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Preparation of *Aloe Vera* Powder by Different Drying Methods

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***Abstract*:** The present research was carried at PG Institute of Post Harvest Management in department of Medicinal Aromatic Plants, Spices and Forest Crops, Killa, Roha Maharashtra, India to find out suitable drying method and to standardize the *Aloe vera* powder preparation process. The physico-chemical properties of *A. vera* powder were evaluated to study storage stability. Packaging material and storage time significantly influenced all the parameters. Quality of powder showed good shelf life in convective tray drying method at 50ºC when packed in polyethylene bags. Storage for 90 days at room temperature did not affect the quality and was suitable for human consumption.

***Keywords*:** *Aloe vera,* Pulp, Powder, Drying methods, Storage

Aloe vera is a short-stemmed juicy plant with green pointed and fleshy leaves entrapping a clear viscous gel. It can achieve a stature of 60-100 cm with a spread up to 50-60 cm. It is native of Africa, the Arabian Peninsula, Madagascar and Indian Ocean Islands. *Aloe* species are also found in the Mediterranean region, Canary Islands, Mexico, India, and the Caraibes. The genus *Aloe* contains over 400 different species. However, *Aloe barbadensis* is considered the most biologically active species (Bozzi and Perrin 2007). In India, the major areas under *A. vera* cultivation are in Rajasthan, Andhra Pradesh and Gujarat (Jilariya et al 2017, Thakur et al 2018) and also found in the dry areas of states of Maharashtra and Tamil Nadu. Total production in India is estimated to be about 1,00,000 tonnes. Ayurvedic pharmacies are using only 1% of the total production from India (Anonymous 2006). The price of dried *A. vera* leaves in India ranges from Rs 600-1000 per kg depending upon the aloin content and colour of the dried *A. vera*.

Drying is one of the best methods for preserving the food materials. It increases the shelf life by decreasing the water activity in the product which inhibits the growth of microorganisms while decreasing spoilage reactions. Another important advantage of dried product is the reduction in the cost of packaging, storage and transportation due to their comparatively smaller volume and mass. The challenge of *A. vera* drying is to maximize the retention of nutrients while minimizing the moisture content of product to a level with restricted microbiological growth. A faster method of dehydration that yields a higher quality product is always required. It is generally known that freeze-drying produces highest quality dehydrated products, but this technique is very expensive and requires skilled operators. Hence, a method of convective drying could be a good solution. However, some problems like considerable shrinkage due to cell collapse following the loss of water, poor re-hydration characteristics of dried products and unfavourable changes in colour, texture, flavour and nutritive value may occur. This can be solved by controlled drying which helps in overall improvement in the quality of the final product (Ahmed and Singh 2013). Hence, the present study was undertaken to prepare *A. vera* powder by different drying methods to find out suitable powder drying methods and standardize the preparation process.

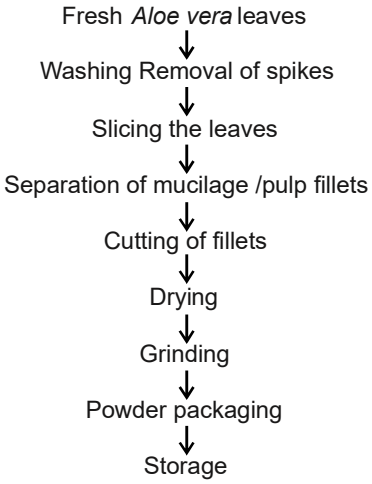
MATERIAL AND METHODS

The present study was conducted at the Department of Post Harvest Management of Medicinal, Aromatic, Plantation, Spices and Forest Crops, Post Graduate Institute of Post-Harvest Technology and Management, Killa - Roha, Dist. Raigad, Maharashtra India, north Kokan (18°42'5947" N, 73°17'9361" E) during 2020-2021. Data was collected on physical parameters of *A. vera* during drying such as initial moisture, final moisture, drying time and rate of drying. The data collected were statistically analysed by the standard procedure using Completely Randomized Design (CRD) with 4 main and 4 sub treatments having 5 replications. The observations on the changes in physical and chemical parameters of *A. vera* powder during drying and storage (at room temperature) were recorded at 0, 30, 60 and 90 days.

The leaves were cut in the early morning for experimentation to avoid moisture loss and spoilage. Each leaf was cut manually with a stainless-steel knife and pulled carefully from the mother plant to avoid breaking of rind. The leaves were transported from farm to the working place in a

covered polyethylene bag to avoid oxidation or contamination and were kept in upright position in order to drain out the 'aloin' (Yellow sap) present in it. After that leaves were washed under tap water to remove sticking materials and dirt. The spikes were removed before slicing the leaves. The thick dark green outer skin was peeled out manually from the thick gel fillet using a stainless-steel knife. The fillets were cut into 5 × 3 × 1 cm cuboids with the help of stainless-steel cutter and stored in an air tight container. The fresh cubes fillet was transferred into a tray for different drying methods *viz.*, sun, polytunnel, convective and microwave drying. *A. vera* pulp cubes/fillets placed for various dryer as per the treatment. Best treatment was selected on basis of statistical analysis for further study. From overall treatment and analysis, suitable drying method was standardized for preparation of *A. vera* powder. Temperature of convective dryer was kept 50º C and Microwave dryer was 60ºC. The sample was dried till constant weight was achieved. After complete drying, sample was ground and sieved to obtain the fine powder. Powder was packed in small polyethylene bag with the help of packaging machine. To find out suitable drying method and storage study, 60-80 g sample was filled in polyethylene bag. The storage was for 90 days and sample was analysed for different quality parameters at 30 days interval. The experiments were done with three replications. The preparation of *A. vera* powder is given in flow chart as under:

Process flowchart for preparation of *Aloe vera* powder



RESULTS AND DISCUSSION

Physical quality parameters of *Aloe vera* pulp: The results indicated that convection drying treatment recorded the highest initial moisture (98.70) per cent which was at par with treatment T3 and T2 (98.60 and 98.50 %) and T1 recorded the lowest initial moisture (98.2) per cent (Table 1). Muaz and Fatma (2012) also found 97 % moisture in the *A. vera* leaves.

The T4 recorded highest final moisture per cent (3.70) which was at par with treatment T3 whereas, T1 recorded significantly lowest final moisture per cent (2.10) which was followed by treatment T2. The present work agrees with Hendravati (2015). The final moisture per cent of *A. vera* pulp was 2.88, 4.04 and 4.89% at 140, 130 and 120º C temperature. Pattali and Yenge (2015) found 8.66 % final moisture in open yard sun drying, 8.61 % in hot air drying and 8.57 % in dehumidified air drying of *A. vera* leaves. Preetider and Amrit (2017) also found 3.59 % moisture in spray dried *A. vera* powder.

The T1 recorded significantly highest drying time (21.44 hr) which was followed by treatment T2 (Table 1). The T3 recorded the lowest drying time (14.44 hr) which was followed by treatment T4. Pattali and Yenge (2015) found that open yard sun drying, hot air drying and dehumidified air drying requires 21,16 and 11 hours, respectively for drying of *A. vera* pulp fillets.

The *A. vera* pulp in T3 recorded the significantly highest rate of drying (6.576) followed by treatment T4. Treatment T1 recorded the lowest rate of drying (4.48) which was at par with treatment T2. Sabat and Patel (2018) also observed that the drying rate increased with an increase in drying air temperature, resulting in a substantial decrease in the drying time. Pattali and Yenge (2015) found that drying process mainly consisted of three drying periods *i.e.* heating up, constant rate and falling rate period. In hot air drying at temperature of 50°C showed only the falling rate period which was due to moderate temperature of drying. The drying rate period decreased from 47.04 to 0.04 % at 50°C.

Physical quality parameters of the *Aloe vera* powder: The lightness of the colour in *A. vera* powder decreased significantly with increase in storage periods from 33.09 to 27.43 during 90 days storage (Table 2). Thus, it can be concluded that lightness of the colour in *A. vera* powder decreased with increase in storage period. The a* value increases with corresponding increase in storage period. The a* value of colour during storage of 0 to 90 days also increased significantly. Redness of the colour in *Aloe vera* powder increased with increase in storage period from 7.83 to 10.93 up to 90 days of storage. Interaction effect between storage period and different treatments was statistically non-significant. The b* value decreased with corresponding increase in storage period. The T3 recorded the highest mean b* value (38.43) for colour which was at par with T2. The b* value of colour during storage of 0 to 90 days also decreased significantly. Yellowness of the colour in *Aloe vera* powder decreased with increase in storage period from 39.98 to 32.48 up to 90 days storage. Interaction effect between storage period and different treatments was non-significant.

The decrease in the L* value and b* value while increase in a* value of dehumidified air-dried *Aloe vera* gel powder was recorded by Ramchandra and Srinivasa (2011).

The particle size during storage of 0 to 90 days slightly increased. Particle size in *Aloe vera* powder slightly increased with increase in storage period from 49.35 to 49.72 µ up to 90 days storage. Interaction effect between storage period and different treatments was non-significant. Gautam and Awasthi (2007) reported maximum water retention of the *Aloe vera* powder on 40 mesh size. Stoklosa and Lipasek (2012) observed the sticking and agglomeration resulting from exposure to relative humidity reduces flow ability and may be influenced by powder composition, particle size and shape.

Changes in the chemical quality parameters of the *Aloe vera* powder: The ash per cent during storage of 0 to 90 days also decreased significantly. Ash percent in *A. vera* powder decreased with increase in storage period from 15.70 to 15.49 per cent up to 90 days storage (Table 4). Similarly effect of drying method was non-significant and effect of storage period on ash also non-significant. Sabat and Patel (2018)y reported that temperature rise from 50 to 80ºC recorded 15.48 to 15.50 % ash, respectively. Gautam and Awasthi, (2007) found 14% ash content in the whole leaf tray

Table 1. Changes in the physical quality parameter of *Aloe vera* during drying

Treatments	Initial moisture %	Final moisture %	Drying time (Hour)	Rate of drying (% moisture/hour)
T1	98.20	2.10	21.44	4.48
T2	98.50	2.60	20.44	4.69
T3	98.60	3.10	14.44	6.58
T4	98.70	3.70	17.44	5.44
CD at 5 %	0.217	0.411	0.493	0.21

T1: Sun drying, T2: Polytunnel drying, T3: Microwave drying, T4: Convection drying

Table 2. Effect of different drying method and storage period on the L* colour value, a* colour value and the b* colour value of *Aloe vera* powder

Treatments (T)	L* Value					a* Value					b* Value				
	Storage (S) period (days)														
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T1	34.63	33.3	32.30	24.6	31.21	8.93	10.5	11.50	12.50	10.86	36.90	36.13	35.9	34.63	35.89
T2	28.23	27.17	26.4	25.57	26.84	7.40	9.90	10.90	12.25	10.11	41.83	39.33	37.67	34.73	38.39
T3	28.67	27.33	26.33	25.47	26.95	11.10	11.83	12.33	13.47	12.18	44.5	41.00	39.00	29.2	38.43
T4	40.83	41.53	40.23	34.10	39.18	3.87	4.70	5.07	5.5	4.78	36.7	35.00	34.00	31.33	32.48
Mean	33.09	32.33	31.32	27.43	31.04	7.83	9.23	9.95	10.93	9.48	39.98	37.87	36.64	32.48	32.48
	T		S		TxS	T		S		TxS	T		S		TxS
CD at 5%	2.56		2.56		NS	0.59		0.59		NS	1.82		1.82		NS

See Table 1 for details

Table 3. Effect of different drying methods and storage periods on the particle size, moisture and solubility of *A. vera* powder

Treatments (T)	Particle size (micron)					Moisture (%)					Solubility (min)				
	Storage (S) period (days)														
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T1	63.20	63.40	63.57	63.67	63.46	2.10	2.20	2.30	2.40	2.25	5.10	5.14	5.18	5.22	5.16
T2	53.10	53.30	53.40	53.50	53.33	2.60	2.70	2.80	2.90	2.75	5.10	5.14	5.18	5.22	5.16
T3	44.10	44.20	44.30	44.40	44.25	3.60	3.70	3.80	3.90	3.75	4.10	4.14	4.18	4.22	4.16
T4	37.00	37.10	37.20	37.30	37.15	3.70	3.80	3.90	4.00	3.85	3.10	3.14	3.18	3.22	3.16
Mean	49.35	49.50	49.62	49.72	49.55	3.00	3.10	3.20	3.30	3.15	4.35	4.39	4.43	4.47	4.41
	T		S		TxS	T		S		TxS	T		S		TxS
CD at 5%	11.07		11.07		NS	0.15		0.15		NS	0.06		0.06		NS

See Table 1 for details

Table 4. Changes in the Ash, fat and protein percentage of the *Aloe vera* powder during storage periods

Treatments (T)	Ash (%)					Fat (%)					Protein (%)				
	Storage (S) period (days)														
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T1	16.2	16.1	16.03	15.99	16.08	1.79	1.74	1.69	1.64	1.72	2.41	2.33	2.23	2.15	2.28
T2	17.2	17.1	17.03	16.99	17.08	1.81	1.78	1.75	1.73	1.77	3.3	3.27	3.23	3.19	3.25
T3	15.2	15.1	15.03	14.99	15.08	2.14	2.12	2.11	2.1	2.12	4.8	4.77	4.73	4.69	4.75
T4	14.2	14.1	14.03	13.99	14.08	2.2	2.18	2.14	2.11	2.16	4.83	4.8	4.77	4.72	4.78
Mean	15.7	15.6	15.53	15.49	15.58	1.98	1.96	1.92	1.9	1.94	3.83	3.79	3.74	3.69	3.76
	T		S		TxS	T		S		TxS	T		S		TxS
CD at 5%	NS		NS		NS	0.03		0.03		NS	0.12		0.12		NS

See Table 1 for details

Table 5. Changes in the fiber, pH and TSS of the *Aloe vera* powder during storage periods

Treatments (T)	Fibre (%)					pH					TSS				
	Storage (S) period (days)														
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T1	16.1	15.94	15.9	15.84	15.94	2.89	2.92	3.17	3.47	3.11	2.08	2.45	2.65	3.17	2.59
T2	16.39	16.33	16.23	16.1	16.27	3.92	3.94	4.13	4.47	4.12	3.03	3.48	3.86	4.03	3.6
T3	16.5	16.45	16.39	16.35	16.42	3.93	4.22	5.13	5.47	4.16	3.1	3.57	3.88	4.03	3.65
T4	16.62	16.57	16.51	16.47	16.54	3.7	4.16	4.64	4.73	4.31	4.03	4.35	4.65	4.95	4.5
Mean	16.4	16.32	16.26	16.19	16.29	3.61	3.74	4.04	4.3	3.92	3.06	3.46	3.76	4.05	3.58
	T		S		TxS	T		S		TxS	T		S		TxS
CD at 5%	0.12		0.12		NS	0.17		0.17		NS	0.08		0.08		NS

See Table 1 for details

dried *A. vera* powder sample at 50ºC. The fat, protein content and fiber percent of *Aloe vera* powder were decreased with corresponding increase in storage period from 0 to 90 days from 1.98 to 1.90, 3.83 to 3.69 and 16.40 to 16.19 per cent, respectively up to 90 days of storage. These results are supported by findings of fat, protein and fiber content per cent in *Aloe vera* powder by Sabat and Patel (2018). As acidity decreased pH of *Aloe vera* powder increased. The pH of *Aloe vera* powder was increased with corresponding increase in storage period 0 to 90 days from 3.61 to 4.30 (Table 5). The pH of *A. vera* powder at different drying methods was recorded by Sabat and Patel, (2018).

The TSS of *A. vera* powder increased significantly with corresponding increase in storage period of 0 to 90 days from 3.06 to 4.05 ºB. Interaction effect between storage period and different treatments was found to be statistically non-significant. TSS of spray dried powder of *Aloe vera* was 2.6 ºB recorded by Preetider and Amrit (2017). The moisture content during storage of 0 to 90 days was also increased significantly from 3.00 to 3.30 per cent. These results are in confirmative with moisture content of *A. vera* powder as recorded by Ramchandra and Srinivasa (2011). Preetider and Amrit (2017) was also reported 3.59 % moisture in spray dried *Aloe vera* powder while Hendravati (2015) noticed 2.88, 4.04, 4.89 and 4.89 % moisture in spray dried *Aloe vera* powder at temperature 140, 130, 120 and 110ºC, respectively. The solubility of *A. vera* powder slightly increased with corresponding increase in storage of 0 to 90 days from 4.35 to 4.47 min. Preetider and Amrit (2017) also reported solubility of *A. vera* powder was 100.54 sec. Gore and Devdas (2011) found solubility of spray dried *A. vera* powder 173 sec. Hendravati (2015) observed 2.26, 1.93, 2.94 and 2.94 min. solubility of spray dried *Aloe vera* powder at temperature 140, 130, 120 and 110 °C, respectively.

CONCLUSIONS

The quality *A. vera* powder with good shelf life was prepared by convective tray drying method at 50ºC and packed in polyethylene bags it is stored for 90 days at room temperature did not affect the quality and found suitable for human consumption.

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