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Effect of different drying methods on active compounds of saffron and comparison with ISO standard

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***Abstract**: Drying is the main post-harvest processing of saffron which converts fresh stigmas into dried saffron. The current experiment conducted to evaluate the effect of four common drying methods (microwave, electronic dryer, shade and sun-shade drying) on active compounds (Crocin, picrocrocin and safranal) as well as drying time of saffron. The results indicate that the highest value of crocin (212.875) obtained from microwave dried samples ($p>0.05$) while sun-shade method showed lowest values (182.335). Regarding the picrocrocin the highest value (76.975) recorded for electronic dryer ($p>0.01$) but lowest value (54.584) obtained from sun-shade method. The safranal content ranged from 36.295 in microwave to 27.090 in sun-shade method ($p>0.05$). With respect to drying time the shortest drying time (2.5 min) recorded for microwave followed by electronic dryer (45 min) but traditional shade and sun – shade methods had longer time (2160 min and 3600 min respectively). Its justified that drying has significant effect on saffron quality.*

Keywords: Drying, Crocin, Picrocrocin, Saffron, Safranal

1- INTRODUCTION

Saffron as the most expensive spice is the dried stigma of an herbaceous and perennial plant by scientific name of *Crocus sativa* L. The saffron is a subtropical plant spread out in Mediterranean and west Asia, cultivated as source of its spice for at least 3500 years (Muzaffar *et al*., 2015). Iran, India, Greece, Afghanistan and Morocco are the top five saffron producer countries in the world (Statista /1135621/leading-saffron-producers-worldwide).

In Afghanistan saffron is a well-known spice which is traditionally used as food additives and medicine proposes. It has been cultivated for exporting level since 2000 and becoming a new source of income for Afghan farmers specially, in Herat province (International Trade Center, 2018). There is uncertainty regarding the ideal drying method among saffron processors in Afghanistan. Thus, Special attention is required to optimize saffron processing and confirm it with international standards.

Stigma is the main usable part of saffron flower and contains a range of chemical compounds with many applications in food, cosmetic and medical industries (Fallahi *et al*., 2020). Crocin, picrocrocin and safranal are the most important compounds of saffron which are responsible for coloring, tasting and flavoring agents respectively (Tong *et al*., 2015). The color of saffron comes from crocin a glycosil esters of crocetin ($C_{20}H_{24}O_4$). The special better taste of saffron belongs to picrocrocin ($C_{16}H_{26}O_7$) a monoterpene glycoside precursor of safranal ($C_{10}H_{14}O$) which is the main volatile oil responsible for saffron aroma (Maghsoodi *et al*., 2012). As per ISO-3632 standard the quality of saffron classified based on data obtained from spectrophotometer analyzes. The stigma also contains carbohydrates, minerals, vitamin and pigments such as carotin and flavonoids (Winterhalter and Straubinger, 2000). Besides of stigma stamen and petal of saffron flower can be used in food industry (Behdani and Fallahi, 2015). Numerous studies have reported that saffron have the capability to have a variety of pharmacological influences such as antioxidant activity, antigenotoxic, antihypertensive, antitussive and anticonvulsant (Rahaiee *et al*., 2014).

The quality of saffron influenced by various pre and post-harvest factors. Among the post-harvest treatments, drying is the main processing steps which converts *Crocus sativa*. L stigmas into spice saffron (Carmona *et al*., 2006). Reducing the moisture content of stigmas to acceptable threshold (10 – 12%) is the core activity of saffron drying. The water soluble picrocrocin is altered into volatile and insoluble safranal during drying step (Gregory *et al*., 2005).

According to studies different drying methods including sun/solar, shad (room temperature), electronic oven, microwave and freeze drying are applied for saffron in different producing areas. The efficiency of saffron drying is related to various factors such as selected method, time, temperature and air velocity.

2- MATERIAL AND METHODS

1.2- Sample collection

Required amount of saffron flowers were harvested from a single farm located in Ghoryan district Herat-Afghanistan. The fresh flowers were placed inside the special plastic crates directly after harvest and shifted to food technology laboratory agriculture faculty of Herat University under hygienic condition. The stigmas separated from petals and made ready for drying under hygienic requirements.

2.2- Drying treatments

In traditional sun - shade method the stigmas were spread in metal mish trays which was covered by paper role and placed in open condition (not in direct sun shine). Same operation applied for shade drying method but trays were placed in closed condition at room temperature (24ºC). Drying with electronic dryer carried out by using a kiln electronic dryer fixed at 60ºC. In Microwave drying the samples were spread in glass plates and placed in microwave machine by 2000-watt power. Drying time recorded by analyzing of moisture content of samples using moisture analyzer (Model: MA 35) contentiously till ideal moisture content (10 – 12%) obtained.

3.2- Analyzing methods

The quantity of active compounds in samples was measured using spectrophotometric method as per ISO–3632 standards. The dried samples powdered and passed through a 0.4 mish sieve. Afterwards, 500 mg of sample with 950 ml of distilled water poured to a 1000 ml valium metric flask placed on magnetic plate (1000 rpm) to stir with agitator for 60 minutes. 20 ml of aliquot transferred to 200 ml valium metric flask and diluted to valium mad up. The solution filtered with normal filter paper under dark condition. Spectrophotometer (Make: Systronics, Model: UV/VIS spectrophotometer 117), was used to the UV–Vis spectra of samples in different ranges (440nm for crocin, 257nm for picrocrocine and 330nm for safranal) and obtained OD values calculated by following formula: (ISO-3632, 2011).

$$E = \frac{A * 100}{W!} * \frac{100}{100 - H}$$

Where:
A = Optical density values (OD values) from spectrophotometer
W = Weight of samples (0.5 gr)
H = Moisture content of samples

3- Result and discussion

1.3- Drying time

As shown in table 1, the shortest drying time (2.5 min) recorded for microwave followed by electronic drying (45 min) methods, in contrast both traditional shade and sun – shade methods had longer time (2160 and 3600 min respectively). Similarly, Tong *et al*. (2015) reported that saffron drying time ranged from 3 for microwave to 45 min for electronic oven drying method. Variation in drying time is reported to be because of different temperature and air velocity (Gregory *et al*., 2005).

Table -1. Effects of different drying methods on drying time of saffron

Drying methods	Microwave	Electronic dryer	Shade	Sun - Shade
Time (min)	2.5	45	2160	3600

2.3 - Active compounds

Crocin content of samples influenced significantly (P>0.05) by drying methods (Table, 2). The highest value of crocin (212.875) obtained from microwave followed by shade (199.745) method. The loss of crocin would be the result of enzymatic and non-enzymatic browning and pigment destruction occurring in longer drying time (Bolandi and Ghoddusi, 2006).

Table -2. Effects of different drying methods on crocin content of saffron

	Drying methods			
	Microwave	Electronic dryer	Shade	Sun-Shade
Average	212.875	184.650	199.745	182.335
Level of significance	*	*	*	*
Mean Comparison	a	b	ab	b
ISO-3632 range	120 - 200			

With respect to picrocrocin content (table, 3) there is highly significant difference (p>0.01) among drying methods. Samples dried by electronic dryer at 60ºC showed highest value (76.975) of picrocrocin while lowest value (54.584) recorded from sun-shade method.

Table- 3. Effects of different drying methods on Picrocrocin content of saffron

	Drying methods			
	Microwave	Electronic dryer	Shade	Sun - Shade
Average	64.570	76.975	61.940	54.584
Level of significance	**	**	**	**
Mean Comparison	b	a	b	c
ISO-3632 range	40 - 70			

According to table 4, safranal content ranged from 36.295 in microwave to 27.090 in sun-shade method which shows a significant different among the different drying methods (p>0.05). Higher safranal content in microwave drying is probably due to direct thermal conversion of picrocrocin to relative safranal (Campo *et al*., 2010). The amount active compounds in all samples by different drying treatments confirmed with ISO-3632 standard range (crocin:120-200, picrocrocin: 40-70 and safranal: 20-50).

Table-4. Effects of different drying methods on safranal content of saffron

	Drying methods			
	Microwave	Electronic dryer	Shade	Sun - Shade
Average	36.295	31.745	28.050	27.090

Level of significance	*	*	*	*
Mean Comparison	a	b	c	c
ISO-3632 range		20 - 50		

4- Conclusion

From the interpretation of the results, it was found that the active compounds of saffron are strongly influenced by drying methods. The use of microwave and electric dryer methods in comparison with traditional methods, in addition to reducing the drying time leads to the preservation of active ingredients of saffron. The quality of saffron samples from Herat-Afghanistan in all drying methods confirmed with-ISO 3632 standard range.

5- REFERENCES

Behdani, M. A and. Fallahi, H. R. (2015). Saffron: Technical Knowledge Based on Research Approaches. *Journal of Food Science*. Vol. 43, pp: 323–326.

Campo, M., carmona, L. and Maggi, L. (2010). Effect of mild temperature conditions during dehydration procedures on saffron quality parameters. *Journal of the science of food and Agriculture*. vol. 90, no. 4, pp. 719 – 725.

Carmona, M., Zalacain, A., Pardo, J. E., Lopez, E., Alvarruiz, A. and Alonso, G. L. (2005). Influence of different drying and aging conditions on saffron constituents. *Journal of Agriculture and Food Chemistry*. 53, 3974–3979.

Fallahi, H. R., Mahsa, A. S., Hossein, S., Mohammad, A. B., Mohammad Hassan, S. Z. and Safieh, V. (2020). Influence of some pre and post-harvest practices on quality of saffron stigmata. *Journal of Scientia Horticulturae*. 278-109846.

Gregory, M. J., Menary, R. C. and Davies, N. W. (2005). Effect of drying temperature and air flow on production and retention of secondary metabolites in saffron, *Journal of Agriculture and food chemistry*. vol. 53, no 15, pp: 5969 – 5975.

Huang, W., Zuoshan, F., Reheman, A., Yakun, H., Alan, C. and Ahmed, B. (2019). Effect of pulsed electric fields on physic-chemical properties, Beta carotene and antioxidant activity of air-dried apricots. *Journal of food chemistry.* 253 – 262.

ISO 3632-1. (2011) establishes specifications for dried saffron obtained from the pistils of *Crocus sativus* L. flowers.

Maghsoodi, V., Akhtar, K., Ebrahim, A. (2012). Effect of Different Drying Methods on Saffron (Crocus Sativus L) Quality. *Iranian Journal of Chemistry and Chemical Engineering*. vol. 31, no. 2. pp. 85–89.

Muzaffar, S., Khaliquz, Z. K., Mohd, R., Javid, A. M and Ajaz, A. (2015). Aroma of Kashmir saffron (Crocus sativus L.) and variation of safranal content by different drying methods. *Research Journal of Chemical Pharm*, vol. 7, no 1, pp. 111-115.

Rahiahee, S., Hashemi, M and Sayed, S. (2014). Evaluation of antioxidant activities of bioactive compounds and various extracts obtained from saffron (Crocus sativus L.): a review. *Journal of Food Science and Technology-Mysore*. vol. 52 no 4. pp: 1-8.

Red gold rush: Managing quality for Afghan saffron export. (2018). International Trade Center.

Saffron: leading producers worldwide.(2019) *Statista*. Retrieved *2021-01-14.*

Tong, Y., Zhu, X., Yan, Y., Liu, R., Gong, F., Zhang, L., Hu, J., Fang, L., Wang, R and Wang, P. (2015). The influence of different drying methods on constituents and antioxidant activity of saffron from China. *International Journal of Analytical Chemistry*, pp: 1–8.

Winterhalter, P. and Straubinger, M. (2000). Saffron - Renewed interest in an ancient spice, *Food Reviews International*, vol. 16, pp. 39-59.