regarding the dehydration of fruits and storage quality of dried Amla. Fresh Amla offers a serious problem during storage, transport and marketing because of its high perishable nature. Amla has many functions including medicinal, but the moisture content of the Amla is a problem decreasing the shelf life of amla. The high moisture content of amla causes insect and pest attack or yeast and mould growth and it is decayed or spoiled. Drying is considered as one of the best preservation methods to increase the shelf life of amla and also to overcome from all the above problems which is stated above (4).

Materials and Methods

Physical properties of amla

Average length (L) and width (W)

To determine the size and **s**hape of the amla, a sample of 10 fruits were randomly picked.

The dimensions along three perpendiculars mutually axes of the amla was measured with a Vernier caliper to an accuracy of 0.01mm. The Average length (L) and width (W) was calculated by using the following relationship 2.1 and 2.2 (Mohsenin, 1986).

$$L = \frac{\sum_{i=1}^{n} L}{n} \quad … (2.1)$$

$$W = \frac{\sum_{i=1}^{n} W}{n} \quad … (2.2)$$

Where,
L = Major diameter (length), mm; and
W= Intermediate diameter (width), mm.

Determination of moisture content

Moisture content of the amla slices was calculated by the following formula.

$$MC\ (db) = (M_w \div M_d) \times 100 \quad … (2.3)$$

Where,
MC (db) = Moisture content, percent (dry basis),
M_w = Mass of water (g), and
M_d = Mass of dry matter (g).

Determination of drying rate

Drying rate of the amla slices at any time was calculated by the following formula.
$$R = (W_r \div (T \times W_d)) \times 100 \quad … (2.4)$$

Where,
R = Drying rate (min^{-1}),
W_r = Amount of moisture removed (g),
T = Time of drying (min), and
W_d= Total bone dry weight of sample (g).

Cost evaluation

Fixed cost = Depreciation+Interest + miscellaneous (Housing and insurance) … (2.5)

$$Depreciation = (P - S) \div (N \times L) \quad … (2.6)$$

$$Interest = ((P + S) \div 2) \times (R \div 100) \times (1 \div N) \quad … (2.7)$$

Where,
P = Investment cost,
L = Expected life,
N= Hourly use per year,
S= Salvage value,
R= Interest.
Variable cost = Labour cost + Repair and

maintenance cost + Electricity cost. … (2.8)
Total cost (per kg of dried product) = fixed
cost + variable cost + material cost. … (2.9)

Net profit (per kg) = Cost of processed
product - Total cost. … (2.10)

Results and Discussion

Physical properties of amla

The variety of amla fruit taken for the study
was Chakaiya and it tends to be flattened
round in shape. The average length and width
of fruit was measured to be 3.40 and 4.10 cm
respectively. The average weight of fruit was
measured to be 30.66 g. Table 1 shows the
physical properties of amla fruit.

Drying characteristics of amla

Amla were dried using two methods viz.,
cabinet dryer at a temperature of at 50°C, at
60°C, at 70°C and open sun drying. The
drying characteristics of amla under different
drying methods are summarized below.

Change in moisture content of amla with drying time

The drying behavior of amla in different
drying methods has been presented in Figure
1 as a plot of moisture content versus time of
exposure. The maximum drying temperature
was achieved during the period of 12 to 2.00
pm for the sun drying whereas the cabinet
dryer was set at 50°C, 60°C and 70°C
throughout the drying period. Final moisture
content for different drying methods at 50°C
is 2.69 (% db), at 60°C is 2.38 (% db), at
70°C is 2.22 (% db) in cabinet dryer and in
open sun drying is 3.72 (% db).The final
weight of amla sample in cabinet drying at
50°C is 12.96 g, at 60°C is 12.92 g, 70°C is
12.90 g and in open sun drying is 13.09 g.
When drying time is increases the moisture

content is decreased due to when drying time
is increases then the moisture of amla gets
removing that's why the moisture content of
amla decreases. The time required to achieve
the final moisture content were 1500 minutes
at 50°C, 1260 minutes at 60°C, 960 minutes
at 70°C for cabinet drying and 2400 minutes
for open sun drying of amla in respective
drying.

Change in drying rate of amla with drying time

The drying characteristics of the amla were
also evaluated on the basis of drying rate in
different methods. It can be seen that as the
drying time increased the drying rate
decreased. The rate was higher at the
beginning of the process, which gradually
reduced as the drying process progressed and
the availability of moisture was reduced. The
drying rate for different drying methods at
50°C is 5.19 to 0.46 (min^{-1}), at 60°C is 6.78 to
0.55 (min^{-1}), at 70°C is 8.19 to 0.72 (min^{-1})
and in open sun drying is 1.26 to 0.29 (min^{-1}).
When drying time is increases the drying rate
is decreased due to duration of drying time
increased the amount of moisture losses is
also increases that's why drying rate
decreases. Figure 2 presents the Change in
drying rate Vs drying time for cabinet drying
and open sun drying methods

Change in drying rate of amla with moisture content

The variation of drying rate with moisture
content under different drying methods is
shown in Figure 3. It can be seen that the
drying rate decreases as the moisture content
of the amla decreases. This was fact because
the availability of moisture for the drying
reduced with the time of drying which
eventually reduced the rate of drying. As
already said the highest drying rate was
observed in case of cabinet drying at 70°C

and was lowest for the open sun drying. Efforts have been made to correlate the drying rate with the moisture content of the amla (Fig. 4 and 5).

Cost economics of different drying methods

Cost economics of drying of amla in cabinet drying and open sun drying was estimated.

This cost economics shows that the cost of drying was maximum (Rs. 224.43/kg) in case of cabinet drying at 50°C followed by cabinet drying at 60°C (Rs. 192.47/kg), cabinet drying at 70°C (Rs. 152.52/kg) and open sun drying (Rs. 75.90/kg). The net saving of Rs. 74.10 per kg of processed product was recorded for open sun drying.

Table.1 Shows the physical properties of chakaiya variety of amla

Fruit variety	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	No of segments/ fruit	Fruit size	Fruit shape
Chakaiya	3.40	4.10	30.66	6	Medium	Flattened round

Fig.1 Change in moisture content Vs drying time for cabinet drying and open sun drying methods
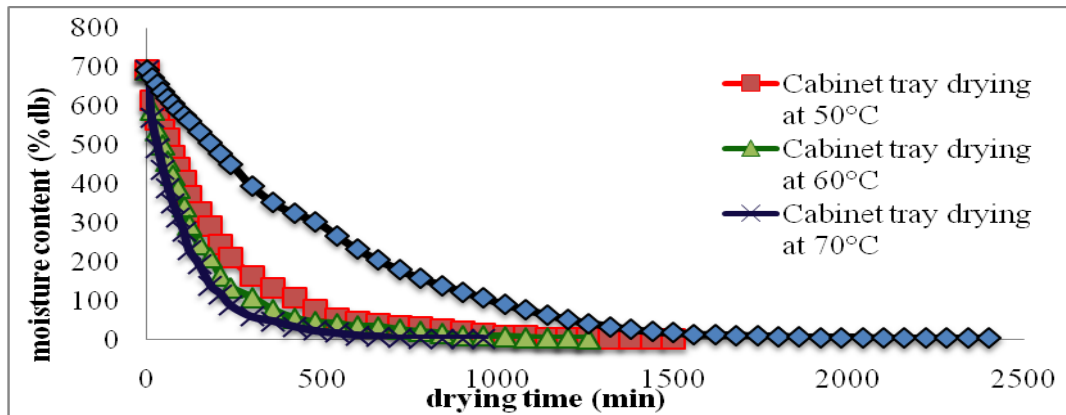

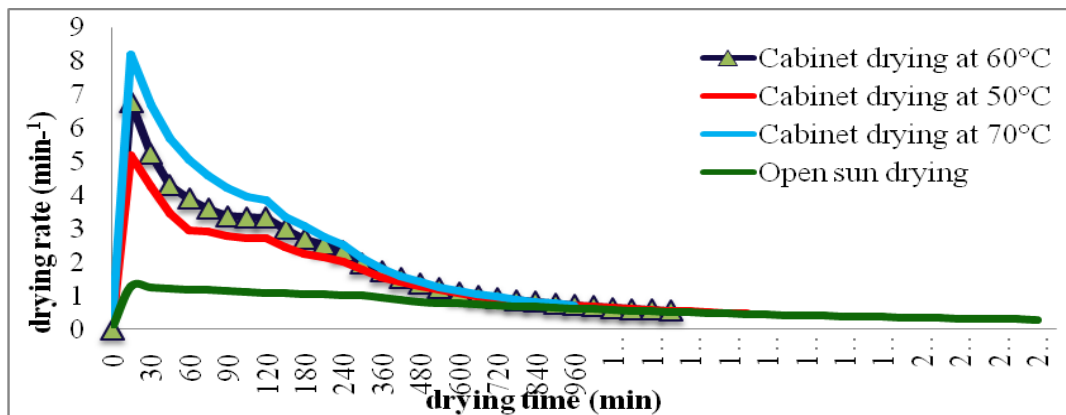**Fig.2** Change in drying rate Vs drying time for cabinet drying and open sun drying methods

Fig.3 Change in moisture content Vs drying rate for cabinet drying and open sun drying methods
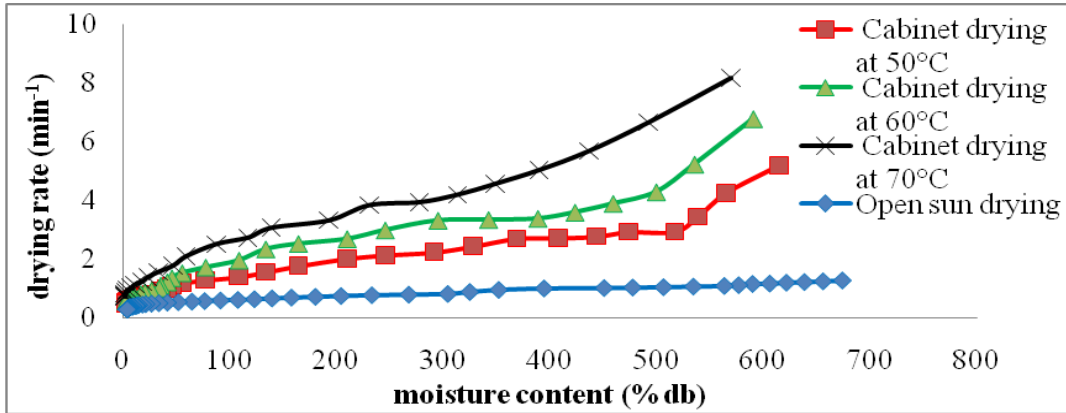

Fig.4 Dried amla sample after cabinet drying at 50°C, 60°C and 70°C

Fig.5 Dried amla sample after open sun drying

In conclusion, the advantages of Sun drying have simplicity and the small capital investment. But, there are many technical problems which are uncertainties like rain and cloudiness, contamination from outer sources and lack of control over drying conditions. It

requires large areas and long drying time. The final product may be contaminated from dust and insects and suffer from enzyme and microbial activity. It is limited to climates with hot sun and dry atmosphere with strong winds. Cabinet tray drying was found to be better over open sun drying in respect of Final moisture content, rate of drying, drying time moisture evaporation, as they required lesser time. Open sun drying is more profitable compared to cabinet drying. However cabinet dryer was found to be uneconomical for drying of 1 kg amla slices. Thus cabinet drying can be preferred over the sun drying method.

References

1. Akhtar, M. S., Ramzan, A., Ali, A. and Ahmad, M. 2011. Effect of amla fruit (*Emblica officinalis* Gaertn.) on blood glucose and lipid profile of normal subjects and type 2 diabetic patients. *Int. J. Food. Sci. Nutr*.
2. Ahmad, J., Mehmood, Z. and Mohammad, F. 1998. Screening of some Indian medicinal plants for their antimicrobial properties. *Journal of Ethanopharmacology*. 62, 183–193.
3. Chadha, K. L. 2003. Handbook of horticulture. New Delhi: ICAR Publications.
4. Chowdhury Amina Parvin 2013. Degradation of vitamin C during drying and storage of amla (*Emblica Officinalis)* and development of pickles from amla. MS Thesis. Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh.
5. Deokar, A.B., 1998. Medicinal Plants Grown at Rajegaon, first ed. DS Manav Vikas Foundation, Pune, pp. 48–49.
6. Horticultural Statistics at a Glance, 2015. Horticulture statistics division, department of agriculture, cooperation & farmers welfare ministry of agriculture & farmers welfare government of India. Page- 17, 177, 259.
7. Krishnaveni, M. and Mirunalini, S. 2011. Amla – The role of Ayurvedic therapeutic herb in cancer. *Asian J. Pharm. Clin. Res.,* 4 (3) 13–17.
8. Minj, P. Studies on drying characteristics of amla. M. Tech. Thesis, SHIATS, Allahabad; 2016.
9. National Horticulture Board. http://nhb.gov.in/report_files/aonla/AONLA.htm.
10. Rege, N. N., Thatte, U. M. and Dahanukar, S. A. 1999. Adaptogenic properties of six rasayana herbs used in Ayurvedic medicine. *Phytotherapy Research*. 13, 275–291.
11. Singh, V., Singh, H. K. and Chopra, C. S. 2005. Studies on processing of aonla (*Emblica officinalis* Garten) fruits. *Beverage and Food World,* 32(12): 50-52.